CJMW ARCHITECTURE

PROJECT MANUAL

Museum Of The Marine

Jacksonville
North Carolina

Architectural Specification Sections
99% Review Set

Commission No. 22-0410

Museum of the MARINE
Community•Corps•Carolinas

August 1, 2023

SECTION 00 0101

PROJECT TITLE PAGE

PROJECT MANUAL

FOR

MUSEUM OF THE MARINE

ARCHITECT'S PROJECT NUMBER: 22-0410.

PROJECT LOCATION: MONTFORD POINT DRIVE
JACKSONVILLE, NC 28540

DATE: 08-01-2023

ABC ARCHITECT: CJMW ARCHITECTURE

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END OF SECTION

SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Museum Of The Marine

B. Owner's Name: Museum of the Marine.

C. Architect's Name: CJMW Architecture, Winston Salem, 119 Brookstown Avenue, Suite 100, North Carolina 27101.

D. The Project consists of the construction of exhibit space, office and support areas as indicated in the Contract Documents. The poject is designed to comply with Certification Level according to the US Green Building Council's Leadership in Energy & Environmental Design (LEED) Rating System..

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5000 - Contracting Forms and Supplements.

1.03 FUTURE WORK

A. Project is designed for future museum expansion and site development..

1.04 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Utility Outages and Shutdown:
   1. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE

A. Coordinate construction schedule and operations with Owner.

1.07 SPECIFICATION SECTIONS APPLICABLE TO EVERY CONTRACT

A. Unless otherwise noted, provisions of the sections listed below apply to every contract. Specific items of work listed under individual contract descriptions constitute exceptions.

B. Section 01 2000 - Price and Payment Procedures.

C. Section 01 2200 - Unit Prices.

D. Section 01 2500 - Substitution Procedures.

E. Section 01 3000 - Administrative Requirements.

F. Section 01 3216 - Construction Progress Schedule.

G. Section 01 4000 - Quality Requirements.

H. Section 01 5000 - Temporary Facilities and Controls.

I. Section 01 5100 - Temporary Utilities.

J. Section 01 6000 - Product Requirements.

K. Section 01 7000 - Execution and Closeout Requirements.

L. Section 01 7800 - Closeout Submittals.

END OF SECTION

SECTION 01 2000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

1.02 RELATED REQUIREMENTS

A. Section 00 5000 - Contracting Forms and Supplements: Forms to be used.

1.03 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Execute certification by signature of authorized officer.

E. Submit one electronic and agreed upon quantity of hard-copies of each Application for Payment.

1.05 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within ____ days.

D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
   3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.
   4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.

E. Substantiation of Costs: Provide full information required for evaluation.
   1. On request, provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.

c. Overhead and profit.
d. Justification for any change in Contract Time.
e. Credit for deletions from Contract, similarly documented.

2. Support each claim for additional costs with additional information:
   a. Origin and date of claim.
   b. Dates and times work was performed, and by whom.
   c. Time records and wage rates paid.
   d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

F. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

G. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

H. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2200
UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. List of unit prices, for use in preparing Bids.

B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

C. Defect assessment and non-payment for rejected work.

1.02 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section.

B. Take all measurements and compute quantities. Measurements and quantities will be verified by Owner.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

D. Measurement Devices:

E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.

F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

G. Measurement by Area: Measured by square dimension using mean length and width or radius.

H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

1.05 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

B. Payment will not be made for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from the transporting vehicle.
   4. Products placed beyond the lines and levels of the required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling, and disposing of rejected Products.

1.06 DEFECT ASSESSMENT

A. Replace Work, or portions of the Work, not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Architect.

2. The defective Work will be partially repaired to the instructions of the Architect, and the unit price will be adjusted to a new unit price at the discretion of Architect.

1.07 SCHEDULE OF UNIT PRICES

A. Unit Price No.1 - Unsatisfoactory Soil Onsite:
   1. Description: Removal of soil material determined, by the testing engineer, to be unsatisfactory and disposed in an approved onsite location and prepared to specified standards.
   2. Unit of Measurement: Cubic Yard.

B. Unit Price No. 2 - Unsatisfactory Soil Offsite:
   1. Description: Removal of soil material determined, by the testing engineer, to be unsatisfactory and disposed offsite.
   2. Unit of Measurement: Cubic Yard.

C. Unit Price No. 3 Satisfactory Soil Onsite:
   1. Description: Placement of soil material, determined by using a testing engineer, to be satisfactory which was excavated on site as part of contract work.
   2. Unit of Measurement: Cubic Yard.

D. Unit Price No. 4 - Satisfactory Soil Offsite:
   1. Description: Placement of soil material, determined by using a testing engineer, to be satisfactory which is from an offsite source.
   2. Unit of Measurement: Cubic Yard.

E. Unit Price No. 5 - Mass Rock:
   1. Description: Removal of material, determined by using a testing engineer, to be mass rock and disposed offsite.
   2. Unit of Measurement: Cubic Yard.

F. Unit Price No. 6 - Trench Rock:
   1. Description: Removal of material, determined by using a testing engineer, to be trench rock and disposed offsite.
   2. Unit of Measurement: Cubic Yard.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 00 4325 - Substitution Request Form - During Procurement: Required form for substitution requests made prior to award of contract (During procurement).

B. Section 00 6325 - Substitution Request Form - During Construction: Required form for substitution requests made after award of contract (During construction).

C. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.04 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.
   2. No specific form is required. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
         2) Owner's, Architect's, and Contractor's names.
      b. Substitution Request Information:
         1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
         2) Indication of whether the substitution is for cause or convenience.
         3) Issue date.
         4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
         5) Description of Substitution.
         6) Reason why the specified item cannot be provided.
         7) Differences between proposed substitution and specified item.
         8) Description of how proposed substitution affects other parts of work.
      c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
         1) Physical characteristics.
         2) In-service performance.
         3) Visual effect.
         4) Warranties.
         5) Other salient features and requirements.
         6) Include, as appropriate or requested, the following types of documentation:
            (a) Product Data:
            (b) Certificates, test, reports or similar qualification data.
            (c) Drawings, when required to show impact on adjacent construction elements.
      d. Impact of Substitution:
         1) Savings to Owner for accepting substitution.
         2) Change to Contract Time due to accepting substitution.

E. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
   1. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

B. Submittal Form (before award of contract):
   1. Submit substitution requests by completing CSI/CSC Form 1.5C - Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Architect will consider requests for substitutions only within 15 days after date of Agreement.

B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
3. Bear the costs engendered by proposed substitution of:
   a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

D. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
2. Without a separate written request.
3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record.

END OF SECTION

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Electronic document submittal service.
C. Preconstruction meeting.
D. Progress meetings.
E. Construction progress schedule.
F. Coordination drawings.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Requests for Interpretation (RFI) procedures.
J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 6000 - Product Requirements: General product requirements.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information; 2004.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Make the following types of submittals to Architect:
    1. Requests for Interpretation (RFI).
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Test and inspection reports.
    5. Design data.
    6. Manufacturer's instructions and field reports.
    7. Applications for payment and change order requests.
    8. Progress schedules.
    9. Coordination drawings.
    10. Correction Punch List and Final Correction Punch List for Substantial Completion.
    11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
    1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
    2. Contractor and Architect are required to use this service.

3. It is Contractor's responsibility to submit documents in allowable format.
4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.

C. Submittal Service: Use one of the following:
1. Submittal Exchange (tel: 1-800-714-0024): www.submittalexchange.com/#sle.
2. Procore.

D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
1. Representatives of Owner are scheduled and included in this training.

E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice of Award.

B. Attendance Required:
1. Owner.
2. Architect.
3. Contractor.
4. Mager subcontractors, as mutually agreed..

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Designation of personnel representing the parties to Contract, _____ and Architect.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.

5. Major subcontractors.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measures to regain projected schedules.
8. Planned progress during succeeding work period.
9. Maintenance of quality and work standards.
10. Effect of proposed changes on progress schedule and coordination.
11. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.05 COORDINATION DRAWINGS

A. Review drawings prior to submission to Architect.

3.06 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
b. Do not forward requests which solely require internal coordination between subcontractors.
2. Prepare in a format and with content acceptable to Owner.
a. Use AIA G716 - Request for Information .
3. Prepare using software provided by the Electronic Document Submittal Service.

C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.

2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
   a. Approval of submittals (use procedures specified elsewhere in this section).
   b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
   c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
   a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Owner's, Architect's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date, and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.

G. Review Time: Architect will respond and return RFIs to Contractor within ten calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.

3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.07 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Submit at the same time as the preliminary schedule specified in Section - 01 3216 - Construction Progress Schedule.
   2. Coordinate with Contractor's construction schedule and schedule of values.
   3. Format schedule to allow tracking of status of submittals throughout duration of construction.
   4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.

3.08 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.09 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.11 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a single transmittal for related items.
   2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   3. Transmit using approved form.
   4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      a. Send submittals in electronic format via email to Architect.
   8. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
      c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
   9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   10. Provide space for Contractor and Architect review stamps.
   11. When revised for resubmission, identify all changes made since previous submission.
   12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
   13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
   14. Submittals not requested will not be recognized or processed.

B. Product Data Procedures:
   1. Submit only information required by individual specification sections.
   2. Collect required information into a single submittal.
   3. Submit concurrently with related shop drawing submittal.
   4. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
   2. Use of reproductions of Contract Documents in digital data form to create shop drawings is only permitted as defined _____.

3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. High-resolution image files of samples may be acceptable for preliminary review by Architect to facilitate electronic review and preliminary approval. Provide separate submittal page for each item image.
a. Provide actual samples in size and format requested by Architect, for final selection.

3.13 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
a. "Approved", or language with same legal meaning.
b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
2) Non-responsive resubmittals may be rejected.
2. Not Authorizing fabrication, delivery, and installation:
a. "Revise and Resubmit".
1) Resubmit revised item, with review notations acknowledged and incorporated.
2) Non-responsive resubmittals may be rejected.
b. "Rejected".
1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
a. "Received" - to notify the Contractor that the submittal has been received for record only.
2. Items for which action was taken:
a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.02 RELATED SECTIONS

A. Section 01 1000 - Summary: Work sequence.

1.03 REFERENCE STANDARDS

A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.

B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2015.

1.04 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit in PDF format.

1.05 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Identify work of separate stages and other logically grouped activities.

D. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

E. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

F. Indicate delivery dates for owner-furnished products.

G. Coordinate content with schedule of values specified in Section 01 2000 - Price and Payment Procedures.

H. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.04 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.06 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.
B. Quality assurance.
C. References and standards.
D. Testing and inspection agencies and services.
E. Contractor's construction-related professional design services.
F. Contractor's design-related professional design services.
G. Control of installation.
H. Mock-ups.
I. Tolerances.
J. Manufacturers' field services.
K. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Document 00 7200 - General Conditions: Inspections and approvals required by public authorities.
B. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2019).
B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2017.
C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2022a.
D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2019.
E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2021.
F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.04 DEFINITIONS

A. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
    1. Design Services Types Required:
        a. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.

C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
   1. Concrete Mix Design: As described in Section 03 3000 - Cast-in-Place Concrete. No specific designer qualifications are required.
   2. Structural Calculations and Design: As described in Section 03 4100 - Precast Structural Concrete.
   3. Concrete Mix and Structural Design: As described in Section 03 4500 - Precast Architectural Concrete.
   4. Structural Design of Steel Connections: As described in Section 05 1200 - Structural Steel Framing.
   5. Structural Design of Steel Connections: As described in Section 05 2100 - Steel Joist Framing.
   6. Structural Design of Steel Decking: As described in Section 05 3100 - Steel Decking.
   7. Structural Design of Metal Framing: As described in Section 05 4000 - Cold-Formed Metal Framing.
   8. Fire Protection Design: As described in Section 07 8700 - Smoke Containment Barriers.
   9. Structural Design: Include physical characteristics, engineering calculations, and resulting dimensional limitations as described in Section 08 4435 - Protective Framed Glazing Assemblies.
   10. Structural Design: Include physical characteristics, engineering calculations, and resulting dimensional limitations as described in Section 08 4313 - Aluminum-Framed Storefronts.
   11. Structural design: Include calculations for resisting wind loads, anchor locations, and loads at points of attachment as described in Section 08 4327 - Channel Glass Storefronts.
   12. Structural Design: Include calculations for resisting wind loads, anchor locations, loads at points of attachment to building structure, physical characteristics, resulting dimensional limitations as described in Section 08 4413 - Glazed Aluminum Curtain Walls.
   13. Structural Design of Canopy: As described in Section 10 7316.13 - Metal Canopies.
   14. Structural Design of Foundation: As described in Section 10 7500 - Flagpoles.
   15. Structural Design and Calculations: As described in Section 10 8213 - Exterior Grilles and Screens.

1.07 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.

k. When requested by Architect, provide interpretation of results.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications:

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.09 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.10 TESTING AND INSPECTION AGENCIES AND SERVICES

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.

D. Room Mock-ups: Construct room mock-ups as indicated on drawings. Coordinate installation of materials, products, and assemblies as required in specification sections; finish according to requirements. Provide required lighting and any supplemental lighting where required to enable Architect to evaluate quality of the mock-up.

E. Notify Architect and _____ Consultant fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

F. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.

G. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

H. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

I. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.

J. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

K. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

2.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

2.04 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment, and _____ as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

2.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Owner, it is not practical to remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 4013

UL ASSEMBLIES

GENERAL

1.01 SECTION INCLUDES

A. Folling this pare are the complete UL Assemblies that are referenced from the drawings.

B. The Contractor and Subcontractors shall install the following UL Assemblies at the appropriate, required, and indicated locations.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUATION – NOT USED

UL Product iQ®

BXUV.H505 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

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- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

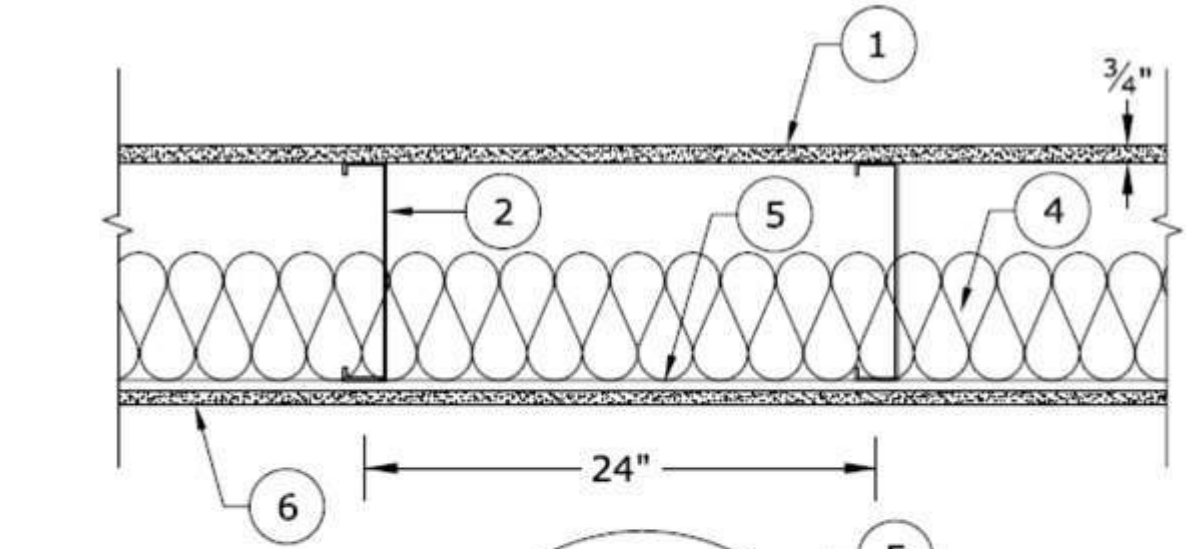
Design No. H505

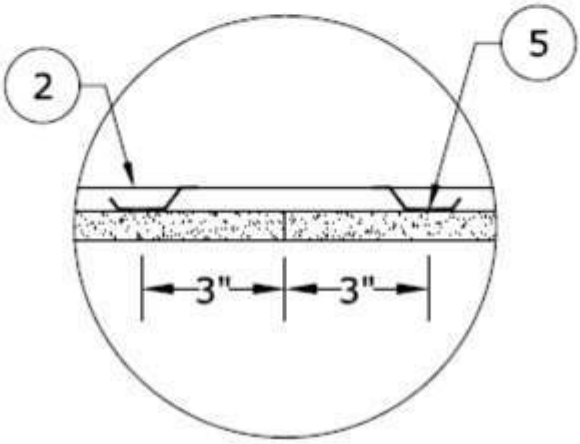
June 30, 2020

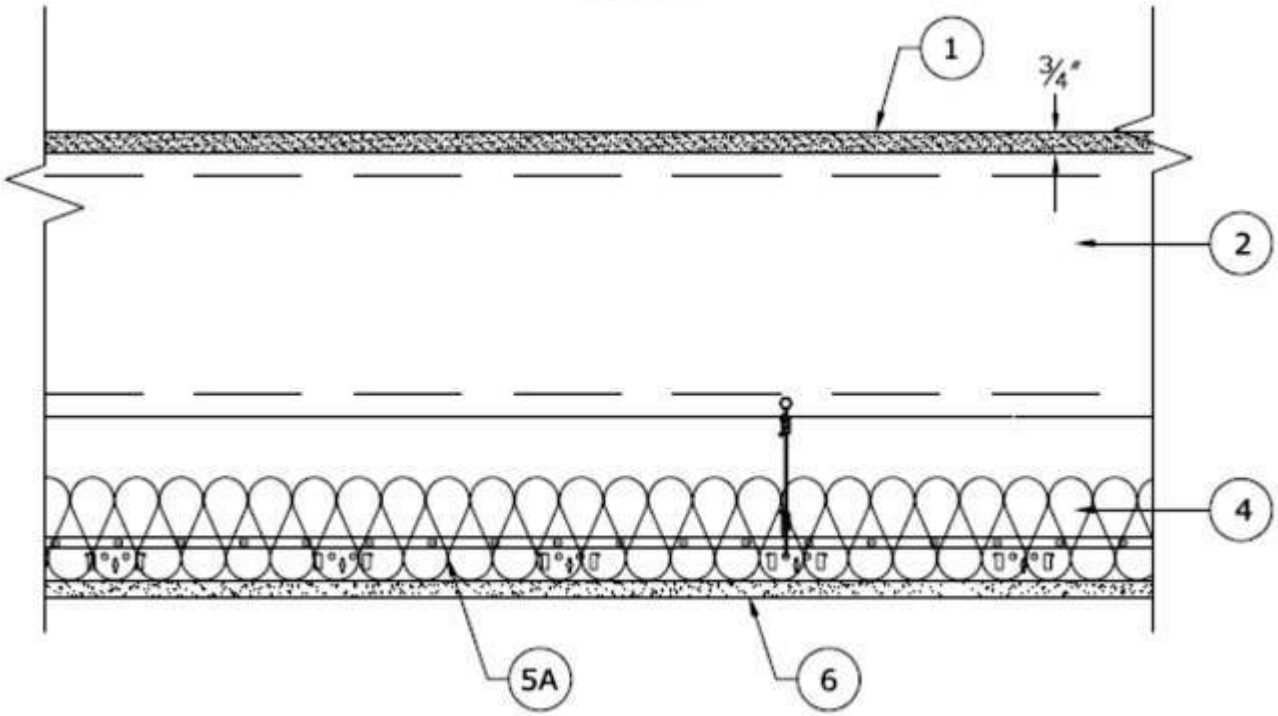
Unrestrained Assembly Rating —1 and 2 Hr (Refer to Item 4)

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.







1. **Structural Cement-Fiber Units* —** Nom 3/4 in. thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a min of 2 ft and centered over the joists. Panels secured to steel joists with 1-5/8 in. long No. 8 self-drilling, self-countersinking steel screws spaced a max of 12 in. OC in the field with a screw located 1 in. and 2 in. from each edge, and 8 in. OC on the perimeter with a screw located 2 in. from each edge, located 1/2 in. from the side edges of the panel.

As an alternate to the 1-5/8" long No. 8 fastener, the following power-actuated pins may be used for min. 1/8" thick, hot-rolled A36 steel sections for joist specified in Item 2E:

Hilti pin model X-U 32MX with a min. 0.157" shank diameter min. 1-1/4" long, DeWalt pin model 50458-PWR with a min. 0.157" shank diameter min. 1-1/4" long or Aerosmith model 5324HPG with a min. 0.145 shank diameter min. 1-1/4" long.

UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

2. **Steel Joists —** Channel-shaped, min 8 in. deep with min 1-5/8 in. wide flanges and 1/2 in. long stiffening flanges. Fabricated from min No. 16 MSG galv steel. Min yield strength of 50,000 psi. Joists spaced max 24 in. OC. Supplied with appropriate rim tracks of same size and gauge.

2A. **Clip Angles —** (Not Shown) - 18 MSG, 7-1/4 in. long steel angles with 1-1/2 in. legs for 8 in. deep joists. Secured to track and joist with six No.10, 3/4 in. long, self -drilling, hex head screws, located 1 in. from each end of the clip angle and at the centerline. Only one clip angle per joist end.

2B. **Structural Steel Members* —** (Not Shown) - As an alternate to Item 2, - Pre-fabricated steel truss system consisting of cold-formed, galvanized steel chord and web sections. Truss top and bottom chords min. 4 in. high by 1-11/16 in. wide by 18 ga. Truss webs min. 1-1/2 in. by 1-1/2 in. by 20 ga. square tube bent and triangulated as shown. Chords and web connected by fillet welds. Overall truss depth min. 12 in. Trusses spaced a max of 24 in. OC. Truss ends placed over and secured to Bearing Seats (Item 2B1) with two min. #10 by 3/4 in. long screws on each side of Bearing Seats. Allowable loading must be calculated so as to stress the steel trusses to a maximum of 98% of the stress calculated in accordance with the allowable stress design approach outlined in the manufacturer's load tables.
EISEN PANEL SYSTEMS L L C — Type Gateway Panel pre-fabricated steel truss system.

2B1. **Bearing Seats* —** (Not Shown) — Galvanized steel tube, min. 1 in. by 2-1/2 in. by 13 ga., oriented vertically and welded to min. 4 in. by 4 in. by 10 ga., galvanized steel plate. Bearing seats spaced 24 in. OC and attached to bearing supports by welding or screw attaching the steel plate to the bearing supports.
EISEN PANEL SYSTEMS L L C — Type Gateway Panel bearing seat.

2B2. **Bracing —** (Not Shown) - For use with Item 2B — Galvanized channel-shaped steel sections, min. 1-1/2 in. wide with 1/4 in. flanges, min. 16 ga. Bracing attached to underside of trusses with min. #10 by 3/4 in. long screws through truss bottom chord. Bracing installed in truss cavities by scoring, bending and flattening the ends to form a tab for attachment to truss top and bottom chords. Two pieces of bracing crossed and tabs secured to truss chords with min. #10 by 3/4 in. long screws. Location and spacing of underside and crossed bracing to be specified on truss engineering.

2C. **Structural Steel Members* —** As an alternate to Item 2 — Pre-fabricated light gauge steel truss system consisting of cold-formed, galvanized steel cord and web sections. Trusses fabricated in various sizes, depths, and from various steel thickness. Trusses minimum 12 in. deep, spaced a max of 24 in. OC.
AEGIS METAL FRAMING, DIV OF MITEK — Ultra-Span, Pre-fabricated Light Gauge Steel Truss System

TRUSSTEEL, DIV OF ITW BUILDING COMPONENTS INC — TrusSteel

2D. **Steel Trusses —** As an alternate to Item 2, - Cold-formed galvanized steel truss chord and web sections manufactured from steel conforming to ASTM A653 Grade 33 or higher yield strength. Steel thickness of truss chord and web sections as required by design to meet governing code requirements. Truss members connected together with No. 10-16 (min size) self-drilling screws or equivalent. Truss chord and web members to be designed in accordance with the American Iron and Steel Institute's Specification for the Design of Cold-Formed Steel Structural Members, 1996 Edition. Trusses spaced a max of 24 in. OC. Where the truss intersects with the interior face of the exterior walls, the min truss depth shall be 12 in.

2E. **Steel Joists —** As an alternate to Item 2, minimum 12K1, spaced a max 24 in. OC.

2F. **Structural Steel Members* —** As an alternate to Item 2 - Limited to the 1 Hour Ratings. Pre-fabricated light gauge steel truss system consisting of cold-formed, galv steel cord and web sections. Trusses fabricated in various sizes, depths and from various steel thickness. Trusses spaced a max of 24 in. OC. Location of lateral bracing for truss chord and web sections to be specified on truss engineering.
TRUSS LINK INC — Truss Link

3. **Joist Bridging —** (Not Shown) - For use with Item 2 — Installed immediately after joists are erected and before construction loads are applied. The bridging shall consist of rim track cut 8 in. longer than span between joists, with rim track legs cut through 4 inches back from each end and bent at a 90° angle and screw attached through the rim track legs into the joists with four screws at each end, two on top and two on the bottom at each end of rim track. Flat strap bracing of 1-1/2 in. wide by 20-ga galvanized steel is also screw-attached to bottom joist flange at mid-span.

4. **Batts and Blankets* —** (When Insulation is not used the rating shall be 1 Hr.). 3-1/2 in. thick glass fiber batt insulation draped over the resilient channels. Any glass fiber batt insulation bearing the UL Classification Marking for Surface Burning Characteristics having a flame spread index of 25 or less and a smoke developed index of 50 or less may be used. See **Batts and Blankets** (BKNV) category in the Building Materials Directory for names of manufacturers.

5. **Resilient Channels —** Formed of No. 25 MSG galv steel, 1/2 in. deep, spaced max 12 in. OC, perpendicular to joists. Channel splices located beneath joists and overlapped 4 in. Channels secured to each joist with one 1/2 in. long Type S-12 low profile steel screw. Two channels, spaced 6 in. OC, oriented opposite each gypsum board end joint as shown on the illustration above. Additional channels shall extend min 6 in. beyond each side edge of board.

5A. **Steel Framing Members* —** (Optional, Not Shown) — When it is desired to drop the ceiling below the bottom plane of the structural steel members (Item 2), a suspension system may be used in lieu of the resilient channels. Main runners, cross tees, cross channels and wall angle as listed below:

a. **Main Runners —** Nom 10 or 12 ft long , 15/16 in. or 1-1/2 in. wide face, spaced 4 ft. OC. Main runners suspended by min 12 SWG galv steel hanger wires spaced 24 in. OC, a min of 4 in. below bottom flange of joist, twist-tied to #10 -3/4 in. long screws installed in the web, 1/2 in. from the bottom flange of the steel joist. Hanger wires to be located adjacent to main runner/cross tee intersections.

b. **Cross Tees —** Nom 4 ft long, 1-1/2 in. wide face, installed perpendicular to the main runners, spaced 16 in. OC. Additional cross tees or cross channels used at 8 in. from each side of butted gypsum panel end joints. The cross tees or cross channels may be riveted or screw attached to the wall angle or channel to facilitate the ceiling installation.

c. **Cross Channels —** Nom 4 ft or 12 ft long, installed perpendicular to main runners, spaced 16 in. OC.

d. **Wall Angle or Channel —** Painted or galv steel angle with 1 in. legs or channel with 1 in. legs, 1-9/16 in. deep attached to walls at perimeter of ceiling with fasteners 16 in. OC. To support steel framing member ends and for screw-attachment of the gypsum panel.
CGC INC — Type DGL or RX

USG INTERIORS LLC — Type DGL or RX.

5B. **Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Item 5 — Furring channels and Steel Framing Members as described below:

a. **Furring channels —** Formed of No. 25 MSG galv steel, 2-3/8 in. wide by 7/8 in. deep, spaced 12 in. OC, perpendicular to joists. Channel secured to joists as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. Additional channels shall be positioned so that the distance from the end of the board to the center of the first channel is 3 in. and from the board end to the center of the next channel is 12 in.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to joists (Item 2). Clips spaced 48 in. OC and secured to the bottom chord of joists with min 1-5/8 in. long No. 8 self-drilling, self-tapping, bugle, flat or hex head screw through the center grommet. Furring channels are friction fitted into clips. Additional clips required to hold furring channel that supports the gypsum board butt joints.
PLITEQ INC — Type Genie Clip

5C. **Alternate Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Items 5 to 5B, furring channels and Steel Framing Members as described below.

a. **Furring channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 12 in. OC, perpendicular to joists. Channels secured to joists as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to the steel joists (Item 2). Clips spaced a max of 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to alternating joists with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clips for use with 2-23/32 in. wide furring channels. Adjoining channels are overlapped as described in Item a. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the wallboard butt joints, as described in Item 6.
PAC INTERNATIONAL L L C — Types RSIC-1 or RSIC-1 (2.75)

5D. **Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Item 5.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 12 in. OC, perpendicular to the joists. Channels secured to Cold Rolled Channels at every intersection with a 3/4 in. TEK screw through each furring channel leg. Ends of adjoining channels overlapped 12 in. and fastened together with two double strand No. 18 SWG galv steel wire ties, one at each end of overlap, or with two 3/4 in. TEK screws in each leg of the overlap section. Two furring channels used at end joints of gypsum board (Item 6), each extending a min of 6 in. beyond both side edges of the board.

b. **Cold Rolled Channels —** 1-1/2 in. by 1/2 in., formed from No. 16 ga. galv steel, positioned vertically and parallel to joists, friction-fitted into the channel caddy on the Steel Framing Members (Item 5Dc) and secured with two 3/4 in. TEK screws. Adjoining lengths of cold rolled channels lapped min. 12 in. and secured along bottom legs with four 3/4 in. TEK screws and wire-tied together with two double strand 18 SWG galv steel wire ties, one at each end of overlap.

c. **Steel Framing Members* —** Spaced 48 in. OC. max along joist, and secured to the joist on alternating joists with two, No. 10-16 TEK screws through mounting holes on the hanger bracket.
PAC INTERNATIONAL L L C — Type RSIC-SI-CRC EZ Clip

5E. **Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Item 5.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 12 in. OC perpendicular to joists and friction fit into Steel Framing Members (Item 5Eb). Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap or with two TEK screws along each leg of the 6 in. overlap. Two furring channels used at end joints of gypsum board (Item 6). Butt joint channels held in place by strong back channels placed upside down, on top of, and running perpendicular to primary furring channels, extending 6 in. longer than length of gypsum side joint. Strong back channels spaced maximum 48 in. OC. Strong back channels secured to every intersection of primary furring channels with four 7/16 in. pan head screws, two along each of the legs at intersections. Butt joint channels run perpendicular to strong back channels and shall be minimum 6 in. longer than length of joint, secured to strong back channels with 7/16 in. pan head screws, two along each of the legs at intersection with strong back channels.

b. **Steel Framing Members* —** Used to attach furring channels (Item 5Ea) to joists. Clips spaced 48 in. OC and secured along joist webs at each furring channel intersection with min. 3/4 in. long self-drilling No. 10-16 TEK screws through each of the provided hole locations. Furring channels are friction fitted into clips.
PAC INTERNATIONAL L L C — Type RSIC-S1-1 Ultra

6. **Gypsum Board* —** One layer of nom 5/8 in. thick by 48 in. wide gypsum panels installed with long dimension perpendicular to resilient channels, furring channels or cross tees of suspension system. Gypsum panels secured to resilient channels, furring channels or drywall suspension system with 1 in. long Type S bugle-head screws spaced 8 in. OC, with screws located minimum of 1 in. from the side joints and 3 in. from the end joints. End joints secured to both resilient/furring channels as shown in end joint detail. When **Steel Framing Members** (Item 5B or 5C) are used, the butt joints in the gypsum board shall be supported by two furring channels. The two furring channels shall be spaced approximately 3-1/2 in. OC, and be attached to underside of the joist with one RSIC-1, RSIC-1 (2.75) or Genie clip at each end of the channel.
When **Steel Framing Members** (Item 5D) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 6 as per hourly ratings. Adjacent butt joints staggered minimum 48 in. OC.

When **Steel Framing Members** (Item 5E) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 6 as per hourly ratings. Butt joints staggered minimum 24 in. OC.

CGC INC — Type ULIX

UNITED STATES GYPSUM CO — Type ULIX

7. **Finishing System - (Not Shown) —** Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nom 2 in. wide paper tape embedded in first layer of compound over all joints. As an alternate, nom 3/32 in. thick veneer plaster may be applied to the entire surface of gypsum panels.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2020-06-30

BXUV.N823 - Fire-resistance Ratings - ANSI/UL 263

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BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. N823

April 29, 2020

Restrained Beam Ratings — 1, 1-1/2, 2, 3 and 4 Hr.

Unrestrained Beam Ratings — 1, 1-1/2, 2, 3 and 4 Hr.

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

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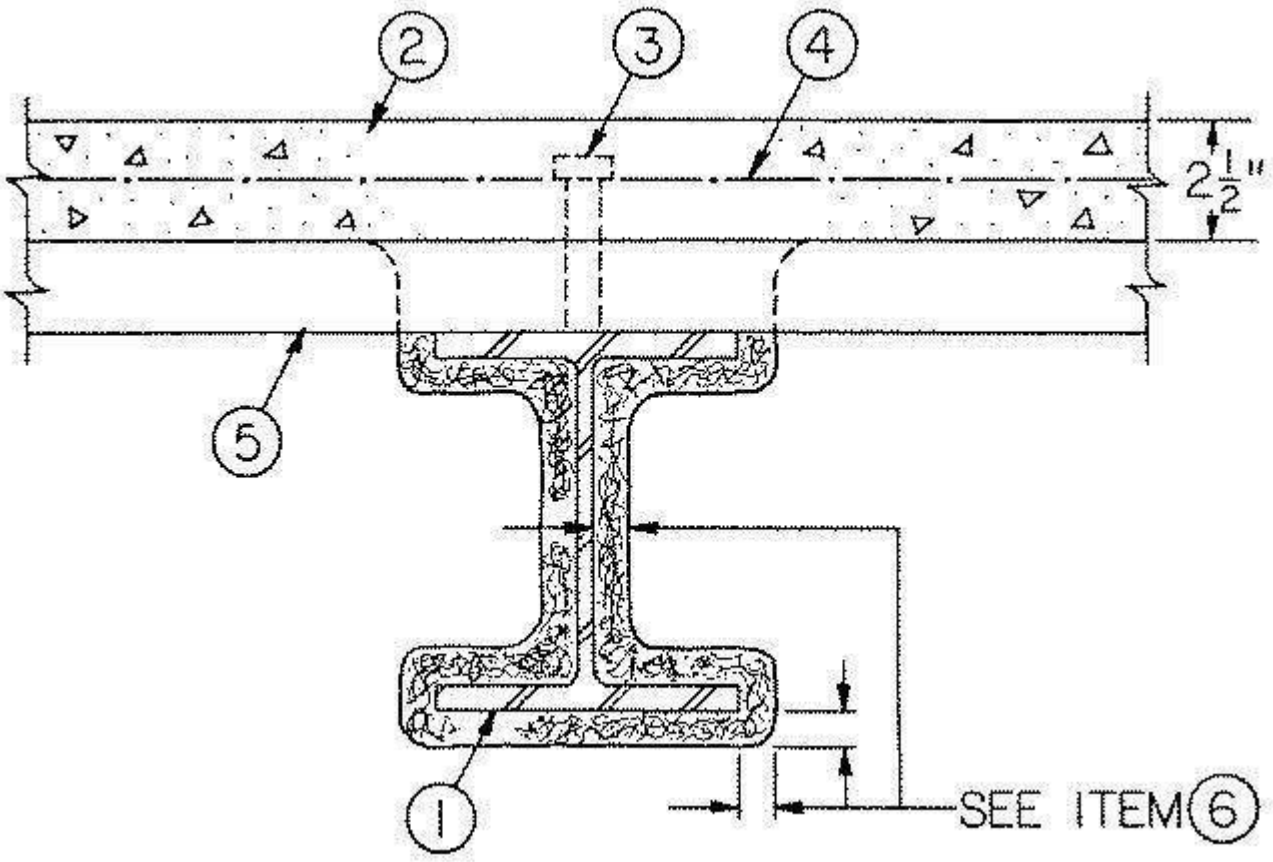

1. **Steel Beam —** W8x28 min size.

2. **Normal Weight or Lightweight Concrete —** Compressive strength 2800 psi. For normal weight concrete either carbonate or siliceous aggregate may be used. Unit weight 150 pcf. For lightweight concrete, unit weight 102 pcf.

3. **Shear Connector (Optional) —** Studs, 3/4 in. diameter headed type or equivalent per AISC specifications. Welded to top flange of beam through the steel floor units.

4. **Welded Wire Fabric —** (optional) 6x6, W1.4xW1.4.

5. **Steel Floor and Form Units —** 1-1/2 to 3 in. deep fluted, cellular or corrugated units, welded to beam.

6. **Spray-Applied Fire Resistive Materials* —** Applied by spraying with water to the final thicknesses shown below. Crest areas shall be filled with Spray-Applied Fire Resistive Materials above the beam. Beam surfaces must be clean and free of dirt, loose scale and oil. Min average density of 13 pcf with min. ind density of 11 pcf for Types II, II HS, , or DC/F. Min avg and min ind densities of 22 and 19 pcf, respectively, for Type HP. For method of density determination, refer to Design Information Section.

Normal Weight Concrete, Fluted Floor and Form Units, Min Thkns, In.

Rating, Hr	Restrained Beam	Unrestrained Beam
1	3/8	3/8
1-1/2	3/8	1/2
2	1/2	3/4
2-1/2*	3/4	15/16
3	1	1-3/16
3-1/2*	1-1/4	1-3/8

4	1-7/16	1-9/16

Lightweight Concrete, Fluted Floor and Form Units, Min Thkns, In.

Rating, Hr	Restrained Beam	Unrestrained Beam
1	3/8	3/8
1-1/2	7/16	5/8
2	3/4	1
2-1/2*	1	1-5/16
3	1-1/4	1-9/16
3-1/2*	1-1/2	1-13/16
4	1-13/16	2

Normal Weight Concrete, Cellular or Corrugated Form Units, Min Thkns, In.

Rating, Hr	Restrained Beam	Unrestrained Beam
1	3/8	3/8
1-1/2	3/8	1/2
2	1/2	13/16
2-1/2*	7/8	1-1/8
3	1	1-5/16
3-1/2*	1-1/4	1-5/8
4	1-7/16	1-7/8

Lightweight Concrete, Cellular or Corrugated Form Units, Min Thkns, In.

Rating, Hr	Restrained Beam	Unrestrained Beam
1	7/16	7/16
1-1/2	1/2	11/16
2	3/4	1
2-1/2*	1-1/16	1-5/16
3	1-1/4	1-5/8
3-1/2*	1-9/16	1-15/16
4	1-13/16	2-3/16

*The 2-1/2 and 3-1/2 hour ratings are for use when mineral fiber boards, polystyrene insulation exceeding 5 pcf, or polyisocyanurate insulation are used over the concrete in D900 series designs as stated in the front of the Fire Resistance Directory - III. FLOOR-CEILINGS AND ROOF-CEILINGS, item 21. Roof Insulation.

ISOLATEK INTERNATIONAL — Type D-C/F, HP, II, or Type II HS. Investigated for exterior use. Type EBS or Type X adhesive/surface sealer optional.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2020-04-29

BXUV.U415 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

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- Authorities Having Jurisdiction should be consulted before construction.
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Fire-resistance Ratings - ANSI/UL 263

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

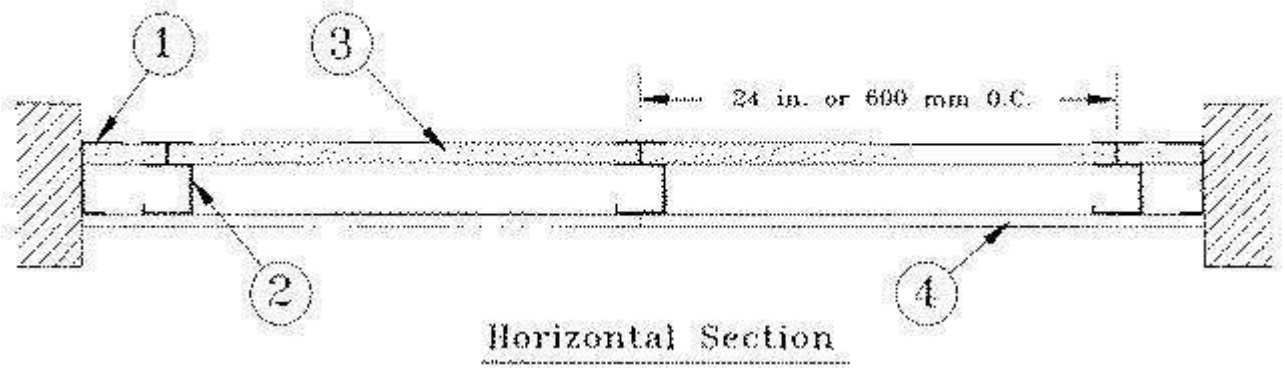
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **U415**

February 14, 2022

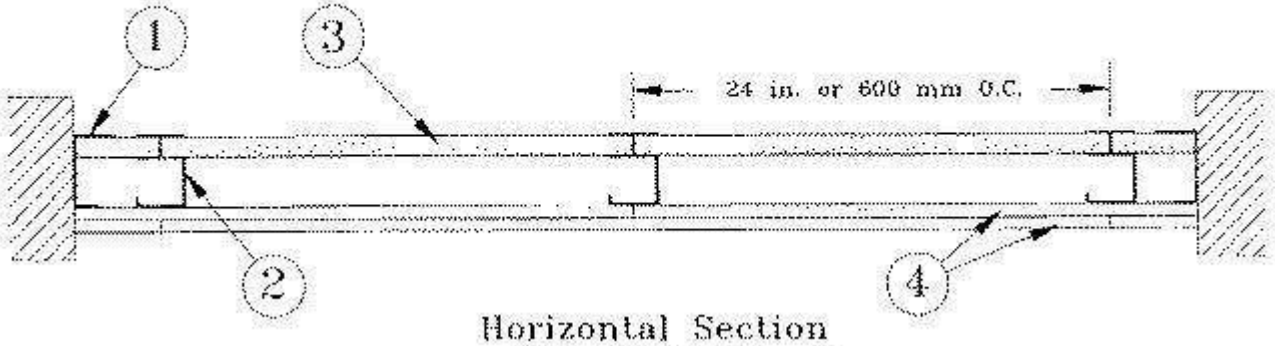
Nonbearing Wall Ratings — 1, 2, 3 or 4 Hr
*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

System A — 1 Hr.



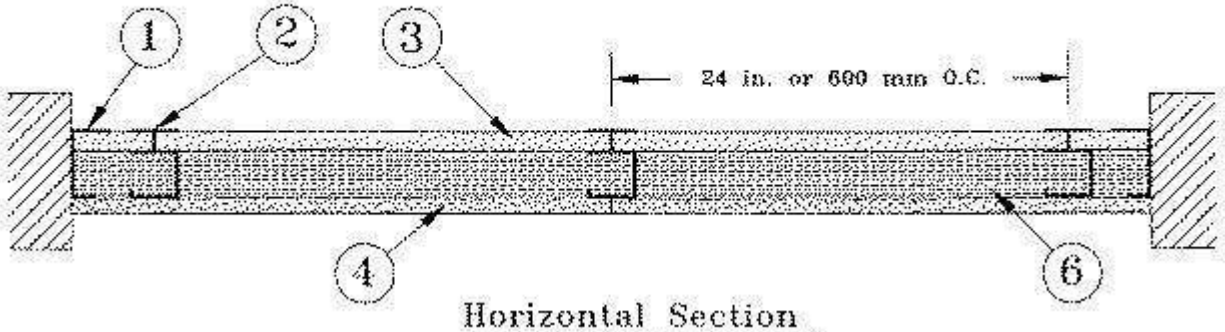
Horizontal Section

System B – 2 Hr.



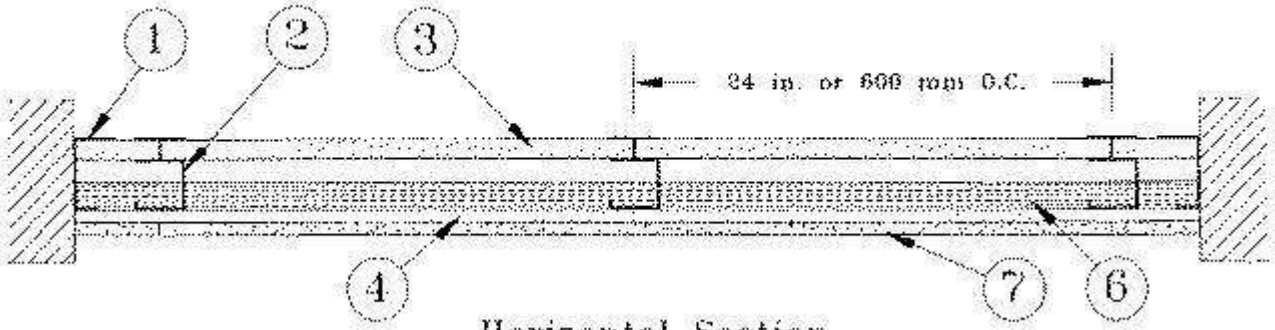
Horizontal Section

System C – 2 Hr.



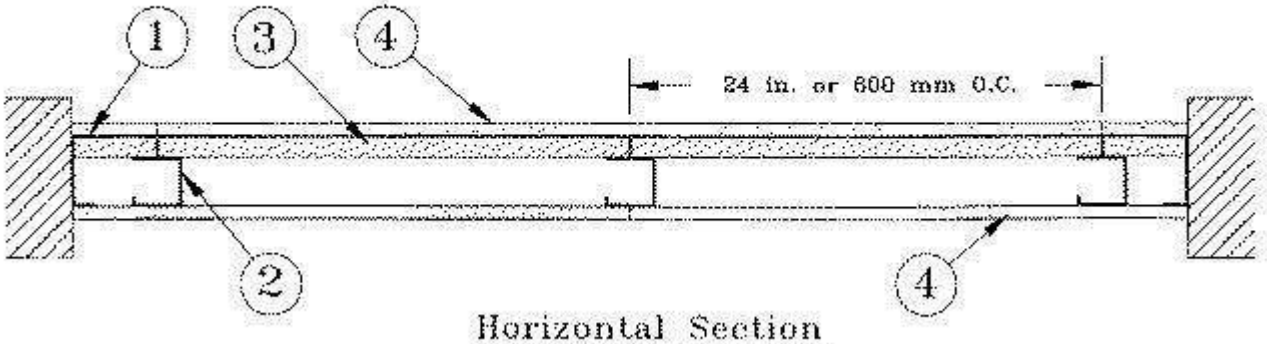
Horizontal Section

System D – 2 Hr.



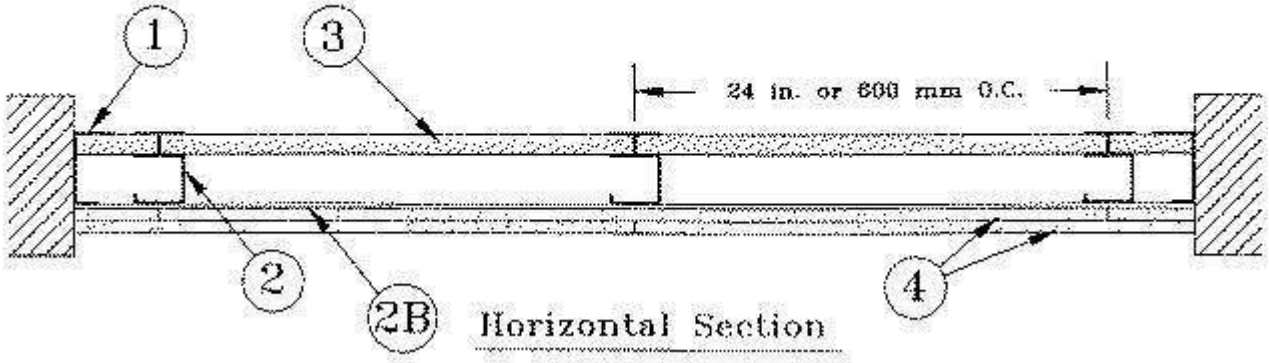
Horizontal Section

System E – 2 Hr.



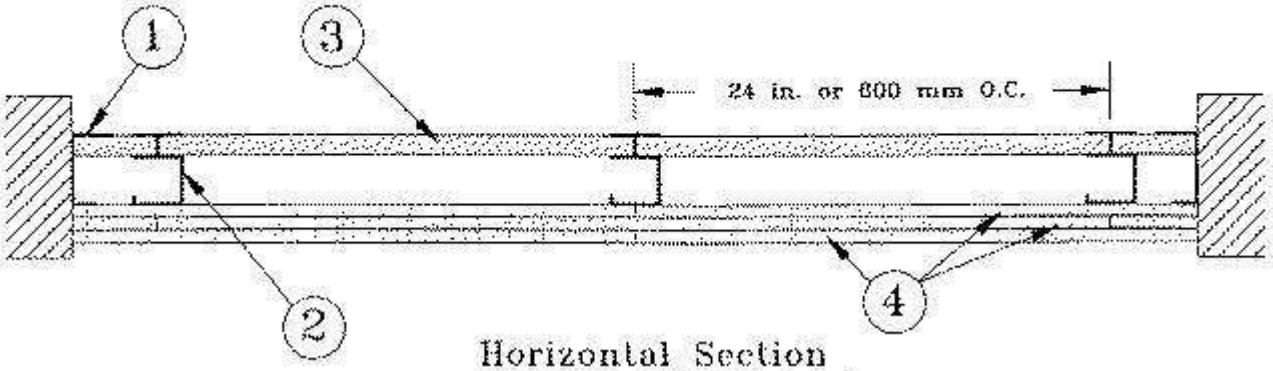
Horizontal Section

System F – 2 Hr.



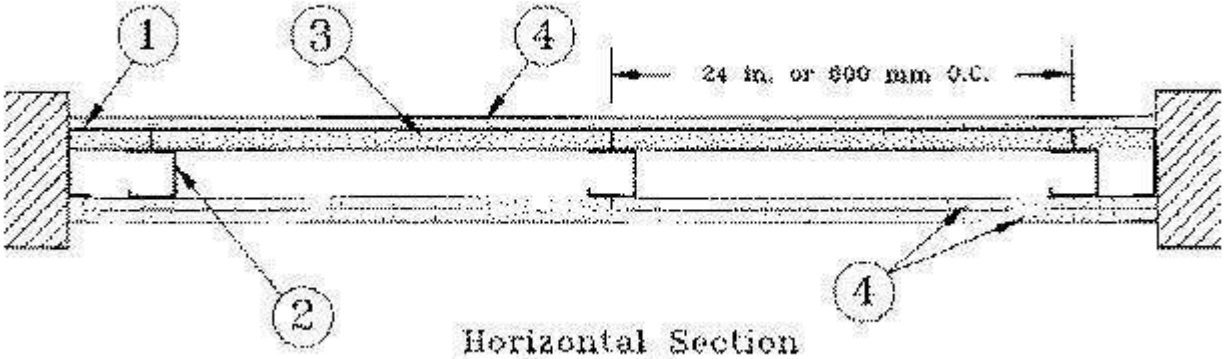
Horizontal Section

System G – 3 Hr.



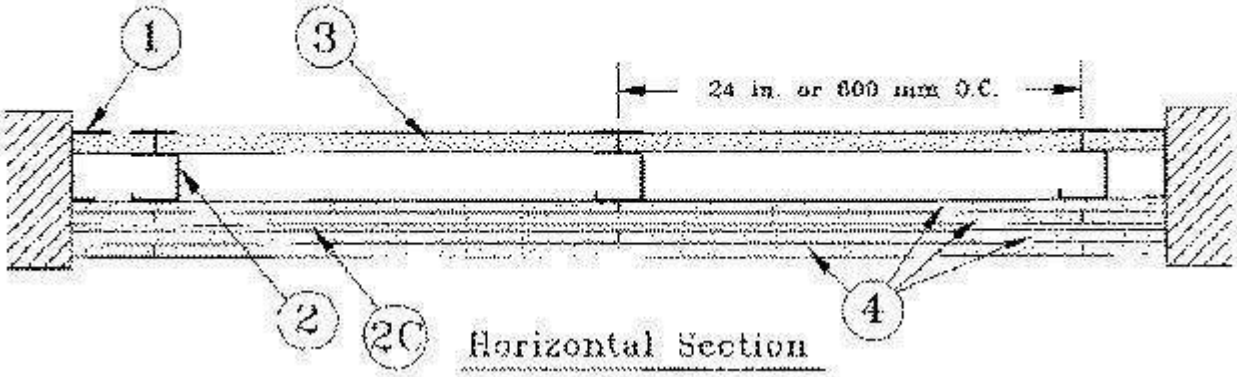
Horizontal Section

System H – 3 Hr.



Horizontal Section

System I – 4 Hr.



Horizontal Section

Feedback

1. **Floor, Side and Ceiling Runners —** "J" - shaped runner, min 2-1/2 in. deep (min 4 in. deep when System C is used), with unequal legs of 1 in. and 2 in., fabricated from min 24 MSG (min 20 MSG when Item 4A, 4B, 4C, 4D or 7 are used) galv steel. Runners

positioned with short leg toward finished side of wall. Runners attached to structural supports with steel fasteners located not greater than 2 in. from ends and not greater than 24 in. OC. "E" - shaped studs (Item 2A) may be used as side runners in place of "J" - shaped runners.

2. **Steel Studs —** "C-H" - shaped studs, min 2-1/2 in. deep (min 4 in. deep when System C is used), fabricated from min 25 MSG (min 20 MSG when Items 2D, 4A, 4B, 4C, 4D or 7 is used) galv steel. Cut to lengths 3/8 to 1/2 in. less than floor-to-ceiling height and spaced 24 in. or 600 mm OC (max 16 in. OC when Items 4A, 4B, 4C, or 4D are used).

2A. **Steel Studs —** (Not Shown) — "E" - shaped studs installed back to back in place of "C-H" - shaped studs (Item 2) "E" - shaped studs secured together with steel screws spaced a maximum 12 in. OC. Fabricated from min 25 MSG (min 20 MSG when Item 2D, 4A, 4B or 7 is used) galv steel, min 2-1/2 in. deep (min 4 in. deep when System C is used), with one leg 1 in. long and two legs 3/4 in. long. Shorter legs 1 in. apart to engage gypsum liner panels. Cut to lengths 3/8 to 1/2 in. less than floor to ceiling heights.

2B. **Furring Channels —** (Optional, Not Shown) — For use with single or double layer systems. Resilient furring channels fabricated from min 25MSG corrosion protected steel, installed horizontally, and spaced vertically a max 24 in. OC. Flange portion of channel attached to each intersecting "C-H" or "E" stud on side of stud opposite the 1 in. liner panels with 1/2 in. long Type S or S-12 pan-head steel screws. When furring channels are used, wallboard to be installed vertically only. . Not to be used with Type FRX-G gypsum board, lead backed gypsum boards (Items 4A-4D), or cementitious backer units (Item 7).

2C. **Furring Channels —** For use with System I - "Hat" - shaped, 25 MSG galv steel furring channels attached directly over the inner layers of wallboard to each stud with 2 in. long Type S pan head steel screws. Screws alternate from top flange to bottom flange at each stud intersection. Furring channels spaced vertically max 24 in. OC.

2D. **Steel Framing Members* —** (Optional, Not Shown) — For use with single or double layer systems. Furring channels and Steel Framing Members as described below. Not to be used with Type FRX-G gypsum board, lead backed gypsum boards (Items 4A-4D), or cementitious backer units (Item 7).
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board installed vertically only and attached to furring channels as described in Item 4.

b. **Steel Framing Members* —** Used to attach furring channels (Item 2Da) to studs (Item 2 or 2A). Clips spaced max. 24 in. OC., and secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clip for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clip for use with 2-23/32 in. wide furring channels.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-1 (2.75)

2E. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below. . Not to be used with Type FRX-G gypsum board, lead backed gypsum boards (Items 4A-4D), or cementitious backer units (Item 7).
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire.Gypsum board attached to furring channels as described in Item 4.

b. **Steel Framing Members* —** Used to attach furring channels (Item 2Ea) to studs. Clips spaced 24 in. OC., and secured to studs with 2 in. coarse drywall screw with 1 in. diam washer through the center hole. Furring channels are friction fitted into clips.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237R

2F. **Steel Framing Members* —** (Optional, Not Shown) — For use with single or double layer systems. Furring channels and Steel Framing Members as described below. Not to be used with Type FRX-G gypsum board, lead backed gypsum boards (Items 4A-4D), or cementitious backer units (Item 7).
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board installed vertically only and attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 2Da) to studs (Item 2 or 2A). Clips spaced max. 24 in. OC. GENIECLIPS secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring

channels are friction fitted into clips.
PLITEQ INC — Type GENIECLIP

2G. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below. Not to be used with Type FRX-G gypsum board, lead backed gypsum boards (Items 4A-4D), or cementitious backer units (Item 7).
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item 2Gb. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 4.

b. **Steel Framing Members* —** Used to attach furring channels (Item 2Ga) to studs. Clips spaced 24 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
REGUPOL AMERICA — Type SonusClip

2H. **Steel Framing Members* —** (Optional, Not Shown) — Resilient channels and Steel Framing Members as described below. Not to be used with Type FRX-G gypsum board, lead backed gypsum boards (Items 4A-4D), or cementitious backer units (Item 7).
a. **Resilient Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with two No. 8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board attached to resilient channels as described in Item 4.

b. **Steel Framing Members* —** Used to attach resilient channels (Item 2Ha) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Resilient channels are secured to clips with one No. 10 x 1/2 in. pan-head self-drilling screw.
KEENE BUILDING PRODUCTS CO INC — Type RC+ Assurance Clip

2I. **Steel Framing Members* —** (Optional, Not Shown) — For use with single or double layer systems. Furring channels and Steel Framing Members as described below. Not to be used with Type FRX-G gypsum board, lead backed gypsum boards (Items 4A-4D), or cementitious backer units (Item 7).
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board installed vertically only and attached to furring channels as described in Item 4.

b. **Steel Framing Members* —** Used to attach furring channels (Item 2Ia) to studs (Item 2 or 2A). Clips spaced max. 24 in. OC., and secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring channels are friction fitted into clips.
CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

3. **Gypsum Board* —** Gypsum liner panels, nom 1 in. thick, 24 in. or 600 mm (for metric spacing) wide. Panels cut 1 in. less in length than floor to ceiling height. Vertical edges inserted in "H" portion of "C-H" studs or the gap between the two 3/4 in. legs of the "E" studs. Free edge of end panels attached to long leg of vertical "J" - runners with 1-5/8 in. long Type S steel screws spaced not greater than 12 in. OC. When wall height exceeds liner panel length, liner panel may be butted to extend to the full height of the wall. Horizontal joints need not be backed by steel framing. In System I, butt joints in liner panels are staggered min 36 in. Butt joints backed with 6 in. by 22 in. strips of 3/4 in. thick gypsum wallboard (Item 4). Wallboard strips centered over butt joints and secured to liner panels with six 1-1/2 in. long Type G steel screws, three screws along the 22 in. dimension at the top and bottom of the strips.
CGC INC — Type SLX

UNITED STATES GYPSUM CO — Type SLX

USG BORAL DRYWALL SFZ LLC — Type SLX

USG MEXICO S A DE C V — Type SLX

4. **Gypsum Board* —**

System A — 1 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, attached to studs with 1 in. long Type S steel screws spaced 12 in. when installed vertically or 8 in OC when installed horizontally. Horizontal joints need not be backed by steel framing.

CGC INC — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULIX, ULX, USGX, WRC, WRX

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Types C and SCX

UNITED STATES GYPSUM CO — Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULIX, ULX, WRC, WRX, USGX.

USG BORAL DRYWALL SFZ LLC — Types C, SCX, SGX, USGX

USG MEXICO S A DE C V — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

System B — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 1/2 in. or 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally in two layers. Inner or base layer attached to studs with 1 in. long Type S steel screws spaced 24 in. OC when installed vertically or 16 in. OC when installed horizontally. Outer or face layer attached to studs with 1-5/8 in. long Type S steel screws spaced 12 in. OC when installed vertically and staggered 12 in. from base layer screws or 8 in. OC when installed horizontally and staggered 8 in. from base layer screws. Horizontal joints between inner and outer layers staggered a min of 12 in. Horizontal joints need not be backed by steel framing. Vertical joints centered over studs and staggered 24 in.

CGC INC — 1/2 in. Type C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Types C and SCX

UNITED STATES GYPSUM CO — 1/2 in. Types C, IP-X2, IPC-AR, or WRC; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULIX, ULX, USGX, WRC, WRX.

USG BORAL DRYWALL SFZ LLC — 1/2 in. Type C; 5/8 in. Types C, SCX, SGX, USGX

USG MEXICO S A DE C V — 1/2 in. Types C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

System C — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 3/4 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, secured with 1-1/4 in. long Type S steel screws spaced 8 in. OC along vertical edges and 12 in. OC in the field when installed vertically or 8 in. OC along the vertical edges and in the field when installed horizontally. Horizontal joints need not be backed by steel framing. Screws along side joints offset 4 in. Requires min 4 in. deep framing per Items 1, 2 and 3. Requires min 3 in. thick mineral wool batts per Item 6.

CGC INC — Types IP-X3 or ULTRACODE

UNITED STATES GYPSUM CO — Types IP-X3 or ULTRACODE

USG BORAL DRYWALL SFZ LLC — Type ULTRACODE

USG MEXICO S A DE C V — Types IP-X3 or ULTRACODE

System D — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, attached directly to studs with 1 in. long Type S steel screws spaced 24 in. when installed vertically or 16 in. OC when installed horizontally. Horizontal joints need not be backed by steel framing. Requires face layer of 1/2 or 5/8 in. thick cementitious backer units per Item 7 and min 1-1/2 in. thick mineral wool batts per Item 6.

CGC INC — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Types C and SCX

UNITED STATES GYPSUM CO — Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULIX, ULX, USGX, WRC, WRX.

USG BORAL DRYWALL SFZ LLC — Types C, SCX, SGX, USGX

USG MEXICO S A DE C V — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

System E — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 1/2 in. or 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, attached to studs with 1 in. long Type S steel screws spaced 12 in. OC when installed vertically or 8 in. when installed horizontally. Horizontal joints need not be backed by steel framing.

CGC INC — 1/2 in. Types C, IP-X2, IPC-AR; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Types C and SCX

UNITED STATES GYPSUM CO — 1/2 in. Types C, IP-X2, IPC-AR; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULIX, ULX, USGX, WRC, WRX.

USG BORAL DRYWALL SFZ LLC — 1/2 in. Type C; 5/8 in. Types C, SCX, SGX, USGX

USG MEXICO S A DE C V — 1/2 in. Types C, IP-X2, IPC-AR; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

System F — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 1/2 in. or 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically in two layers. Inner or base layer attached to resilient furring channels (Item 2B) with 1 in. long Type S steel screws spaced 24 in. Outer or face layer attached to resilient furring channels (Item 2B) with 1-5/8 in. long Type S steel screws spaced 12 in. OC and staggered 12 in. from base layer screws. Joints between inner and outer layers staggered 24 in.

CGC INC — 1/2 in. Type C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Types C and SCX

UNITED STATES GYPSUM CO — 1/2 in. Type C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULIX, ULX, USGX, WRC, WRX.

USG BORAL DRYWALL SFZ LLC — 1/2 in. Type C; 5/8 in. Types C, SCX

USG MEXICO S A DE C V — 1/2 in. Types C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, USGX, WRC, WRX

System G — 3 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally in three layers. Inner or base layer attached to studs with 1 in. long Type S steel screws spaced 24 in. OC when installed vertically or 16 in OC when installed horizontally. Middle layer attached to studs with 1-5/8 in. long Type S steel screws spaced 24 in. when installed vertically or 16 in. OC when installed horizontally. Outer or face layer attached to studs with 2-1/4 in. long Type S steel screws spaced 16 in. when installed vertically or 12 in. OC when installed horizontally. Screws offset 6 in. from layer below. Horizontal joints on adjacent layers staggered a min of 12 in. . Horizontal joints need not be backed by steel framing. Vertical joints centered over studs and staggered 24 in. on adjacent layers.

CGC INC — Types C, IP-X2, IPC-AR, ULIX, WRC

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Type C

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR, ULIX, WRC

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR, WRC

System H — 3 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, two layers over the flange of the "C" section of the studs, one layer over the flange of the "H" section of the studs. Inner or base layer attached to studs with 1 in. long Type S steel screws spaced 24 in. OC when installed vertically or 16 in. OC when installed horizontally. Face layer attached to studs with 1-5/8 in. long Type S steel screws spaced 16 in. when installed vertically or 12 in. OC when installed horizontally. Screws offset 6 in. from layer below. Horizontal joints on adjacent layers staggered a min of 12 in. Horizontal joints need not be backed by steel framing. Vertical joints centered over studs and staggered 24 in. on adjacent layers.

CGC INC — Types C, IP-X2, IPC-AR, ULIX, WRC

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Type C

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR, ULIX, WRC

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR, WRC

System I — 4 Hr

Gypsum panels, with beveled, square or tapered edges, nom 3/4 in. thick, 4 ft wide (or 1200 mm for metric spacing) wallboard with square or tapered edges. Total of four layers to be used. First and second (inner) layers applied vertically or horizontally over the steel studs. Horizontal joints need not be backed by steel framing. When applied vertically, joints centered over studs and staggered min 24 in., otherwise all joints staggered min 12 in. First layer secured to studs with 1-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 24 in. OC. Second layer secured to studs with 2-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 12 in. OC. Third layer applied vertically over the furring channels (Item 2C) with a 1-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 12 in. OC. Fourth layer applied vertically or horizontally with 2-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 12 in. OC. When applied vertically, joints to be staggered min 24 in. from third layer, otherwise all joints staggered min 12 in.

CGC INC — Types IP-X3 or ULTRACODE

UNITED STATES GYPSUM CO — Types IP-X3 or ULTRACODE

USG BORAL DRYWALL SFZ LLC — Type ULTRACODE

USG MEXICO S A DE C V — Types IP-X3 or ULTRACODE

4A. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only) — Nom 5/8 in. or 3/4 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over 20 MSG steel studs and staggered min 1 stud cavity on opposite sides of studs. See Items 1, 2, 2A, 2B and 2D. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. For Joint Compound see Item 5. To be used with Lead Batten Strips (see Item 9) or Lead Discs or Tabs (see Item 10).

RAY-BAR ENGINEERING CORP — Type RB-LBG

4B. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only) — Nominal 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 (or #6 by 1-1/4 in. long bugle head fine driller) steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field.
NEW ENGLAND LEAD BURNING CO INC, DBA NELCO — Type Nelco

4C. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only) — Nom 5/8 or 3/4 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over 20 MSG steel studs and staggered min 1 stud cavity on opposite sides of studs. See Items 1, 2, 2A, 2B and 2D. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. For Joint Compound see Item 5. To be used with Lead Batten Strips (see Item 9A) or Lead Discs (see Item 10A). Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 10 ft long with a max thickness of 0.140 in. placed on the face of studs and attached to the stud with two 1 in. long Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip.
MAYCO INDUSTRIES INC — Type X-Ray Shielded Gypsum

4D. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only) — Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws gypsum panel steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".
RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

5. **Joint Tape and Compound —** (Not Shown)

Systems A, B, C, E, F, G, H, I

Joints on outer layers of gypsum boards (Item 4 and 4A) covered with paper tape and joint compound. Paper tape and joint compound may be omitted when gypsum boards are supplied with square edges. Exposed screw heads covered with joint compound.

6. **Batts and Blankets* —**

Systems A, B, E, F, G, H, I

(Optional) — Mineral wool or glass fiber batts partially or completely filling stud cavity. Any mineral wool or glass fiber batt mineral bearing the UL Classification Marking as to Fire Resistance.

Systems C & D

Min 3 in. (System C) and min 1-1/2 in. (System D) thick mineral wool batts, friction fitted between the studs and floor and ceiling runners.

ROCKWOOL — Type AFB, min. density 1.8 pcf / 28.8 kg/m^3

THERMAFIBER INC — Type SAFB, SAFB FF

7. **Cementitious Backer Units* —** (System D) — Nom 1/2 or 5/8 in. thick panels, square edge, attached to studs over gypsum wallboard with 1-5/8 in. long, Type S-12, corrosion resistant steel screws spaced 8 in. OC and staggered 8 in. from gypsum wall board screws. Joints covered with glass fiber mesh tape. Vertical joints staggered one stud cavity from gypsum wallboard joints. Horizontal joints staggered a min of 12 in. from the gypsum wallboard joints.
UNITED STATES GYPSUM CO — Type DCB

8. **Laminating Adhesive* —** (Optional, Not Shown) — Used to bond outer layer of Cementitious Backer Units (Item 7) to inner layers of Gypsum Board (Item 4) in System D. ANSI A136.1 Type 1 organic adhesive applied with 1/4 in. square notched trowel. See Adhesives (BYWR) in the Fire Resistance Directory or Adhesives (BJLZ) in the Building Materials Directory for names of Classified companies.

9. **Lead Batten Strips —** (Not Shown, For Use With Item 4A) — Lead batten strips, min 1-1/2 in. wide, max 10 ft long with a max thickness of 0.125 in. Strips placed on the interior face of studs and attached from the exterior face of the stud with two 1 in. long

Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 4A) and optional at remaining stud locations. Required behind vertical joints.

9A. **Lead Batten Strips —** (Not Shown, for use with Item 4C) — Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.140 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D".. Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 6) and optional at remaining stud locations.

10. **Lead Discs or Tabs —** (Not Shown, For Use With Item 4A) — Used in lieu of or in addition to the lead batten strips (Item 9) or optional at other locations - Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards (Item 4A) underneath screw locations prior to the installation of the screws. Lead discs or tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

10A. **Lead Discs —** (Not Shown, for use with Item 4C) — Max 5/16 in. diam by max 0.140 in. thick lead discs compression fitted or adhered over steel screw heads. Lead discs to have a purity of 99.5% meeting the Federal Specification QQ-L-201f, Grades "B, C or D".

11. **Lead Batten Strips —** (Not Shown, For Use With Item 4B) — Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.142 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 4B) and optional at remaining stud locations.

12. **Lead Tabs —** (Not Shown, For Use With Item 4B) — 2 in. wide, 5 in. long with a max thickness of 0.142 in. Tabs friction-fit around front face of stud, the stud folded back flange, and the back face of the stud. Tabs required at each location where a screw (that secures the gypsum boards, Item 4B) will penetrate the steel stud. Lead tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead tabs may be held in place with standard adhesive tape if necessary.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2022-02-14

BXUV.U419 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

Fire-resistance Ratings - ANSI/UL 263

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

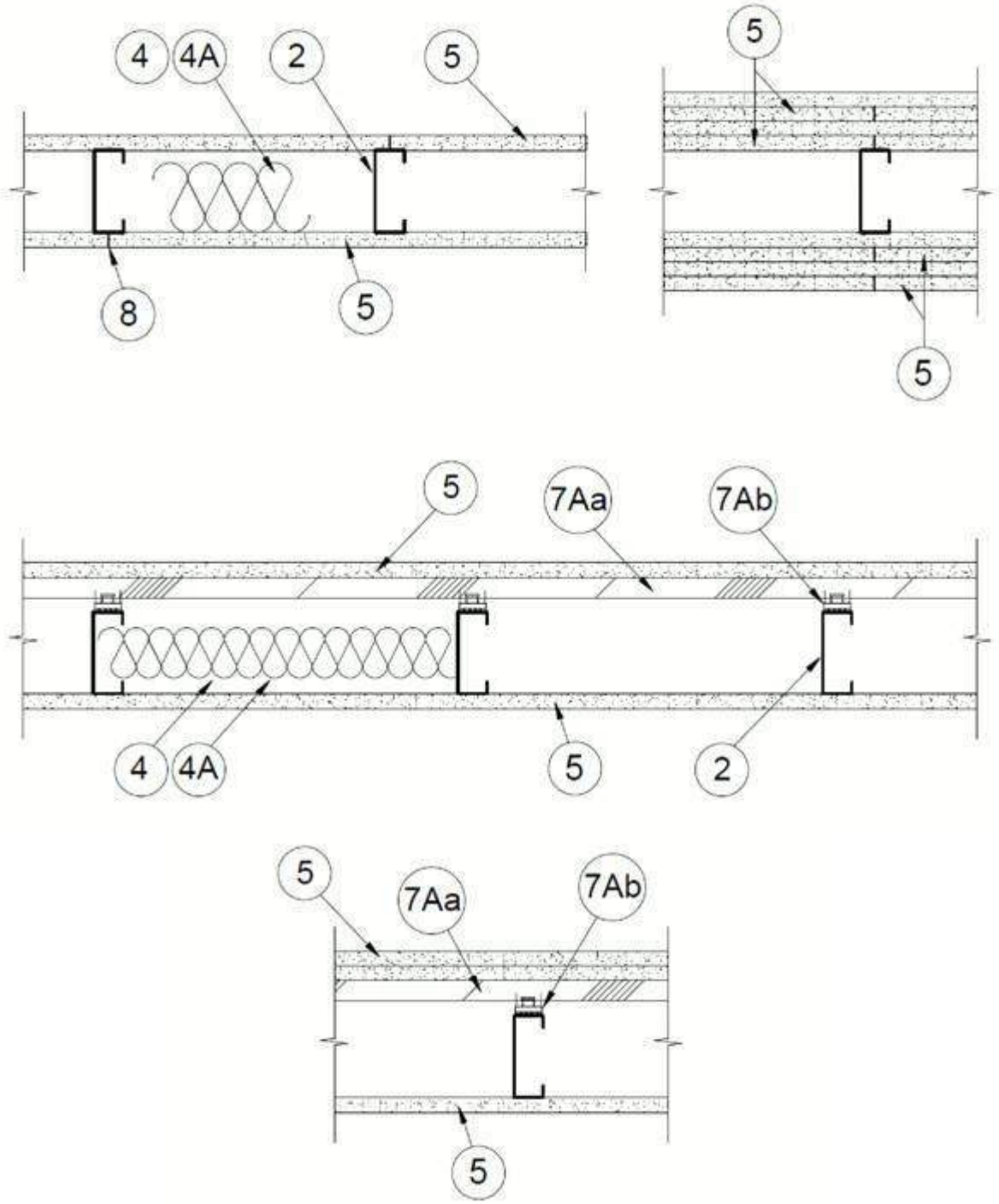
See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **U419**

September 5, 2022

Nonbearing Wall Ratings — 1, 2, 3 or 4 Hr (See Items 4 & 5 through 5J)
*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Floor and Ceiling Runners —** (Not Shown) — For use with Item 2 — Channel shaped, fabricated from min 25 MSG corrosion-protected steel, min depth to accommodate stud size, with min 1-1/4 in. long legs, attached to floor and ceiling with fasteners 24 in. OC max.

1A. **Framing Members* — Floor and Ceiling Runner —** Not Shown — In lieu of Item 1 — For use with Item 2B, proprietary channel shaped runners, 3-5/8 in. deep attached to floor and ceiling with fasteners 24 in. OC max.

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper25™ Track

CRACO MFG INC — SmartTrack25™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper25™ Track

IMPERIAL MANUFACTURING GROUP INC — Viper25™ Track

1B. **Framing Members* — Floor and Ceiling Runner —** Not Shown — In lieu of Item 1 — For use with Item 2C, proprietary channel shaped runners, 1-1/4 in. wide by 3-5/8 in. deep fabricated from min 0.018 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.
CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™ Track

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track

IMPERIAL MANUFACTURING GROUP INC — Viper20™ Track

1C. **Framing Members* — Floor and Ceiling Runners —** (Not Shown) — In lieu of Item 1 — Channel shaped, attached to floor and ceiling with fasteners 24 in. OC. max.
ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME D24/30EQD and Type SUPREME D20

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME D24/30EQD and Type SUPREME D20

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME D24/30EQD and Type SUPREME D20

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME D24/30EQD and Type SUPREME D20

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME D24/30EQD and Type SUPREME D20

TELLING INDUSTRIES L L C — Type SUPREME D24/30EQD and Type SUPREME D20

UNITED METAL PRODUCTS INC — Type SUPREME D24/30EQD and Type SUPREME D20

1D. **Floor and Ceiling Runners —** (Not Shown) — For use with Item 2A — Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, min depth to accommodate stud size, with min 1 in. long legs, attached to floor and ceiling with fasteners spaced max 24 in. OC.

1E. **Framing Members* — Floor and Ceiling Runners —** (Not Shown, As an alternate to Item 1) — For use with Items 2E, 5F or 5G or 5I only, channel shaped, fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, attached to floor and ceiling with fasteners 24 in. OC. max.
CLARKDIETRICH BUILDING SYSTEMS — CD ProTRAK

DMFCWBS L L C — ProTRAK

MBA METAL FRAMING — ProTRAK

RAM SALES L L C — Ram ProTRAK

STEEL STRUCTURAL PRODUCTS L L C — Tri-S ProTRAK

1F. **Framing Members* — Floor and Ceiling Runner —** Not Shown — In lieu of Item 1 — For use with Item 2F, proprietary channel shaped runners, minimum width to accommodate stud size, with 1- 1/8 in. long legs fabricated from min 0.015 in. (min bare metal thickness) galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.
SUPER STUD BUILDING PRODUCTS — The Edge

1G. **Framing Members* — Floor and Ceiling Runner —** For use with Item 2G, proprietary channel shaped runners, minimum width to accommodate stud size attached to floor and ceiling with fasteners 24 in. OC max.
STUDCO BUILDING SYSTEMS — CROCSTUD Track

1H. **Floor and Ceiling Runners —** (Not Shown) — Channel shaped, fabricated from min 0.02 in. galv steel, min width to accommodate stud size, with min 1 in. long legs, for use with studs specified below and fabricated from min 0.018 in. galv steel or thicker, attached to floor and ceiling with fasteners spaced max 24 in. OC.
MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track VT100

IMPERIAL MANUFACTURING GROUP INC — Viper20™ Track VT100

1I. **Framing Members* — Floor and Ceiling Runners —** (Not Shown, As an alternate to Item 1) — For use with Items 2H, channel shaped, fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, attached to floor and ceiling with fasteners 24 in. OC. max.
TELLING INDUSTRIES L L C — TRUE-TRACK™

1J. **Framing Members* — Floor and Ceiling Runner —** Not Shown — In lieu of Item 1 — For use with Item 2I, proprietary channel shaped runners, 3-5/8 in. deep attached to floor and ceiling with fasteners 24 in. OC max.

1K. **Framing Members* — Floor and Ceiling Runner —** Not Shown — In lieu of Item 1 — For use with Item 2J, proprietary channel shaped runners, 1-1/4 in. wide by 3-5/8 in. deep fabricated from min 0.018 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

1L. **Framing Members* — Floor and Ceiling Runner —** Not Shown — In lieu of Item 1 — For use with Item 2N, proprietary channel shaped runners, 1-1/4 in. wide by min. 3-1/2 in. deep fabricated from min 0.018 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.
RESCUE METAL FRAMING, L L C — AlphaTRAK

1M. **Framing Members* — Floor and Ceiling Runners —** Not Shown — As an alternate to Item 1 — For use with Item 2O, proprietary channel shaped runners, min width to accommodate stud size, galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.
RONDO BUILDING SERVICES PTY LTD — Rondo Wall Track

1N. **Framing Members* — Floor and Ceiling Runners —** Not Shown — As an alternate to Item 1 — For use with Item 2P, proprietary channel shaped runners, min width to accommodate stud size, galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.
OEG BUILDING MATERIALS — OEG Track

1O. **Framing Members* — Floor and Ceiling Runner —** Not Shown — In lieu of Item 1 — For use with Item 2Q, proprietary channel shaped runners, min width to accommodate stud size, fabricated from min. 25 MSG (0.018 in. min. bare metal thickness), attached to floor and ceiling with fasteners spaced 24 in. OC max.
CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper X Track

2. **Steel Studs —** Channel shaped, fabricated from min 25 MSG corrosion-protected steel, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height.

2A. **Steel Studs —** (As an alternate to Item 2, For use with Items 5B, 5E, 5H, 5J or Type ULIX) — Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, 3-1/2 in. min depth, spaced a max of 16 in. OC. Studs friction-fit into floor and ceiling runners. Studs to be cut 5/8 to 3/4 in. less than assembly height.

2B. **Framing Members* - Steel Studs —** (As an alternate to Item 2, For use with Items 5C, 5I or Type ULIX) — Proprietary channel shaped studs, 3-5/8 in. deep spaced a max of 24 in. OC. Studs to be cut 3/4 in less than the assembly height and installed with a 1/2 in. gap between the end of the stud and track at the bottom of the wall. For direct attachment of gypsum board only.
CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper25™

CRACO MFG INC — SmartStud25™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper25™

IMPERIAL MANUFACTURING GROUP INC — Viper25™

2C. **Framing Members* — Steel Studs —** Not Shown — In lieu of Item 2 — proprietary channel shaped steel studs, min depth as indicated under Item 5, spaced a max if 24 in. OC, fabricated from min 0.018 in. thick galv steel. Studs cut 3/8 in. to 3/4 in. less in lengths than assembly heights.
CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™

IMPERIAL MANUFACTURING GROUP INC — Viper20™

2D. **Framing Members* — Steel Studs —** In lieu of Item 2 — Channel shaped studs, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.
ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME D24/30EQD and Type SUPREME D20

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME D24/30EQD and Type SUPREME D20

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME D24/30EQD and Type SUPREME D20

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME D24/30EQD and Type SUPREME D20

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME D24/30EQD and Type SUPREME D20

TELLING INDUSTRIES L L C — Type SUPREME D24/30EQD and Type SUPREME D20

UNITED METAL PRODUCTS INC — Type SUPREME D24/30EQD and Type SUPREME D20

2E. **Framing Members* — Steel Studs —** (Not Shown, As an alternate to Item 2) — For use with Items 5F or 5G or 5I or Type ULIX only, channel shaped studs, min depth as indicated under Item 5F, 5G or 5I, fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.
CLARKDIETRICH BUILDING SYSTEMS — CD ProSTUD

DMFCWBS L L C — ProSTUD

MBA METAL FRAMING — ProSTUD

RAM SALES L L C — Ram ProSTUD

STEEL STRUCTURAL PRODUCTS L L C — Tri-S ProSTUD

2F. **Framing Members* — Steel Studs —** Not Shown — In lieu of Item 2 — proprietary channel shaped steel studs, minimum width indicated under Item 5, 1-1/4 in. deep fabricated from min 0.015 in. (min bare metal thickness) galvanized steel. Studs 3/8 in. to 3/4 in. less in lengths than assembly heights.
SUPER STUD BUILDING PRODUCTS — The Edge

2G. **Framing Members* — Steel Studs —** Not Shown — In lieu of Item 2 — proprietary channel shaped studs, minimum width indicated under Item 5, Studs to be cut 3/8 to 3/4 in less than the assembly height.
STUDCO BUILDING SYSTEMS — CROCSTUD

2H. **Framing Members* — Steel Studs —** (Not Shown, As an alternate to Item 2) — Fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.
TELLING INDUSTRIES L L C — TRUE-STUD™

2I. **Framing Members* — Steel Studs —**

2J. **Framing Members* — Metal Studs —** Not Shown — In lieu of Item 2 — proprietary channel shaped steel studs, min depth as indicated under Item 5, spaced a max if 24 in. OC, fabricated from min 0.018 in. thick galv steel. Studs cut 3/8 in. to 3/4 in. less in lengths than assembly heights

2K. **Framing Members* — Steel Studs —** As an alternate to Item 2 — For use with Item 1, channel shaped studs, fabricated from min 25 MSG corrosion-protected steel, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height.
EB METAL INC — NITROSTUD

2L. **Framing Members* — Steel Studs —** As an alternate to Item 2 — For use with Item 1, channel shaped studs, fabricated from min 25 MSG corrosion-protected steel, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height.
OLMAR SUPPLY INC — PRIMESTUD

2M. **Framing Members* — Steel Studs —** As an alternate to Item 2 — For use with Item 1, channel shaped studs, fabricated from min 25 MSG corrosion-protected steel, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height.
MARINO/WARE, DIV OF WARE INDUSTRIES INC — StudRite™

2N. **Framing Members*— Steel Studs —** As an alternate to Item 2 — proprietary channel shaped steel studs, min depth 3-1/2 in. and as indicated under Item 5, spaced a max of 24 in. OC, fabricated from min 0.018 in. thick galv steel. Studs cut 3/8 in. to 3/4 in. less in length than assembly height.
RESCUE METAL FRAMING, L L C — AlphaSTUD

2O. **Framing Members* — Steel Studs —** As an alternate to Item 2 — proprietary channel shaped steel studs, min width as indicated under Item 5, galv steel. Studs to be cut 3/8 to 3/4 in. less in lengths than assembly height. Spaced 24 in. OC max.
RONDO BUILDING SERVICES PTY LTD — Rondo Lipped Wall Stud

2P. **Framing Members* — Steel Studs —** As an alternate to Item 2 — proprietary channel shaped steel studs, min width as indicated under Item 5, min 25 MSG galv steel. Studs to be cut 3/8 to 3/4 in. less in lengths than assembly height. Spaced 24 in. OC max.
OEG BUILDING MATERIALS — OEG Stud

2Q. **Framing Members* — Steel Studs —** Not Shown — In lieu of Item 2 — For use with Item 1O, proprietary channel shaped steel studs, min depth as indicated under Item 5, spaced a max of 24 in. OC, fabricated from min 25 MSG (0.018 in. min. bare metal thickness). Studs cut 3/8 in. to 3/4 in. less in lengths than assembly heights.
CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper X

3. **Wood Structural Panel Sheathing —** (Optional, For use with Item 5 Only) — (Not Shown) — 4 ft wide, 7/16 in. thick oriented strand board (OSB) or 15/32 in. thick structural 1 sheathing (plywood) complying with DOC PS1 or PS2, or APA Standard PRP-108, manufactured with exterior glue, applied horizontally or vertically to the steel studs. Vertical joints centered on studs, and staggered one stud space from wallboard joints. Attached to studs with flat-head self-drilling tapping screws with a min. head diam. of 0.292 in.

at maximum 6 in. OC. in the perimeter and 12 in. OC. in the field. When used, gypsum panels attached over OSB or plywood panels and fastener lengths for gypsum panels increased by min. 1/2 in.

4. **Batts and Blankets* —** (Required as indicated under Item 5) — Mineral wool batts, friction fitted between studs and runners. Min nom thickness as indicated under Item 5.
See **Batts and Blankets** (BKNV or BZJZ) Categories for names of Classified companies.

4A. **Batts and Blankets* —** (Optional) — Placed in stud cavities, any glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance.
See **Batts and Blankets** (BKNV or BZJZ) Categories for names of Classified companies.

4B. **Fiber, Sprayed* —** (Optional, for use with Type ULIX) Where insulation is required - Spray applied granulated mineral fiber material. The fiber is applied with adhesive at a minimum density of 4.0 pcf to completely fill the wall cavity in accordance with the application instructions supplied with the product. See **Fiber, Sprayed** (CCAZ).
AMERICAN ROCKWOOL MANUFACTURING, LLC — Type Rockwool Premium Plus

4C. **Foamed Plastic* —** (Where Batts and Blankets*, Item 4, are optional, for use with Item 5K) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity, for 2 hour rated assemblies only. When foamed plastic is used, minimum stud depth shall be 3-1/2 in.

CARLISLE SPRAY FOAM INSULATION — Types SealTite Pro Closed Cell (CC), SealTite Pro Open Cell (OC), SealTite Pro OCX, SealTite Pro No Trim 21, SealTite Pro One Zero, Foamsulate Closed Cell, Foamsulate OCX, Foamsulate 70, and Foamsulate HFO.

4D. **Foamed Plastic* —** (Where Batts and Blankets*, Item 4, are optional, for use with Item 5L) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity, for up to 2 hour rated assemblies only. When foamed plastic is used, minimum stud depth shall be 3-1/2 in. with minimum 20 MSG steel thickness.

BASF CORP - Enertite® NM, Enertite® G, FE178®, Spraytite® 178, Spraytite® 81206, Walltite® 200, Walltite® US, Walltite® US-N, Walltite HP+, FE137®, FE158®, Spraytite® 158, Spraytite® SP and Spraytite® 81205

5. **Gypsum Board* —** Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layers (multilayer systems) staggered one stud cavity. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) staggered a min of 12 in. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) with Type ULIX need not be staggered. The thickness and number of layers for the 1 hr, 2 hr, 3 hr and 4 hr ratings are as follows:

Gypsum Board Protection on Each Side of Wall

Rating, Hr	Min Stud Depth, in. Items 2, 2C, 2D, 2F, 2G, 2O	No. of Layers & Thkns of Panel	Min Thkns of Insulation (Item 4)
1	3-1/2	1 layer, 5/8 in. thick	Optional
1	2-1/2	1 layer, 1/2 in. thick	1-1/2 in.
1	1-5/8	1 layer, 3/4 in. thick	Optional
2	1-5/8	2 layers, 1/2 in. thick	Optional
2	1-5/8	2 layers, 5/8 in. thick	Optional
2	3-1/2	1 layer, 3/4 in. thick	3 in.
3	1-5/8	3 layers, 1/2 in. thick	Optional

3	1-5/8	2 layers, 3/4 in. thick	Optional
3	1-5/8	3 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 1/2 in. thick	Optional
4	2-1/2	2 layers, 3/4 in. thick	2 in.

CGC INC — 1/2 in. thick Type C, IP-X2 or IPC-AR; WRC, 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULIX, WRX or WRC; 3/4 in. thick Types IP-X3 or ULTRACODE

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — 1/2 in. thick Type C and 5/8 in. thick Type SCX

UNITED STATES GYPSUM CO — 1/2 in. thick Type C, IP-X2, IPC-AR or WRC; 5/8 in. thick Type SCX, SGX, SHX, ULIX, WRX, IP-X1, AR, C, WRC, FRX-G, IP-AR, IP-X2, IPC-AR; 3/4 in. thick Types IP-X3 or ULTRACODE

USG BORAL DRYWALL SFZ LLC — 1/2 in. Type C; 5/8 in. Types C, SCX, SGX, ULTRACODE

USG MEXICO S A DE C V — 1/2 in. thick Type C, IP-X2, IPC-AR or WRC; 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRX, WRC or; 3/4 in. thick Types IP-X3 or ULTRACODE

When Item 7B, **Steel Framing Members***, is used, Nonbearing Wall Rating is limited to 1 Hr. Min. stud depth is 3-1/2 in., min. thickness of insulation (Item 4) is 3 in., and two layers of gypsum board panels (1/2 in. or 5/8 in. thick) shall be attached to furring channels as described in Item 6. One layer of gypsum board panels (1/2 in. or 5/8 in. thick) attached to opposite side of stud without furring channels as described in Item 6.

5A. **Gypsum Board* —** (As an alternate to Item 5) — 5/8 in. thick, 24 to 54 in. wide, applied horizontally as the outer layer to one side of the assembly. Secured as described in Item 6.
CGC INC — Type SHX.

UNITED STATES GYPSUM CO — Type FRX-G, SHX.

USG MEXICO S A DE C V — Type SHX.

5B. **Gypsum Board* —** (Not Shown) — As an alternate to Item 5 when used as the base layer on one or both sides of wall when 5/8 in or 3/4 in. thick products are specified. For direct attachment only to steel studs Item 2A, (not to be used with Item 3) — Nom 5/8 in. or 3/4 in. may be used as alternate to all 5/8 in. or 3/4 in. shown in Item 5, Wallboard Protection on Each Side of Wall table. Nom 5/8 in. or 3/4 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Gypsum board secured to 20 MSG steel studs Item 2A with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. To be used with Lead Batten Strips (see Item 11) or Lead Discs or Tabs (see Item 12).
RAY-BAR ENGINEERING CORP — Type RB-LBG

5C. **Gypsum Board* —** (For Use With Item 2B) — Rating Limited to 1 Hour. 5/8 in. thick, 48 in. wide, Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally. (Vertical Application) - The gypsum board is to be installed on each side of the studs with 1 in. long Type S coated steel screws spaced 8 in. OC starting 4 in. from the edge of the board at the vertical edges and 12 in. OC starting 6 in. from the edge of the board at the center of each board. Gypsum boards are to be secured to the top and bottom track with screws spaced 8 in. OC starting 4 in. from the board edge. Fasteners shall not penetrate through both the stud and the track at the same time. Vertical joints are to be centered over studs and staggered one stud cavity on opposite sides of studs. (Horizontal Application) - The gypsum board is to be installed on each side of the studs with 1 in. long Type S coated steel screws spaced 8 in. OC starting 4 in. from the edge of the board at the vertical edges and 12 in. OC starting 6 in. from the edge of the board at the center of each board. Gypsum boards are to be secured to the top and bottom track with screws spaced 8 in. OC starting 4 in. from the board edge. Fasteners shall not penetrate through both the stud and the track at the same time. All horizontal joints are to be backed as outlined under section VI of Volume 1 in the Fire Resistive Directory.

CGC INC — Type SCX, ULIX.

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Type SCX

UNITED STATES GYPSUM CO — Type SCX, SGX, ULIX.

USG BORAL DRYWALL SFZ LLC — Type SCX

USG MEXICO S A DE C V — Type SCX

5D. **Gypsum Board* —** (As an alternate to Item 5) — 5/8 in. thick, 48 in. wide, applied vertically or horizontally. Secured as described in Item 6. For use with Items 1 and 2 only.
CGC INC — Type USGX

UNITED STATES GYPSUM CO — Type USGX

USG BORAL DRYWALL SFZ LLC — Type USGX

USG MEXICO S A DE C V — Type USGX

5E. **Gypsum Board* —** (Not Shown) — (As an alternate to Item 5 when used as the base layer on one or both sides of wall when 1/2 in. or 5/8 in thick products are specified, For direct attachment only to steel studs Item 2A, not to be used with Item 3). Nominal 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 (or No. 6 by 1-1/4 in. long bugle head fine driller) steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field.
NEW ENGLAND LEAD BURNING CO INC, DBA NELCO — Nelco

5F. **Gypsum Board* —** (As an alternate to Item 5) — For use with Items 1E and 2E and limited to 1 Hour Rating only, Gypsum panels with beveled, square or tapered edges, applied vertically, and fastened to the steel studs with 1 in. long Type S screws spaced 8 in. OC along vertical and bottom edges and 12 in. OC in the field. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Steel stud depth shall be a minimum 3-5/8 in.
THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Type SCX

UNITED STATES GYPSUM CO — 5/8 in. thick Type SCX, SGX, ULIX

USG BORAL DRYWALL SFZ LLC — 5/8 in. thick Type SCX, SGX

5G. **Gypsum Board* —** (As an alternate to Item 5) — For use with Items 1E and 2E only, Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally, as specified in the table below and fastened to the steel studs as described in Item 6. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layers (multilayer systems) staggered one stud cavity. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) staggered a min of 12 in. The thickness and number of layers for the 2 hr, 3 hr and 4 hr ratings are as follows:

Gypsum Board Protection on Each Side of Wall

Rating, Hr	Min Stud Depth, in. Item 2E	No. of Layers & Thickness of Panel	Min Thkns of Insulation (Item 4)
2	1-5/8	2 layers, 1/2 in. thick	Optional
2	1-5/8	2 layers, 5/8 in. thick	Optional
3	1-5/8	3 layers, 1/2 in. thick	Optional

3	1-5/8	3 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 1/2 in. thick	Optional

CGC INC — 1/2 in. thick Type C, IP-X2 or IPC-AR;, 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULIX or 3/4 in. thick Types IP-X3 or ULTRACODE

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — 1/2 in. thick Types C and 5/8 in. thick SCX

UNITED STATES GYPSUM CO — 1/2 in. thick Type C, IP-X2, IPC-AR or; 5/8 in. thick Type SCX, SGX, SHX, IP-X1, AR, C, , FRX-G, IP-AR, IP-X2, IPC-AR, ULIX; 3/4 in. thick Types IP-X3 or ULTRACODE

USG BORAL DRYWALL SFZ LLC — 1/2 in. Type C; 5/8 in. Types C, SCX, SGX, ULTRACODE

USG MEXICO S A DE C V — 1/2 in. thick Type C, IP-X2, IPC-AR or; 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, or; 3/4 in. thick Types IP-X3 or ULTRACODE

5H. **Gypsum Board* —** (Not Shown) — (As an alternate to Item 5 when used as the base layer on one or both sides of wall when 5/8 or 3/4 in thick products are specified. For direct attachment only to steel studs Item 2A, (not to be used with Item 3) - Nom 5/8 or 3/4 in. may be used as alternate to all 5/8 or 3/4 in. shown in Item 5, Wallboard Protection on Each Side of Wall table. Nom 5/8 or 3/4 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over 20 MSG steel studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Gypsum board secured to 20 MSG steel studs Item 2B with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. For Joint Compound see Item 5. To be used with Lead Batten Strips (see Item 11A) or Lead Discs (see Item 12A).
MAYCO INDUSTRIES INC — Type X-Ray Shielded Gypsum

5I. **Gypsum Board* —** (As an alternate to Item 5) — Nom. 5/8 in. thick gypsum panels with beveled, square or tapered edges installed as described in Item 5. Steel stud minimum depth shall be as indicated in Item 5.
CGC INC — Type ULIX, ULX

UNITED STATES GYPSUM CO — Type ULIX, ULX

USG MEXICO S A DE C V — Type ULX

5J. **Gypsum Board* —** (Not Shown) — (As an alternate to Item 5 when used as the base layer on one or both sides of wall when 1/2 in. or 5/8 in thick products are specified, For direct attachment only to steel studs Item 2A, not to be used with Item 3). Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws gypsum panel steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".
RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

5K. **Gypsum Board* —** (As an alternate to Item 5 when Foam Plastic insulation (Item 4C) is used) **—** Any 5/8 in. thick, 4 ft. wide, Gypsum Board listed in Item 5 above. Applied vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Gypsum panels secured to studs with 1 in. long Type S steel screws spaced 8 in. OC at perimeter and in the field. For 2 layer assemblies outer layer will be attached to studs over inner layer with the 1-5/8 in. long steel screws spaced 8 in. OC.

5L. **Gypsum Board* —** (As an alternate to Item 5 when Foam Plastic insulation (Item 4D) is used) **—** Any 5/8 in. thick, 4 ft. wide, Gypsum Board listed in Item 5 above. Applied vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Gypsum panels secured to studs with 1-1/4 in. long Type S steel screws spaced 8 in. OC at perimeter and in the field. For 2 layer assemblies outer layer will be attached to studs over inner layer with the 1-7/8 in. long steel screws spaced 8 in. OC.

6. **Fasteners —** (Not Shown) — For use with Items 2 and 2F - Type S or S-12 steel screws used to attach panels to studs (Item 2) or furring channels (Item 7). **Single layer systems:** 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 8 in. OC when panels are applied horizontally, or 8 in. OC along vertical and bottom edges and 12 in. OC in the field when panels are applied vertically. **Single layer system with Type ULIX:** 1 in. long, spaced 12 in. OC in the field and perimeter, when panels are applied horizontally or vertically.**Two layer systems:** First layer- 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels or 2-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC with screws offset 8 in. from first layer.**Three-layer systems:** First layer- 1 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Third layer- 2-1/4 in. long for 1/2 in., 5/8 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 12 in. OC. Screws offset min 6 in. from layer below. **Four-layer systems:** First layer- 1 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Third layer- 2-1/4 in. long for 1/2 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 24 in. OC. Fourth layer- 2-5/8 in. long for 1/2 in. thick panels or 3 in. long for 5/8 in. thick panels, spaced 12 in. OC. Screws offset min 6 in. from layer below.

7. **Furring Channels —** (Optional, Not Shown, for single or double layer systems) — Resilient furring channels fabricated from min 25 MSG corrosion-protected steel, spaced vertically a max of 24 in. OC. Flange portion attached to each intersecting stud with 1/2 in. long Type S-12 steel screws. Not for use with Item 5A.

7A. **Framing Members* —** (Optional on one or both sides, not shown, for single or double layer systems) — As an alternate to Item 7, furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board attached to furring channels as described in Item 6. Not for use with Item 5A.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Aa) to studs (Item 2). Clips spaced max. 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. RSIC-V and RSIC-V (2.75) clips secured to studs with No. 8 x 9/16 in. minimum self-drilling, S-12 steel screw through the center hole. Furring channels are friction fitted into clips. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) and RSIC-V (2.75) clips for use with 2-23/32 in. wide furring channels.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-V, RSIC-1 (2.75), RSIC-V (2.75).

7B. **Framing Members* —** (Optional, Not Shown) — As an alternate to Item 7, for single or double layer systems, furring channels and Steel Framing Members on only one side of studs as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Batts and Blankets placed in stud cavity as described in Item 5. Two layers of gypsum board attached to furring channels as described in Item 5. Not for use with Item 5A.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Ba) to one side of studs (Item 2) only. Clips spaced 48 in. OC., and secured to studs with two No. 8 x 2-1/2 in. coarse drywall screws, one through the hole at each end of the clip. Furring channels are friction fitted into clips.
KINETICS NOISE CONTROL INC — Type Isomax

7C. **Framing Members* —** (Not Shown) — (Optional on one or both sides, not shown, for single or double layer systems) — As an alternate to Item 7, furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board attached to furring channels as described in Item 6. Not for use with Item 5A.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Ca) to studs (Item 2). Clips spaced max. 48 in. OC. GENIECLIPS secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring channels are friction fitted into clips.
PLITEQ INC — Type GENIECLIP

7D. **Steel Framing Members* —** (Optional on one or both sides, not shown, for single or double layer systems) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire.. Gypsum board attached to furring channels as described in Item 6. Not for use with Item 5A.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Da) to studs. Clips spaced 48 in. OC., and secured to studs with 2 in. coarse drywall screw with 1 in. diam washer through the center hole. Furring channels are friction fitted into clips
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237 or A237R

7E. **Steel Framing Members* —** (Optional on one or both sides, not shown, for single or double layer systems) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item 7Eb. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire.. Gypsum board attached to furring channels as described in Item 6. Not for use with Item 5A and 5E.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Ea) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
REGUPOL AMERICA — Type SonusClip

7F. **Steel Framing Members* —** (Optional on one or both sides, not shown, for single or double layer systems) — Resilient channels and Steel Framing Members as described below:
a. **Resilient Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with two No. 8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board attached to resilient channels as described in Item 5. Not for use with Item 5A and 5E.

b. **Steel Framing Members* —** Used to attach resilient channels (Item 7Fa) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Resilient channels are secured to clips with one No. 10 x 1/2 in. pan-head self-drilling screw.
KEENE BUILDING PRODUCTS CO INC — Type RC+ Assurance Clip

7G. **Framing Members* —** (Optional on one or both sides, not shown, for single or double layer systems) — As an alternate to Item 7, furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board attached to furring channels as described in Item 6. Not for use with Item 5A.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Ga) to studs (Item 2). Clips spaced max. 48 in. OC. Clips secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center hole. Furring channels are friction fitted into clips.

CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

8. **Joint Tape and Compound —** Vinyl or casein, dry or premixed joint compound applied in two coats to joints and screw heads of outer layers. Paper tape, nom 2 in. wide, embedded in first layer of compound over all joints of outer layer panels. Paper tape and joint compound may be omitted when gypsum panels are supplied with a square edge.

9. **Siding, Brick or Stucco —** (Optional, Not Shown) — Aluminum, vinyl or steel siding, brick veneer or stucco, meeting the requirements of local code agencies, installed over gypsum panels. Brick veneer attached to studs with corrugated metal wall ties attached to each stud with steel screws, not more than each sixth course of brick.

10. **Caulking and Sealants* —** (Optional, Not Shown) — A bead of acoustical sealant applied around the partition perimeter for sound control.

UNITED STATES GYPSUM CO — Type AS

11. **Lead Batten Strips —** (Not Shown, For Use With Item 5B) — Lead batten strips, min 1-1/2 in. wide, max 10 ft long with a max thickness of 0.125 in. Strips placed on the interior face of studs and attached from the exterior face of the stud with two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 5B) and optional at remaining stud locations. Required behind vertical joints.

11A. **Lead Batten Strips —** (Not Shown, For Use With Item 5H) — Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.140 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D". Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations.

12. **Lead Discs or Tabs —** (Not Shown, For Use With Item 5B) — Used in lieu of or in addition to the lead batten strips (Item 11) or optional at other locations - Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards (Item 5B) underneath screw locations prior to the installation of the screws. Lead discs or tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

12A. **Lead Discs —** (Not Shown, for use with Item 5H) — Max 5/16 in. diam by max 0.140 in. thick lead discs compression fitted or adhered over steel screw heads. Lead discs to have a purity of 99.5% meeting the Federal Specification QQ-L-201f, Grades "B, C or D".

13. **Lead Batten Strips —** (Not Shown, For Use With Item 5E) — Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.142 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 5E) and optional at remaining stud locations.

14. **Lead Tabs —** (Not Shown, For Use With Item 5E) — 2 in. wide, 5 in. long with a max thickness of 0.142 in. Tabs friction-fit around front face of stud, the stud folded back flange, and the back face of the stud. Tabs required at each location where a screw (that secures the gypsum boards, Item 5E) will penetrate the steel stud. Lead tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead tabs may be held in place with standard adhesive tape if necessary.

15. **Barrier Mesh —** (Optional, Not Shown) - Attached to steel studs on one or both sides of the wall using Barrier Mesh Clips spaced at maximum 12 inches on center vertically, using a flat head type screw penetrating through the steel at least 3/8 of an inch. For Steel Studs less than 0.033 inches in thickness, use self-piercing screws. For Steel Studs equal to or greater than 0.033 inches in thickness, use steel drill screws (self-tapping). Gypsum Board (Item 5) to be installed directly over the Barrier Mesh using prescribed screw patterns with lengths increased by a minimum 1/8 in. Barrier Mesh may be installed with the long dimension of the diamond pattern positioned vertically or horizontally. Barrier Mesh joints may occur as butt joints at the framing members and secured using the Barrier

Mesh Clips or occur in between framing members as overlapping joints secured using 18 SWG wire ties spaced a maximum 12 in. on center.

CLARKDIETRICH BUILDING SYSTEMS — Barrier Mesh, Barrier Mesh Clips

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2022-09-05

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

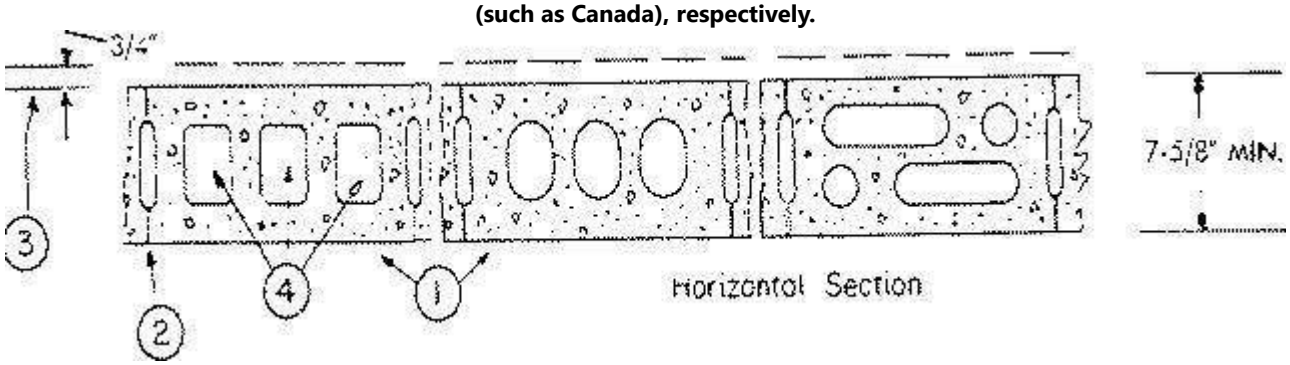
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **U905**

April 14, 2023

Bearing Wall Rating — 2 HR.
Nonbearing Wall Rating — 2 HR
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Concrete Blocks* —** Various designs. Classification D-2 (2 hr).

See **Concrete Blocks** category for list of eligible manufacturers.

2. **Mortar —** Blocks laid in full bed of mortar, nom. 3/8 in. thick, of not less than 2-1/4 and not more than 3-1/2 parts of clean sharp sand to 1 part Portland cement (proportioned by volume) and not more than 50 percent hydrated lime (by cement volume). Vertical joints staggered.

3. **Portland Cement Stucco or Gypsum Plaster —** Add 1/2 hr to classification if used. Where combustible members are framed in wall, plaster or stucco must be applied on the face opposite framing to achieve a max. Classification of 1-1/2 hr. Attached to concrete blocks (Item 1).

4. **Loose Masonry Fill —** If all core spaces are filled with loose dry expanded slag, expanded clay or shale (Rotary Kiln Process), water repellant vermiculite masonry fill insulation, or silicone treated perlite loose fill insulation add 2 hr to classification.

5. **Foamed Plastic* —** (Optional-Not Shown) — 1-1/2 in. thick max, 4 ft wide sheathing attached to concrete blocks (Item 1).
ATLAS ROOFING CORP — EnergyShield Pro Wall Insulation, EnergyShield Pro 2 Wall Insulation, EnergyShield CGF Pro, EnergyShield Ply Pro, EnergyShield® CGF, EnergyShield® PanelCast, EnergyShield® and "EnergyShield® XR

DUPONT DE NEMOURS, INC. — Types Thermax Sheathing, Thermax Light Duty Insulation, Thermax Heavy Duty Insulation, Thermax Metal Building Board, Thermax White Finish Insulation, Thermax ci Exterior Insulation, Thermax XARMOR ci Exterior Insulation, Thermax IH Insulation, Thermax Plus Liner Panel, Thermax Heavy Duty Plus (HDP), TUFF-R™ ci Insulation, Thermax Butler Stylwall Insulation Board and Thermax Morton Heavy Duty Insulation Board

FIRESTONE BUILDING PRODUCTS CO L L C — "Enverge™ CI Foil Exterior Wall Insulation" and "Enverge™ CI Glass Exterior Wall Insulation"

HUNTER PANELS, A DIVISION OF CARLISLE CONSTRUCTION MATERIALS, LLC — Types "Xci-Class A", "Xci Foil (Class A)", "Xci 286"

RMAX, A BUSINESS UNIT OF SIKA CORPORATION — Types "TSX-8500", "ECOMAXci FR", "TSX-8510", "ECOMAX xi FR White", "ECOMAXci", "ECOMAXci FR Air Barrier", "Thermasheath-XP", "Thermasheath", "Durasheath"

JOHNS MANVILLE — Type "AP Foil-Faced Foam Sheathing"

5A. **Building Units* —** As an alternate to Items 5, min. 1-in thick polyisocyanurate composite foamed plastic insulation boards, nom. 48 by 48 or 96 in.

ATLAS ROOFING CORP — EnergyShield® Ply

HUNTER PANELS, A DIVISION OF CARLISLE CONSTRUCTION MATERIALS, LLC — "Xci NB", "Xci Ply"

RMAX, A BUSINESS UNIT OF SIKA CORPORATION — "Thermasheath-SI", "ECOBASEci", "ThermaBase-CI", "ECOMAXci FR Ply", "ECOMAXci Ply".

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2023-04-14

BXUV.X829 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

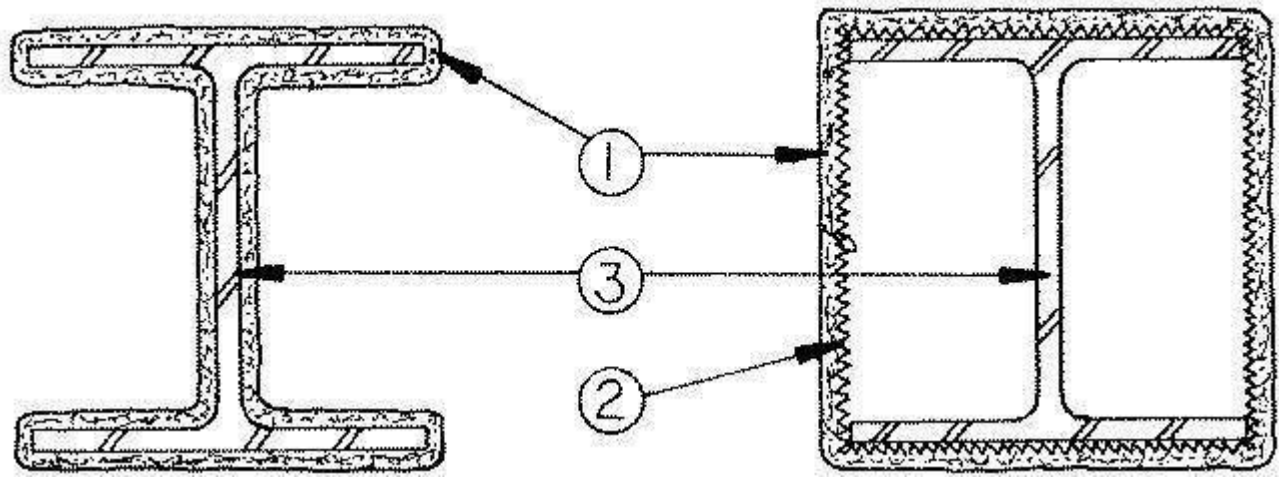
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. X829

May 03, 2018

Ratings — 1/2, 1, 1-1/2, 2, 3, 4 Hr

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.



1. **Spray-Applied Fire Resistive Materials* —** Applied by spraying with water, in one or more untamped coats at the thickness shown in the table below to steel surfaces which are free of dirt, oil or scale. Use of adhesive is optional. Minimum average untamped density is 13 pcf with minimum ind untamped density of 11 pcf for Types II, II HS, and D-C/F. Min avg and min ind untamped densities of 22 and 19 pcf, respectively, for Type HP. Tamping is optional. For method of density determination refer to Design Information Section.

The thickness of Spray-Applied Fire Resistive Materials (Item 1) required for rating periods of 1 h, 1-1/2 h, 2 h, 3 h, 4 h of contour sprayed columns may be determined by the equation:

$$h = \frac{R}{1.01\,(W/D) + 0.66}$$

Where:

h=Protection material thickness in the range 0.375-3.75 in.

R=Fire resistance rating in hours (1-4 h).

D=Heated perimeter of steel column in inches.

W=Weight of steel column in lbs per foot.

W/D=0.55 to 7.0

The thickness of Spray-Applied Fire Resistive Materials in the range of 0.375-3.75 in. required for rating periods of 1 h, 1-1/2 h, 2 h, 3 h, 4 h of contour sprayed columns with W/D=0.30-0.55 may be determined by the equation:

$$h = \frac{R}{0.95\,(W/D) + 0.45}$$

As an alternative to the equations, the minimum thickness of protection Material required for various fire resistance ratings of contour or box sprayed columns may be determined from the table below:

Column Size	W/D	Min Thkns In. 1 Hr	1-1/2 Hr	2 Hr	3 Hr	4 Hr
W8X10	0.33	1-1/4	1-13/16	2-5/16	3-9/16	—
*W6X16	0.57	11/16	1-1/8	1-9/16	2-7/16	3-1/4
W8X28	0.68	11/16	1-1/8	1-7/16	1-7/8	2-5/16
W10X49	0.83	11/16	1	1-1/4	1-11/16	2-1/8
W12X106	1.46	7/16	3/4	1	1-7/16	1-15/16
W14X233	2.52	5/16	1/2	1/2	15/16	1-5/16
W14X730	6.68	3/8	3/8	3/8	3/8	9/16
* = A 1/2 Hour Rating may be obtained on a minimum W6x16 column with a minimum 3/8 in. of material.						
The thicknesses of protection material contained in the table below are applicable when the protection of the contour sprayed column's flange tips are reduced to one-half.						
W8X10	0.33	1-3/8	2	2-5/8	—	—
W6X16	0.57	13/16	1-5/16	1-3/4	2-3/4	3-11/16

W8X28	0.68	13/16	1-5/16	1-11/16	2-9/16	3-7/16
W10X49	0.83	13/16	1-1/8	1-7/16	1-15/16	2-7/16
W12X106	1.46	1/2	13/16	1-1/8	1-5/8	2-3/16
W14X233	2.52	7/16	9/16	9/16	1-1/16	1-1/2
W14X730	6.68	3/8	3/8	3/8	1/2	11/16

ISOLATEK INTERNATIONAL — Type D-C/F, HP, II, or II HS. Type D-C/F, HP or II investigated for exterior use. Type EBS or Type X adhesive/sealer optional.

2. **Metal Lath —** (Optional for contour application) — 3.4 lb/sq yd galvanized or painted expanded steel lath. Lath shall be lapped 1 in. and tied together with No. 13 SWG galvanized steel wire spaced vertically 6 in. O.C. or alternately, attached with No. 24 MSG spring clips, 1/2 in. wide, pushed onto column flanges, vertically spaced 6 in. O.C.

3. **Steel Column —** Min. sizes as shown above in Item 1.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2018-05-03

END OF SECTION

SECTION 01 4533

CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

A. Applicable Code: ICC (IBC)-2018 with local amendments.

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Code-required special inspections.

B. Testing services incidental to special inspections.

C. Submittals.

D. Manufacturers' field services.

E. Fabricators' field services.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements.

1.03 ABBREVIATIONS AND ACRONYMS

A. AHJ: Authority having jurisdiction.

B. NIST: National Institute of Standards and Technology.

1.04 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.

B. Special Inspection:
   1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.
   2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.05 REFERENCE STANDARDS

A. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2019.

B. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.

C. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.

D. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage; 2007 (Reapproved 2019).

E. ICC (IBC)-2018 - International Building Code; 2018.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
   1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Special Inspection Agency is acceptable to AHJ.

1.07 SPECIAL INSPECTION AGENCY

1.08 TESTING AND INSPECTION AGENCIES

1.09 QUALITY ASSURANCE

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
   1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
   2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION

3.03 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION

3.04 SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION

3.05 SPECIAL INSPECTIONS FOR SOILS

A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
   1. Design bearing capacity of material below shallow foundations; periodic.
   2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
   3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
   4. Subgrade, prior to placement of compacted fill verify proper preparation; periodic.

B. Testing: Classify and test excavated material; periodic.

3.06 SPECIAL INSPECTIONS FOR CAST-IN-PLACE DEEP FOUNDATIONS

A. Materials, Equipment and Final Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
   1. Element length; continuous.
   2. Element diameters and bell diameters; continuous.
   3. Embedment into bedrock; continuous.
   4. End bearing strata capacity; continuous.
   5. Placement locations and plumbness; continuous.
   6. Type and size of hammer; continuous.

B. Drilling Operations: Observe and maintain complete and accurate records for each element; continuous.

C. Material Volume: Record concrete and grout volumes.

D. Concrete Elements Associated with Cast-in-Place Deep Foundations: Perform additional inspections as required by the Special Inspections for Concrete Construction article of this section.

3.07 SPECIAL INSPECTIONS FOR EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)

A. Verify water resistive barrier coating applied over sheathing complies with ASTM E2570/E2570M.

3.08 SPECIAL INSPECTIONS FOR FIRE RESISTANT PENETRATIONS AND JOINTS

A. Verify penetration firestops in accordance with ASTM E2174.

B. Verify fire resistant joints in accordance with ASTM E2393.

3.09 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

A. Designated Seismic System Verification: Verify label, anchorage or mounting complies with certificate of compliance provided by manufacturer or fabricator.

B. Structural Observations for Seismic Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

3.10 SPECIAL INSPECTIONS FOR WIND RESISTANCE

3.11 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

A. Special Inspection Agency shall:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified reference standards.
   3. Ascertain compliance of materials and products with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests or inspections specified.

B. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

C. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.12 TESTING AGENCY DUTIES AND RESPONSIBILITIES

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests or inspections specified.

B. Limits on Testing or Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the work.

C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.

D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

3.13 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. Contractor Responsibilities, General:
   1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
   2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to work to be tested or inspected.

b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
c. To facilitate tests or inspections.
d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

B. Contractor Responsibilities, Seismic Force-Resisting System, Designated Seismic System, and Seismic Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

C. Contractor Responsibilities, Wind Force-Resisting System and Wind Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

3.14 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES

A. When specified in individual specification sections, require material suppliers, assembly fabricators, or product manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, to test, adjust, and balance equipment and _____ as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering
B. Temporary utilities.
C. Temporary telecommunications services.
D. Temporary sanitary facilities.
E. Temporary Controls: Barriers, enclosures, and fencing.
F. Vehicular access and parking.
G. Waste removal facilities and services.
H. Field offices.

1.02 RELATED REQUIREMENTS

1.03 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.

1.04 TEMPORARY UTILITIES - SEE SECTION 01 5100

1.05 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
B. Telecommunications services shall include:
   1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
   2. Internet Connections: Minimum of one; DSL modem or faster.
   3. Project web site.

1.06 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
B. Maintain daily in clean and sanitary condition.

1.07 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Provide barricades and covered walkways required by governing authorities for public rights-of-way.
C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.08 FENCING

A. Construction: Commercial grade chain link fence.
B. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.09 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.10 SECURITY - SEE SECTION 01 3553

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.11 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 5500

A. Coordinate access and haul routes with governing authorities and Owner.

B. Provide and maintain access to fire hydrants, free of obstructions.

C. Provide means of removing mud from vehicle wheels before entering streets.

D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.12 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.13 FIELD OFFICES - SEE SECTION 01 5213

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

C. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Re-use of existing products.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 01 4000 - Quality Requirements: Product quality monitoring.

C. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

D. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.05 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. See Section 01 4000 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:

D. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 6116.
   2. If wet-applied, have lower VOC content, as defined in Section 01 6116.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.

1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

F. For exterior storage of fabricated products, place on sloped supports above ground.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Prevent contact with material that may cause corrosion, discoloration, or staining.

K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work.
C. Pre-installation meetings.
D. Cutting and patching.
E. Surveying for laying out the work.
F. Cleaning and protection.
G. Starting of systems and equipment.
H. Demonstration and instruction of Owner personnel.
I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
C. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
D. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
    1. On request, submit documentation verifying accuracy of survey work.
    2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
    3. Submit surveys and survey logs for the project record.
C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
    1. Structural integrity of any element of Project.
    2. Integrity of weather exposed or moisture resistant element.
    3. Efficiency, maintenance, or safety of any operational element.
    4. Visual qualities of sight exposed elements.
    5. Work of Owner or separate Contractor.
    6. Include in request:
        a. Identification of Project.
        b. Location and description of affected work.
        c. Necessity for cutting or alteration.
        d. Description of proposed work and products to be used.
        e. Alternatives to cutting and patching.
        f. Effect on work of Owner or separate Contractor.
        g. Written permission of affected separate Contractor.
        h. Date and time work will be executed.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.

C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.06 PROJECT CONDITIONS

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.

E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

H. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. Require attendance of parties directly affecting, or affected by, work of the specific section.

B. Notify Architect four days in advance of meeting date.

C. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations; and _____.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations, and _____.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

J. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Protect existing work to be reinstalled.
   2. Remove items indicated on drawings.
   3. Relocate items indicated on drawings.
   4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.

b. Provide temporary connections as required to maintain existing systems in service.

4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

G. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

H. Clean existing systems and equipment.

I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

J. Do not begin new construction in alterations areas before demolition is complete.

K. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. See Section 01 7900 - Demonstration and Training.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.

E. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   4. Incinerator Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
      c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   5. Recycled and Salvaged Materials: Include the following information for each:
      a. Identification of material, including those retrieved by installer for use on other projects.
      b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
      c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
      e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
   6. Material Reused on Project: Include the following information for each:
      a. Identification of material and how it was used in the project.
      b. Amount, in tons or cubic yards (cubic meters).
      c. Include weight tickets as evidence of quantity.
   7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 7900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

1.03 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

END OF SECTION

SECTION 01 9113
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with Contract Documents and the manufacturer92s recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
   4. Verify that the Owner’s operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.

B. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
   1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F (0.3 degree C) and resolution of plus/minus 0.1 degree F (0.05 degree C).
   2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
   3. Calibration: According to the manufacturer’s recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
   1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

A. Commissioning Authority has prepared the Commissioning Plan.
   1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
   2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.

D. Commissioning Schedule:
   1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
   2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
   3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
   4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.

B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
   1. No sampling of identical or near-identical items is allowed.
   2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
   3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
      a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
      b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
      c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
      d. Serial number of installed unit.
      e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer’s start-up checklist items and minor testing.
      f. Sensor and actuator calibration information.

B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
   1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
   2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
   3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
   4. If any Checklist line item is not relevant, record reasons on the form.

5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
7. Submit completed Checklists to Commissioning Authority within two days of completion.

C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in Contract Documents.
2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
4. When asked to review the proposed Checklists, do so in a timely manner.

D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
2. A sampling of non-primary equipment, as allowed by the commissioning plan.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.

C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:

1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
2. Examples of Functional Testing:
   a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
   b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
   c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
   d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.

C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
2. Verify that sensors with shielded cable are grounded only at one end.
3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
2. Connect a signal generator in place of sensor.
3. Connect ammeter in series between transmitter and building automation system control panel.
4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.

7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
8. Reconnect sensor.
9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
11. If not, replace sensor and repeat.
12. For pressure sensors, perform a similar process with a suitable signal generator.

F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
2. Pressure, Air, Water, Gas: 3 percent of design.
3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
4. Relative Humidity: 4 percent of design.
5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
6. Flow Rate, Air: 10 percent of design.
7. Flow Rate, Water: 4 percent of design.
8. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).

G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper to open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
2. Sampling is not allowed for:
   a. Major equipment.
   b. Life-safety-critical equipment.
   c. Prefunctional Checklist execution.
3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.

4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
7. If YY percent of the units in the second sample fail, test all remaining identical units.
8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
   1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority’s request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
   2. Other points will be monitored by the Commissioning Authority using dataloggers.
   3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
   4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
   5. Graphical output is desirable and is required for all output if the system can produce it.
   6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 7800 - Closeout Submittals for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 27 4000
AUDIO VISUAL SYSTEMS GENERAL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The work required under this section of the specifications consists of the furnishing, installation, and programming of independent audio visual systems for Museum of the Marine. Reference floor plan drawings for audio visual equipment locations. In addition to all audio visual components, the contractor shall be required provide coordination with the data infrastructure systems and cable television systems. Also, the contractor shall coordinate with the electrical contractors for all raceway to support the audio visual systems.

B. The audio visual scope of work will require the contractor to provide a complete, quality operating system which will display, playback, and route computer, video, and audio signals as well as control signals to each noted space of the building. A factory-approved representative shall complete all system connections. A factory approved and factory trained representative of the contractor shall complete all onsite programming of equipment.
   1. The contractor shall provide all labor, materials, equipment, and supervision to install specified systems. The installation, testing, and commissioning of all equipment shall be the full responsibility of the audio visual contractor for this project.

1.02 QUALITY CRITERIA AND STANDARDS

A. All audio visual wiring, devices, and equipment shall comply with applicable UL, NEC, and NEMA code standards. All audio visual equipment shall be UL-listed and labeled.

B. Audio visual wiring systems shall conform to established trade and industry standards. The following specifications and standards are incorporated into and become a part of this Specification by reference:
   1. AES14-1992 (s2014): – AES Standard for Professional Audio Equipment
   2. AES26-2001 (r2011)– AES Recommended Practice for Professional Audio
   3. NFPA 70 National Electric Code (Current Adopted Edition)
   4. NFPA 70 70 National Electric Code
   5. UL 50 Enclosures for Electrical Equipment.

C. All Installer's Qualifications:
   1. Firm with at least 3 years of successful application, installation, and testing experience on specified systems and equipment.
   2. The Audio Visual Contractor must show proof of being in the audio visual trade for a minimum of three years and provide three (3) references with contact names and telephone numbers regarding successful completion of audio visual projects of similar scope and size.
   3. The Audio Visual contractor must be an authorized dealer for all of the equipment specified.
   4. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. Unqualified staff shall not be used for the installation of the equipment, system cables, and associated hardware.
   5. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified audio visual equipment and components.
   6. All Audio Visual Contractor staff assigned to this project shall be full-time employees and having been in the employ of the Audio Visual Contractor for at least 12-months. The proposed use of newly hired staff must be disclosed in advance of any work to the Owner/General Contractor and references and certifications submitted for their approval. No more than 25% of the assigned staff for the project and its components can be newly hired.
   7. The Audio Visual contractor shall always have a minimum of one CTS certified personnel on site while work is being performed.

8. Audio Visual Contractors are limited in their use of subcontractors to no more than 20% of the assigned staff for the project and its components. In addition, the proposed use of subcontractors must be disclosed in advance of any work to the Owner/General Contractor and references, certifications and insurance submitted for their approval.

1.03 SUBMITTALS:

A. Product Data: Audio Visual contractor shall provide a numbered equipment list of the systems devices he is providing. The list shall include quantity of items, manufactures product number, description of item and audio visual specification that it represents. Submit manufacturer's technical product technical data sheet for each item of systems equipment in order of the numbered equipment list. Submittal shall include drawings that contain complete floor plans and reflected ceiling plans, wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function as a complete system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings, connector faceplate details, sizes, and type of all cables and raceway.

B. Shop Drawings: Include drawings that contain complete floor plans and reflected ceiling plans, wiring and schematic diagrams and other details required to demonstrate that the System has been coordinated and will function as a complete system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings, connector faceplate details, sizes, and type of all cables and raceway(s). All System(s) single-line diagram(s) are to have wire “Tags” on all connection points that identify the type of signal and/or cabling and a unique identifying number. System single-line drawings that require more than one sheet to properly show System functionality shall have additional wire “Flags”. Wiring Flags shall have the drawing number the signal is going to/from and a unique identifying number. Drawings must be no smaller than Architectural “C” (18-inch x 24-inch) in size and be legible to the naked eye without magnification.

C. Test Plan: Contractor shall submit a test plan that defines the tests required to ensure that the system meets technical, operational, and performance specifications, 45 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

D. Manufacturer Certification: Submit a letter from the manufacturer's representative stating the proposed systems being submitted for review are in accordance with the recommendations of the manufacturer.

1.04 WARRANTY:

A. All equipment shall be new and shall be under warranty for a period of one (1) year, from the date of acceptance by the owner, against defects in equipment or workmanship. Failed equipment shall be replaced by the contractor at no cost to the owner. Owner's personnel may perform initial trouble investigation but replacement of failed equipment and escalated problem support will be handled by the contractor.

B. Audio Visual Contractor shall provide at project closeout a service document that shall clearly detail methods of contact for warranty service including issues categorized as “emergency” with turnaround times for return contact, on-site service and up-and-running time frame. If free loaner equipment is included while equipment is out for service or if there are fees for loaner equipment.

C. Audio Visual Contractor shall also provide details of what constitutes warranty and out of warranty service and a list of rates for out of warranty service.

D. Audio Visual Contractor shall provide the cost of an extended warranty providing the same warranty as the first year for a second year, for years two and three, and years two through five.

E. Audio Visual Contractor standard service response time shall be as follows: 24-hours from time of first contact for a verbal/electronic response, 48-hours to be on-site performing diagnostics and/or repairs.

1.05 ACCEPTABLE MANUFACTURERS – SUBSTITUTIONS

A. Reference Part 2 - Products Section of the specification for complete list of acceptable manufacturers.

B. The chosen Audio Visual Integrator may, and within reason request an equipment substitution by submitting a Substitution Request to the Architect and Audio Visual Consultant within seven (7) days of being awarded the project.

1.06 RECORD DRAWINGS

A. At the time of final inspection, provide three (3) sets of complete data on Audio visual System equipment used in this project. This data shall be in bound form and shall include all shop drawings required for this project.

B. All record drawings shall include "as built" system interconnection diagrams with major components identified and number and type of interconnecting conductors.

C. Maintenance and operating instructions on all systems.

D. Certification from system manufacturers that systems are installed in accordance with manufacturer's recommendations and are functioning correctly at the time of final inspection.

E. As-built drawings to show raceway layout and wiring for all systems.

F. Corrected point-to-point drawings for all systems with color code to show the actual as-built condition.

1.07 CONTROL SYSTEM(S)

A. Audio Visual Contractor is to coordinate with owner their required Control System(s) functionality and Graphic User Interface (GUI) layouts.

B. Audio Visual Contractor is to provide at least one (1) week in advance of System installation details of Control System functionality and complete, sample GUI pages for owner review and comment.

C. Audio Visual Contractor shall make necessary adjustments in functionality and the GUI as directed by owner after their initial review.

D. Audio Visual Contractor shall make appropriate Control System changes as necessary (and within reason) based on owner comments for no additional charge one (1) time after Audio Visual System has been in use for fourteen (14) days.

E. At Project Closeout Audio Visual Contractor is to provide owner with all Control System programming/codes/files in uncompiled format for their use and ownership including all Control System Passwords.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS:

A. Provide all materials under this section of the specifications. Materials and equipment shall be the manufacturers' latest standard design that has been in satisfactory use for at least 1 year prior to installation. See Part 3 - Execution specification section for additional product requirements.

2.02 PROJECTION SCREENS

A. The Video Projection Screen shall be a ceiling recessed mounted motorized screen. The Video Projection Screen shall be mounted and sized as indicated in the contract drawings. The Audio-Visual contractor shall be responsible for providing screens and the coordination of screen sizing aspect ratio with projector system provided. Select black top border length to optimize screen position vertically. The Audio-Visual Contractor shall coordinate installation with Construction Professional and Electrical Contractor. The Audio-Visual Contractor shall provide appropriate projector lens for throw distance for the projection screen provided. Screen Control programming for Up/Down control switch shall be integrated into control system where indicated on drawings. A secondary switch for screen control programming for Up/Down control shall be a product of the screen manufacturer.

B. Basis of Design: Draper Access V
   1. Reference Draper Quote Number: 640820

2.03 PROJECTOR CEILING BOX

A. Audio-Visual Contractor to provide and install plenum rated ceiling enclosure for projector related equipment storage and power distribution. Ceiling box must be accessible from underneath and have adjustable equipment shelf. Integrated 1.5” standard NFS fitting for projector pole attachment. Integrated knockouts for cable entry and internal power connections included.

B. Basis of Design: Wiremold ECB2SP or approved comparable.

2.04 VIDEO PROJECTOR (TYPE 1)

A. The Video Projector shall be mounted as indicated in the contract drawings. Audio-Visual Contractor to provide mounting hardware and submit design for approval by a Structural Design Professional. Audio-Visual Contractor shall provide appropriate projector lens for throw distance for the full coverage of the viewing area of projection screen provided. Audio-Visual Contractor shall provide projector-monitoring software and coordinate monitoring systems requirements including IP network connections with Owner.

B. Video Projector shall meet the following specifications:
   1. Projector Type: WUXGA 3LCD Laser Projector
   2. Light Output: 8,500 Lumens

C. Basis of Design: Epson EB-PU1008B or approved comparable.

2.05 VIDEO PROJECTOR (TYPE 2)

A. The Video Projector shall be mounted as indicated in the contract drawings. Audio-Visual Contractor to provide mounting hardware and submit design for approval by a Structural Design Professional. Audio-Visual Contractor shall provide appropriate projector lens for throw distance for the full coverage of the viewing area of projection screen provided. Audio-Visual Contractor shall provide projector-monitoring software and coordinate monitoring systems requirements including IP network connections with Owner.

B. Video Projector shall meet the following specifications:
   1. Projector Type: 3LCD Large Venue Laser Projector
   2. Light Output: 20,000 Lumens

C. Basis of Design: Epson EB-PU2220B or approved comparable.

2.06 SEVENTY FIVE INCH FLAT PANEL DISPLAY

A. The LCD Screen shall be mounted as indicated in contract drawings. Audio Visual contractor to coordinate screen mounting requirements with General Contractor. Audio visual contractor to provide mounting hardware as per manufactures recommendation. Contractors to ensure that wall surface will accommodate Display weight and installation requirements. Display to be rated for commercial use.

B. Flat Panel Display specifications of equipment shall include:
   1. Video
      a. Screen Size: Diagonal length of TV screen 75" class.
      b. Native Resolution: 3840 X 2160 Progressive Scan
      c. Dynamic Contrast Ratio: 4,000:1 minimum.
      d. Aspect Ratio: 16:9.
      e. Min Refresh Rate: 60Hz.
   2. Audio
      a. Variable line level audio output or variable speaker level audio output.
   3. Tuner
      a. Integrated Digital Tuner.
      b. Inputs & Outputs
   4. Inputs
      a. HDMI: two minimum

b. RF Input: F-Connector
5. Outputs
   a. Audio Output (Mini-Jack): One
6. Control
   a. Accepts RS-232 control.
   b. Network Port for Ethernet Control.

C. Basis of Design is Samsung QET75, or comparable from LG.
1. Accessories shall include:
   a. Appropriate wall mount and associated hardware by Chief Manufacturing, Peerless or Premier.
   b. Display mount must be able to lock from the bottom, tilted away from the wall, for servicing of the monitor, without removing from the wall.

2.07 FLAT PANEL DISPLAY WALL MOUNT – LARGE SIZE DISPLAY

A. The Flat Panel Display shall be wall mounted where indicated in the contract drawings. Audio Visual Contractor to provide mounting hardware and submit design for approval by a Structural Engineer. The wall mount can be used to mount displays from a variety of wall structures. It will mount to wood studs, steel studs, or concrete. It will be UL listed and approved. Assembly and installation will be performed according to the instructions provided by the manufacturer.

B. Flat Panel Display Wall Mount (Large sized displays) shall meet the following specifications:
1. Mounting Pattern Compatibility - 200 x 100 - 700 x 400 mm
2. Orientation – Landscape
3. Tilt - +4.0º, -2.5º
4. Weight Capacity – 150 lbs

C. Acceptable manufacturers include: Chief XTM1U or comparable from Peerless.

2.08 SEVEN-INCH CONTROL TOUCH PANEL (7-INCH) (CTL3)

A. The Audio-Visual contractor to provide Control Panel. The Control Panel shall be located and installed as indicated in contract documents. The Control Panel shall provide interface with local AV system.

B. Control Panel shall meet the following specifications:
1. Active matrix TFT color display, 7” diagonal, widescreen.
2. Size: 7” Diag.
3. Resolution: 800x480
4. Pixel pitch: 134dpi
5. Aspect Ratio: Widescreen
6. Brightness: 400 nits
7. Backlight: LED
8. Memory: SDram-512MB
9. Ethernet Control: RJ45

C. Basis of Design: Extron TLC PRO 725M with XTP-PI-100 PoE Injector

2.09 WIRELESS PRESENTATION SYSTEM

A. The Wireless Presentation System shall be installed as indicated in contract drawings.

B. Basis of Design: Kramer Via Connect 2 or approved comparable

2.10 PoE NETWORK SWITCH

A. The Network Switch shall be mounted as indicated in the contract documents. The Audio-Visual Contractor to review available product offerings at the time of equipment purchase. Confirm final device selection with AV Consultant.

B. PoE Network Switch shall meet the following specifications:
1. 10-Port 10/100/1000 Base T auto sensing
2. Connectors: (10) 8-wire RJ45, female
3. 10Port of PoE+

4. Mounting: Rack mountable

C. Basis of Design: Cisco Catalyst 9300

2.11 CONTROL PROCESSOR

A. The Control System Processor shall operate with the touch-screen panel as a single graphic user interface for the user of the Audio-Visual systems. Audio Visual contractor shall provide a complete and operational system for control of the video presentation and audio systems as indicated in the contract documents, coordinate programming and systems operational functionality requirements for interface and monitoring as owner's requirements. Programming of panels and system shall be by a factory trained representative of the Audio-Visual contractor.

B. The Control Processor shall meet the following specifications:
   1. Ethernet control interface
      a. Connectors: 1 RJ45 female connector
      b. Data rate: 10/100/1000 Base-T, half/full duplex with autodetect
      c. Web server up to 200 simultaneous sessions
      d. 512 MB SDram and 4.5 GB
   2. Serial control interface
      a. Quantity/type: 8 Bi-directional RS-232
      b. Connectors: (2) 3.5mm captive screw connectors, 5 pole (includes RTS, CTS)
      c. (6) 3.5mm captive screw connectors, 3 pole
   3. Digital inputs/outputs
      a. Quantity: 4, input voltage range 0 to 5 VDC, clamped at 5.1 VDC
      b. Threshold: 1.6 VDC
   4. Relay outputs
      a. Quantity: 8, normally open
      b. Rated at 24 VDC, 1 Amp maximum
      c. (1)3.5mm captive screw connector, 5 pole
   5. IR/serial ports
      a. Quantity/type: 8 Infrared (carrier and non-carrier) up to 1MHz
      b. Connectors: (2)3.5mm captive screw connectors, 4 pole

C. Basis of Design: Extron IPCP PRO 550

2.12 VIDEO ENCODER

A. The Video Encoder shall be installed as indicated in the contract drawings.

B. Basis of Design: Visionary E5200

2.13 USB EXTENDER TX & RX

A. The USB Extender shall be mounted as indicated in the contract drawings and interfaced to USB devices.

B. Basis of Design: Extron USB Extender Plus Series or approved comparable.

2.14 VIDEO TWISTED PAIR RECEIVER

A. Audio Visual contractor to provide and install Video Twisted Pair Receiver where indicated or as required by distance for transmission of audio/video signals between input location and rack and between rack and display location. Provide rack or surface mounted device as indicated. Type STP cable utilized shall be compatible with receiver and with distance covered.

B. The Video Twisted Pair Receiver shall meet the following specifications:
   1. Maximum data rate: 6.75 Gbps (2.25 Gbps per color)
   2. Maximum pixel clock: 165 MHz
   3. Resolution range: Up to 1920x1200 or 1080p@ 60Hz
   4. Formats: RGB and YCbCr digital video
   5. Standards: DVI 1.0, HDMI, HDCP 1.1
   6. RJ45 Connector: RJ45 female
   7. HDMI Connector: Type A 19 pin female

8. Interconnection: One STP cable between transmitter and receiver
9. Control Signal Pass-through: Bi-directional RS-232
10. Power Supply: 12V DC, external
11. Power Consumption: 12 watts (max)

C. Basis of Design: Extron DTP HDMI 4K 230 RX

2.15 DIGITAL SIGNAL PROCESSOR (DSP)

A. Audio Digital Signal Processor shall be rack mounted. All internal processing shall be digital (DSP). Software shall be provided for creating/connecting DSP system components within each hardware unit. Available system components shall include (but not be limited to) various forms of: mixers (including automatic), equalizers, filters, crossovers, dynamics/gain controls, meters, generators, and diagnostics. Channels shall gate silently for system response and clarity. Ethernet communications shall be utilized for software control and configuration.

B. Audio Digital Signal Processor shall meet the following specifications:
1. Input and Output: 12 Mic/Line level input with AEC, 8 mic/line level outputs
2. Gigabit Ethernet Port
3. RS-232 serial port
4. Sampling Rate: 48kHz
5. A/D – D/A Converters: 24-bit
6. USB: 8 channels of configurable audio
7. SIP VoIP interface: RJ45 connector for two lines of VoIP
8. Dynamic Range: >108dB
9. Support DANTE

C. Basis of Design: QSC Core 110 F

2.16 VIDEO MATRIX PRESENTATION SWITCHER

A. Video Matrix Presentation Switcher shall be installed as indicated in contract documents for control routing of multiple format audio/video signals within the room.

B. Video Matrix Presentation Switcher shall meet the following requirements:
1. Video input, digital: two (2) DTP/XTP twisted pair (use with TX only) 2 RJ45 8 pin female
2. Video input, digital: Six (6) HDMI digital video, HDCP compliant
3. Minimum/maximum analog levels: 0.0v to 1.0 Vp-p with no offset
4. Horizontal frequency: 15 kHz to 100 kHz
5. Vertical frequency: 24 Hz to 120 Hz
6. Resolution range: 604x480 to 1920x1200 (reduced blanking), 480p, 576p, 720p, 1080i, 1080p, 2048x1080 sampled pixel for pixel
7. Video output: 2 HDMI digital video (HDCP compliant) on HDMI connectors
8. 2 RJ45 8 pin female XTP/DTP twisted pair (use wit RX only)
9. Analog sampling: 12 bits per color; 13.5 MHz standard (video) 170 MHz standard (RGB)
10. Audio inputs: 6 stereo, balanced/unbalanced
11. 4 Mic with 48V phantom power
12. Connectors: (6) 3.5mm captive screw connector, 5 pole, (2) 3.5mm captive screw connector, 3 pole (Line)
13. Nominal level: -60dBV, +4 dBu, -10dBV, adjustable
14. Audio outputs, fixed: 1 analog (balanced/unbalanced), 1 HDMI embedded, all stereo/mono
15. Audio outputs, variable: 4 analog stereo (balanced/unbalanced)
16. Connectors: (2) 3.5mm captive screw connectors, 5 pole
17. Gain error: +/- 0.5 dB channel to channel
18. Maximum output level: >+12 dBu, balanced; >+6 dBu, unbalanced
19. Remote/LAN: Serial control port: (1) One RS-232 (1) RJ45
20. Power supply: 100 VAC to 240 VAC, 50/60 Hz, internal, regulated

C. Basis of Design: Extron CrossPoint 108 4K

2.17 USB CONFERENCE BRIDGE

A. The USB Conference Bridge Device shall be a hardware appliance that is capable streaming audio and video to desktop PC so that professional camera and microphones can be utilized for Skype calls.

B. USB Conference Bridge Device shall meet the following specifications:
   1. Video Input: HDMI
   2. Audio Input: HDMI, Balanced/unbalanced analog stereo
   3. Encoding: IP (H.264 and AAC Audio), Resolution up to 1080p/30. USB 2.0
   4. Control: RS-232 and Embedded Web Server
   5. Mounting: 1RU 19-inch rack mountable

C. Basis of Design: Extron Media Port 300

2.18 VIDEO CONFERENCE CAMERA

A. The Video Conference Camera shall be mounted as indicated in contract documents. Audio Visual Contractor shall provide wall mount for camera.

B. Basis of Design: Panasonic AW-UE50
   1. Appropriate accessories for wall mounting at locations shown on drawings.

2.19 REMOTE CAMERA EXTENDER

A. The Remote Camera Extender shall be mounted as indicated in contract documents.

B. Basis of Design: Sound Control RC5-P40

2.20 TABLETOP CABLE ENCLOSURE

A. The Tabletop Cable Enclosure shall be provided for the spaces indicated in the E AVL drawings and shall operate the in-room control systems as well as provide auxiliary connection access for the systems.

B. Basis of Design Extron 1200 series

2.21 AV EQUIPMENT RACK (Full Size)

A. Audio Visual contractor to provide 19” floor mounted rack for Audio Visual equipment that fits inside reserved and ventilated space in building casework. EIA/TIA compliant rack shall have 44 useable rack spaces with an approximate overall height of 81-1/8”, overall width of 22”, and overall depth of 25”

B. The Equipment Rack to be provided with the following additional features:
   1. Optional steel rack rails with tapped 10-32 mounting holes in universal EIA spacing shall be provided for real cable management and securing rack mounted equipment as needed.
   2. Equipment Rack shall need optional side panels for tempering the rack and security purposes.
   3. Optional Lockable Perforated Front Door
   4. Equipment Rack shall include vented locket and latching rear door with cable entry
   5. Ground equipment rack at base
   6. Low Voltage Fan Top Kit
   7. Blank Panels, shelving, and cable management accessories
   8. Rack based caster kit (where needed for servicing rack)

C. Basis of Design: Middle Atlantic ERK-4425 or comparable from Lowell or Sanus.

2.22 TWO CHANNEL POWER AMPLIFIER

A. Amplifiers shall be rack mounted. Amplifiers shall be solid-state type for use in a commercial sound re-enforcement application with capacity for digital signal processing module. Amplifiers shall contain circuit breaker for overload protection, high temperature automatic reset protection, and electronic output protection. Amplifier controls shall have on/off switch and pilot light, master gain control, signal input/output and input channel controls. Amplifiers shall conform to the following minimum requirements: Independent power limiters on each channel, with

adjustable threshold, attack, and release times. Amplifiers shall not be loaded over 70 percent of the power output rating. Amplifiers shall be one half rack space or less for use in ceiling enclosures.

B. Amplifier shall meet the following specifications:
   1. 70 Volt
   2. 100 Watts per Channel
   3. Minimum 2 Channel
   4. Remote Level Control Capability

C. Basis of Design: Lab Gruppen E2:2 or approved comparable.

2.23 CEILING LOUDSPEAKER (S1)

A. Ceiling Speakers shall be mounted in ceiling. Each speaker installation shall be complete, including, where applicable, matching transformers, mounting brackets/back boxes as per manufacturer's recommended construction compatible with the total system. Speakers shall be mounted as indicated in the contract documents to provide optimum coverage for presentation source material. Coordinate loudspeaker and rigging hardware finishes and locations with structural support with Design professional.

B. Ceiling Speaker shall meet the following specifications:
   1. Frequency Response (-3dB): 51Hz to 24kHz
   2. Frequency Range (-10db): 74Hz to 24kHz
   3. Sensitivity (1 W / 1 m): 89dB SPL
   4. Dispersion: 90-degrees conical
   5. Coverage Angle: 105 degree (1kHZ to 6kHz)
   6. Low Frequency Driver: 6"
   7. Impedance Direct: 6-ohms nominal
   8. Power Handling: 60-watts average, 120-watts program
   9. Transformer Taps (70V): 30W, 15W, 7.5W, OFF and Low Impedance operation.
   10. Mounting:
   11. Supplied with Tile Bridge, C-ring, Cutout template
   12. Optional accessories: Plaster ring
   13. Dimensions (HxW): 8.10" x 8.11"
   14. Finish type: White grille and back can Zinc plated steel.

C. Basis of Design: JBL CONTROL 226CT series or approved comparable.

2.24 PENDANT SPEAKER (S2)

A. Pendant Speakers shall be mounted from ceiling. Each speaker installation shall be complete, including, where applicable, matching transformers, mounting brackets/back boxes as per manufacturer's recommended construction compatible with the total system. Speakers shall be mounted as indicated in the contract documents to provide optimum coverage for presentation source material.

B. Basis of Design: JBL CONTROL 65P/T series or approved comparable.

2.25 WIRELESS MICROPHONE SYSTEM

A. The Wireless Microphone System shall be mounted in the equipment rack as indicated in the audio-visual systems and infrastructure drawings provided by the consultant. Refence quantities to this spec.

B. Wireless Microphone System shall meet the following specifications:
   1. RF Carrier frequency range: 473-937 MHz
   2. Working Range: 100m(328ft) line of sight
   3. RF Tuning Step Size: 25kHz
   4. Audio Dynamic Range: >120dB, A-weighted, Typical

C. Basis of Design: Shure QLX-D Wireless System or approved comparable
   1. Package System shall include:

a. (8) Shure QLXD4 Digital Receiver
b. (4) Shure QLXD1 Bodypack Transmitter
c. (2) Shure WCE6lt Earset Microphone Or Headset Mic
d. (4) Shure QLXD2/58 Handheld Transmitter
e. (2) UA844+SWB/LC Antenna Splitter
f. (4) UA864 Wide Band Antenna
g. (As necessary) UA834 In-Line Antenna Amplifier
h. (As necessary) UA81000-UA850-UA825 Antenna cable(s)
i. (8) Shure SB900A Rechargeable Battery
j. (4) Shure SBC200 Charger

2.26 ASSISTIVE LISTENING SYSTEM

A. Assisted Listening System shall be provided as shown in contract documents to provide audio support for the hearing impaired as specified in the contract documents. Quantities of receivers dependent on room's max occupancy. Follow ADA guidelines posted below for accurate counts of minimum number of users to support with both earphones or neck loop helicoils.

B. Assistive Listening System shall meet the following specifications:
1. Stationary Transmitter
a. Operating Frequencies: 72.1-75.9 MHz, 17 wideband channels (selectable)
b. Deviation: +/- 75kHz maximum
c. Agency Approvals: FCC, RoHS2, WEEE, Industry Canada
2. Universal Antenna Kit
a. Dipole wall-mounted antenna
3. Rack Mounting Kit
4. Ear Speakers
a. Single mono earbud
b. Spare Earpads
5. 8" Neck loop
a. Use with T-coil Hearing Aids
b. Provide quantity of receivers and neck loops per ADA requirements for seating count

C. Basis of Design: Williams Sound or approved comparable

D. Furnish and install the following:
1. Base Transmitter (Qty: 1 ea.)
2. Rack mount Kit (Qty: 1 ea.)
3. Universal Antenna (Qty: 2 ea.) Mount as needed, can be mounted on ceiling, wall, and remote base or flexible dipole. If antenna is remoted, use RG58 for less than 100ft and RG8 for more than 100ft runs (50 Ohm)
4. Portable Display Receiver (Qty: 2 ea. Or as needed, see note*)
5. Ear Speaker (Qty 2 ea.)
6. Neck loop (Qty: 2 ea.)
7. 8-Unit charging carrying case (Qty: 1 ea.)
8. Ni-MH rechargeable batteries (Qty: 4 ea.)
9. ADA Access/Compliance signage kit (Qty 1 ea.)

*The Americans with Disabilities Act (ADA) 2010 ADA Standards requires public facilities to provide auditory assistance devices.

http://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards.pdf

Section: 706 Assistive Listening Systems
Table 219.3 Receivers for Assistive Listening Systems

Capacity of Seating in Assembly Area	Minimum Number of Required Receivers *contact Listen for	Minimum Number of Required Receivers Required to be

	customized quote to accommodate area	Hearing-aid Compatible (using Listen LA-166)
50 or less	2	2
51 to 200	2, plus 1 per 25 seats over 50 seats*	2
201 to 500	2, plus 1 per 25 seats over 50 seats*	1 per 4 receivers*
501 to 1000	20, plus 1 per 33 seats over 500 seats*	1 per 4 receivers*
1001 to 2000	35, plus 1 per 50 seats over 1000 seats*	1 per 4 receivers*
2001 and over	55 plus 1 per 100 seats over 2000 seats*	1 per 4 receivers*

*Or fraction thereof

2.27 WIRING & CONNECTORS:

A. All system wiring shall be plenum rated where not in conduit.

B. Video Transmission UTP cabling shall be at a minimum of the following requirements:
   1. Shielded Category 6A to meet or exceed the Category 6A transmission characteristics per ANSI/TIA/EA-568-C.
   2. No. of Conductors: Eight insulated conductors
   3. Install Plenum rated cabling in Plenum spaces
   4. Acceptable Manufacturers: Belden, CommScope, Legrand Ortronics, Panduit, TE Connectivity.

C. Control System and General Purpose UTP cabling shall be at a minimum of the following requirements:
   1. Shielded Category 6 to meet or exceed the Category 6 transmission characteristics per ANSI/TIA/EIA-568-C.
   2. No. of Conductors: Eight insulated conductors
   3. Install Plenum rated cabling in Plenum spaces
   4. Acceptable Manufacturers: Belden, CommScope, Legrand Ortronics, Panduit, TE Connectivity.

D. Basic speaker cables shall be single twisted pair shielded cables, minimum of 14 gauge, stranded, tinned copper, aluminum polyester shield, with stranded tinned copper drain wire. Cable shall be UL listed type 246A.

E. For balance of A/V cables and connectors, reference one-line diagram in contract documents and provide appropriate cables and connectors to ensure a fully functional audio visual system.

F. UTP cabling shall be at a minimum of CAT6 requirements or as indicated on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions, and as shown. Necessary interconnections, services, and adjustments required for complete and operable audio visual systems shall be provided. Components shall be labeled in accordance with TIA/EIA 606. Penetrations in fire-rated construction shall be fire-stopped. A/V cables shall not be installed in the same raceway with AC power cables. Cables not installed in conduit or wire ways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

B. No “Zip ties” are to be used for cable management. Velcro shall be in lieu of “zip-ties” both in the rack and other areas where cable management is required

C. Equipment Racks and Cabinets
   1. Open frame equipment racks shall be bolted to the floor slab. Cable guides shall be bolted or screwed to racks. Racks shall be installed level.

D. Rack Mounted Equipment
   1. Rack mounted equipment shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

3.02 GROUNDING/BONDING:

A. System should follow the grounding requirements of the National Electrical Code (NEC). Frame of all metal racks should be grounded.

3.03 TESTING AND CHECK-OUT

A. Testing requirements apply to all equipment. Contractor to test each audio visual component as recommended by manufacturer. Test methods and test results shall be submitted to the owner prior to final inspection.

B. Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the audio visual systems conform to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.04 TRAINING:

A. The Contractor shall include in the base Contract all costs required to train owners operating and maintenance personnel in the use and maintenance of systems provided under this section of the Specifications. Training sessions shall be conducted by instructors certified in writing by the manufacturer of the specific system.

B. Sessions shall be conducted for not less than four-hour periods during normal working hours, i.e., Monday through Friday, 8:00 AM to 5:00 PM. Training session schedules shall conform to the requirements of the owner; therefore, such schedules shall be submitted to owner for approval not less than two weeks prior to the training session. All training sessions shall be video-taped for future use. At Owner's discretion, provisions shall be made to allow up to two owner personnel to participate in final system check out of all systems.

C. Videotapes shall be of professional quality for both video and audio and must be approved by the Owner/User. Provide two copies to Owner/User. Time to be included in base Contracts for specific systems shall be as follows:
   1. Audio Visual Systems- 8 hours

3.05 AS-BUILT DRAWINGS AND/OR DOCUMENTATION:

A. As-built drawings shall be provided noting the exact cable path and cable labeling information. Drawings in .DWG format shall be provided by the contractor. As-builts shall be submitted to the owner on formatted CD’s, saved as .DXF or .DWG files. Redline hardcopies shall be provided as well. CAD generated as-built information shall be shown on a new layer named AS-BUILT.
   1. System Acceptance: Before the owner accepts the system, the contractor shall be required to walk-through the installation with the owner's representative and the design engineer to verify proper installation and operation.
   2. Contractor to provide control system programming source code (un-compiled) files to the owner at the end of the project as a deliverable.
   3. Contractor to provide programming files for any programmable digital audio processors (DSP) in the system to the owner at the end of the project as a deliverable.

END OF SECTION

SECTION 27 0500
COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Specifications, Standards, and Codes
   1. All work shall be in accordance with the following:
      a. This Technical Specification and Associated Drawings
      b. TIA/EIA 568-C.0 Generic Telecommunications Cabling for Customer Premises
      c. TIA/EIA 568-C.1 Commercial Building Telecommunications Cabling Standard
      d. TIA/EIA 568-C.2 Balanced Twisted Pair Cabling Components Standard
      e. TIA/EIA 568-C.3 Optical Fiber Cabling Components Standard
      f. TIA/EIA 942 Telecommunications Infrastructure for Data Centers
      g. TIA/TIA 569-A Commercial Building Standard for Telecommunications Pathways and Spaces
      h. TIA/EIA 606-A Administration Standard for the Telecommunications Infrastructure of Commercial
      i. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
      j. ANSI/TIA-758-A Customer Owned Outside Plant Telecommunications Infrastructure Standard
      k. National Fire Protection Agency (NFPA)-70 National Electric Code (NEC)
      l. UL 50 Enclosures for Electrical Equipment
      m. Current design and installation contractor agreement with single solution manufacturer.
   2. If a conflict exists between applicable documents that cannot be verbally negotiated between the contractor and the owner, then the order in the list above starting with #1 above shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency. If a conflict is found, it shall be the discovering party's responsibility to notify the Architect of these specifications for clarification and resolution.
   3. The contractor shall comply with all requirements for permits and tests, shall provide all certificates, and shall pay all costs for same.

B. SCOPE
   1. The work to be done under this Section of the Specifications shall include the furnishing of labor, material, equipment, and tools required for the complete installation of the work indicated on the Drawings or as specified herein.
   2. All materials, obviously a part of the Telecommunications Infrastructures and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.
   3. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the architect shall be notified of the discrepancy.

1.02 WORK INCLUDED

A. The Communications Infrastructures installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:
   1. Horizontal and Backbone Cabling Infrastructure
   2. Telecommunications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards as indicated on the Drawings.
   3. Grounding and Bonding

4. Concrete work for wall and floor penetration.

1.03 DEFINITIONS

A. Terms: The following definitions of terms supplement those of the GENERAL REQUIREMENTS and are applicable to the TELECOMMUNICATIONS WORK SCOPE.

B. Provide: As used herein shall mean "furnish, install and test (if applicable) complete".

C. Infrastructure: As used herein shall mean cable, installed in conduit, raceway, or cable tray with all required boxes, fittings, connectors, and accessories; completely installed."

D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.

1.04 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop Drawings, equipment location Drawings, foundation Drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

C. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.

E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.

F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Technology plans.

H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.

I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.

J. Review all architectural Drawings for modular furniture.

K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as indicated on the Drawings", "In accordance with", "a", "the" and "all are intended" shall be supplied by inference.

1.05 SUBMITTALS

A. Before installation of any cable or support equipment the contractor shall submit shop drawings and product data for the RCDD and designer for review and approval. The contractor shall indicate installation details, cable routing, system configurations, and outlet numbering on all drawings. The contractor shall submit all appropriate product data for each component to be

supplied. The contractor shall also submit manufacturer installation instructions. Three (3) copies of all the above and following shall be submitted.

B. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.

C. Immediately after reward, the contractor shall submit a construction schedule listing construction milestones including: delivery of construction materials, staffing, backbone installations, equipment room fit-out, horizontal cable installation, testing, and pre-final and final construction observations.

D. Also after reward, contractor to submit Schedule of Value that coincides with construction schedule. This schedule of values shall be used for evaluation of pay requests. Schedule of Values to include all labor and material costs.

E. Project Record Documents: The record documents shall be bound and consist of the following:
   1. Product cut sheets for all products supplied.
   2. Test reports for horizontal cabling.
   3. Test reports for backbone cabling.
   4. Manufacturer Warranties
   5. “D-Size” As-Built drawings.

F. As-Built drawings should accurately record location of service entrance conduit, termination backboards, outlet boxes, cable raceways, cable trays, pull boxes, and equipment racks electronically using AutoCAD 2022 or later version and on minimum “D” size reproducible paper prints.

G. The contractor shall prepare 11” x 17” as-built serving zone drawings for each Telecommunication Room. The drawing shall be laminated, framed, and secured to the wall in the Telecom Room.

1.06 QUALITY ASSURANCE

A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.

B. Equipment shall bear labels attesting to Underwriters Laboratories or certification by other recognized laboratory, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

C. The Owner reserves the right to send its RCDD as a representative to inspect the job site during construction to ensure compliance with the Contract Documents.

1.07 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated telecommunications systems.

B. Telecommunications Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Project Engineer of the following:
   1. List of three (3) reference accounts at which similar work, both in scope and design, have been completed by the contractor with the last two (2) years.
   2. The credentials (current BICSI certification stamp) of the responsible RCDD must be attached to the contractor’s response for evaluation by the Project Engineer.

C. Contractor must be licensed in the State of North Carolina as a Telecommunications Class or Unrestricted Class Low-Voltage Contractor (LVL).

D. The Licensed Low-Voltage Telecommunications Contractor (LVLTC) must be based in the State of North Carolina.

E. The installation of all cable, equipment, terminations, & associated services should be performed by a company that is currently a Manufacturer's Certified Structured Cabling System installer in good standing with minimum of three (3) years of experience on similar systems.

F. The installation company must have an RCDD on staff performing the role of Project Manager and be available for consultation and to attend project meetings.

G. A BICSI certified installer shall be employed by the contractor and be on site as the installation manager.

H. Installer's Qualifications:
   1. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.
   2. General electric trade staff shall not be used for the installation of the premises' distribution system cables and associated hardware.
   3. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified copper and fiber optic cable and components.
   4. Installer must be a current Certified Installer and must submit the current certificate with their proposal

1.08 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate telecommunications work with that of other Sections as required to ensure that the entire telecommunications work will be carried out in an orderly, complete and coordinated fashion.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – COPPER CONNECTIVITY SYSTEM

A. All copper cables and components shall be provided and installed by manufacturer certified installers that shall provide an extended warranty of 25 years for certified installations. Manufacturer shall provide warranties and contractor shall provide documentation of certification by manufacturer. Acceptable copper solution manufacturers shall be the products of the following manufacturers:
   1. Panduit
   2. Siemon
   3. Leviton
   4. Belden
   5. CommScope

B. The contractor shall maintain a current status with the manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel in accordance with their current contract agreement to support the 25-Year System Warranty requirements. After installation, the Contractor shall submit all documentation to support the requirements of the Warranty and to obtain said warranty on behalf of the owner. The warranty will cover the components and labor associated with the repair/replacement of any defective link within the warranty period when the defect is a valid warranty claim.

2.02 ACCEPTABLE MANUFACTURERS – FIBER OPTIC CONNECTIVITY SYSTEM

A. All fiber optic cables and components shall be provided and installed by manufacturer certified installers that shall provide an extended warranty of 25 years for certified installations. Manufacturer shall provide warranties and contractor shall provide documentation of certification

by manufacturer. Acceptable fiber optic solution manufacturers shall be the products of the following manufacturers:

1. Panduit
2. Siemon
3. Leviton
4. Belden
5. CommScope
6. OCC

B. The contractor shall maintain a current status with the manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel in accordance with their current contract agreement to support the 25-Year System Warranty requirements. After installation, the Contractor shall submit all documentation to support the requirements of the Warranty and to obtain said warranty on behalf of the owner. The warranty will cover the components and labor associated with the repair/replacement of any defective link within the warranty period when the defect is a valid warranty claim.

2.03 MATERIALS

A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.

B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.

C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.

D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.

E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.

F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 - EXECUTION

3.01 EXAMINATION OF SURFACE CONDITIONS

A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.

B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.

C. In the event of a discrepancy, immediately notify the Project Manager.

D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.

B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.

C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.

D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Project Manager shall be final.

E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.

B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.

C. Where the Project Manager determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Project Manager, at no additional cost to the Owner. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.04 CLEANING

A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by telecommunications work.

B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

3.05 COMPLETION

A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.

B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.

C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

A. See specific Low Voltage sections for testing parameters of sub-systems.

B. The Contractor shall verify that requirements of this specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.

C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.

D. The Contractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the telecommunications systems, components and subsystems meet specification requirements in the "as-installed" operating environment during the "System Operation Test". Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the "System Operation Test".

E. The Contractor shall carefully plan and coordinate the final acceptance tests so that tests can be satisfactorily completed. The Contractor shall provide necessary instruments, labor and materials required for tests, including the equipment manufacturer's technical representative and qualified technicians in sufficient numbers to perform the tests within a reasonable time period.

F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.

G. After the Contractor systems have been installed and tested, the completed test plan shall be signed by the Telecommunications Contractor Project Manager and submitted for approval.

END OF SECTION

SECTION 27 0526
GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Grounding & Bonding for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document.

D. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Grounding Conductors.
   2. Furnish and install all Grounding Lugs and Hardware.

C. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Grounding Conductor manufacturer(s):
   1. Southwire
   2. West Penn
   3. Belden

B. Approved Grounding Lug manufacturer(s):
   1. Burndy
   2. Thomas & Betts
   3. Chatsworth Products, Inc.
   4. Harger

C. Approved Grounding Busbar manufacturer(s):
   1. Burndy
   2. Thomas & Betts
   3. Chatsworth Products, Inc.
   4. Harger

2.02 GROUNDING CONDUCTORS

A. Grounding Conductor
   1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL listed jacket is applied.
   2. Jacket color shall be green. Jacketed cable shall be identified at each termination point with a wrap of green tape.

2.03 GROUNDING LUGS

A. Grounding Lugs and Hardware
   1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

PART 3 - EXECUTION

3.01 GROUNDING

A. All equipment, racks, cabinets, enclosures, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MC/IC/TC shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.

B. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap or green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA/EIA-606-A.

C. The ground/earth system must be designed for high reliability. Therefore, the grounding/earthing system shall meet following criteria:
   1. Local electrical codes shall be adhered to.
   2. The grounding/earthing system shall comply with ANSI/TIA-942 and J-STD-607-A.
   3. All grounding/earthing conductors shall be copper.
   4. Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.

D. The gauge of the connecting ground/earth cable, known as the Telecommunications Bonding Backbone (TBB) will follow J-STD-607-A guidelines, as is shown in the table below.

E.

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
Greater than 20 (66)	3/0

F. Ladder racks shall be bonded per the manufacturer's installation instructions. To provide electrical continuity between ladder rack segments drill holes in rack and use a #6 AWG code cable with green/yellow stripe to jumper between segments. The jumper shall be made with 2-hole copper compression connectors terminated on both ends. Attach jumpers as required to ladder rack and then bond the entire assembly to the TGB.

G. Equipment and racks shall be bonded in accordance with the methods prescribed in ANSI/TIA-942. To provide electrical continuity between rack elements, paint piercing grounding washers shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack. All racks shall utilize a full-length rack ground strip attached to the rear of the side rail with thread-forming screws to ensure metal-to-metal contact. Patch panels will be bonded to racks using bonding screws for racks having #12-24 equipment mounting holes.

H. Reference low voltage drawing package for additional requirements.

3.02 IDENTIFICATION

A. Refer to section 27 0553 for labeling details.

END OF SECTION

SECTION 27 0528
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Pathways for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of interior telecommunications pathways and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install complete Conduit System – Reference Electrical Specifications.
   2. Furnish and install all Telecommunications Outlet Boxes.
   3. Furnish and install all Pull Boxes.
   4. Furnish and install complete Cable Tray System.
   5. Furnish and install all Velcro Straps.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Velcro Strap manufacturer(s):
   1. Panduit
   2. Tyco
   3. Hubbell
   4. Or Approved Equal

B. Innerduct
   1. Exposed innerduct shall be rated CMP (plenum), corrugated plastic equipped with pull-string or mule tape.
   2. Sizes shall be 2”, 1-1/4” & 1” inside diameter.
   3. See Drawings for innerduct details.

2.02 PULL BOXES

A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.

B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.

C. Pull boxes shall have provisions for grounding.

2.03 CABLE TRAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chalfant Manufacturing Company.

2. Cooper B-Line, Inc.
3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
4. GS Metals Corp.; GLOBETRAY Products.
5. MONO-SYSTEMS, Inc.
6. MPHusky.
7. PW Industries.

B. Material & Finishes - Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
1. Factory-standard primer, ready for field painting; with cadmium-plated hardware according to ASTM B 766.
2. Mill galvanized before fabrication, complying with ASTM A 653/A 653M, G90 (Z275) coating; with hardware galvanized according to ASTM B 633. Electrogalvanized before fabrication, complying with ASTM B 633; with hardware galvanized according to ASTM B 633.
3. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, hardware.
4. Epoxy-resin paint over paint manufacturer's recommended primer and corrosion-inhibiting treatment; with cadmium-plated hardware according to ASTM B 766.

C. Sizes and Configurations: Refer to Drawings for specific requirements for types, materials, sizes, and configurations.

D. Center-hanger supports may be used only when specifically indicated.

E. Cable Tray Accessories:
1. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
2. Barrier Strips: Same materials and finishes as cable tray.
3. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

F. Warning - Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

G. Materials and fastening are specified in Division 26 Section "Electrical Identification."

H. Source Quality Control - Perform design and production tests according to NEMA VE 1.

2.04 VELCRO STRAPS

A. Velcro Straps
1. Cables shall be fastened to support structures with Velcro straps.
2. Velcro straps installed in air handling spaces must be plenum rated.
3. Plenum Velcro strap color shall be red.
4. Use 1-inch wide Velcro to secure cables to all support structures.

PART 3 - EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports to building structure.
1. Design each fastener and support to carry load indicated by seismic requirements.
2. Place supports so that spans do not exceed maximum spans on schedules.
3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
4. Support bus assembly to prevent twisting from eccentric loading.

5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA VE 1.

D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.

F. Make changes in direction and elevation using standard fittings.

G. Make cable tray connections using standard fittings.

H. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

I. Workspace: Install cable trays with enough space to permit access for installing cables.

J. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

K. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.02 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

3.03 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.04 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.05 PROTECTION

A. Protect installed cable trays.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
   3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

3.06 PENETRATIONS

A. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base of building. Impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the Project Manager as required by limited working space. X-ray all floor penetrations accordingly.

B. Holes shall be located so as not to affect structural sections such as ribs or beams.

C. Holes shall be laid out in advance. The Project Manager shall be advised prior to drilling through structural sections, for determination of proper layout.

D. Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors provide a code compliant effective barrier against the spread of fire, smoke and gases.

E. All penetrations where conduit is not used shall be sleeved.

F. No gaps or rough edges shall be allowed between wall and conduit/sleeve.

3.07 CONDUIT SYSTEM

A. All conduit shall not be less than 3/4” trade size.

B. No more than two 90 degree sweep bends or the equivalent shall be permitted between junction boxes, pull boxes, cabinets, or cable access points.

C. Conduit shall be provided as a continuous run perpendicular from the cable tray to the work area outlet. All cables shall be enclosed in conduit or cable tray for protection.

D. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the Drawings.

E. Leave all empty conduits with a 200 pound test nylon cord pull line.

F. A 200 pound test nylon cord pull line shall be co-installed with all cable installed in any conduit.

G. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.

H. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.

I. Install conduit with wiring, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.

J. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.

K. Attach backbone conduits larger than one-inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.

L. Where conduits must pass through structural members obtain approval of Architect.

M. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.

N. Provide expansion and deflection coupling where conduit passes over a building expansion joint.

O. All other conduit, unless specified herein, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas. PVC to be installed below concrete in grade. Contractor to utilize Rigid Galvanized Steel (RGS) elbows for all slab penetrations and stub-ups.

P. Telecommunications cables shall not occupy conduits with power cables.

Q. Metallic conduits shall be grounded in accordance with J-STD-607-A.

R. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.

S. Conduit runs shall not have more than two (2) 90-degree bends between pull points.

T. Telecommunications conduit system shall contain no condulets (also known as an LB).

U. Horizontal Conduits
   1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

3.08 TELECOMMUNICATIONS OUTLET BOXES

A. Exact locations of the outlet boxes shall be coordinated with the electrical contractor and other trades.

B. The approximate locations of the outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

C. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on the architectural elevations.

D. Install all outlet boxes in finished areas flush with the wall. Maintain 1/4" or less space between outlet box front and finished wall surface.

E. Outlet boxes shall be firmly anchored in place and shall not depend on the cover plate to hold it secure to the wall.

F. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

3.09 PULL BOXES

A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.

B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.

C. Pull boxes shall be free from burrs, dirt and debris.

D. Pull boxes shall be installed in accordance with ANSI/TIA/EIA-569-A.

E. Pull boxes shall be grounded in accordance with J-STD-607-A.

3.10 CABLE TRAY SYSTEM

A. Install trays in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of the NEC.

B. All open trays shall be installed a minimum of six (6) inches away from any light fixture.

C. Provide external grounding strap at expansion joints, sleeves, crossover and other locations where tray continuity is interrupted.

D. Support all pathways from building construction. Do not support pathways from ductwork, piping or equipment hangers.

E. Install cable tray level and straight.

F. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete cable tray system.

G. Cable trays shall not be used to house both low voltage and power cables unless cables are separated by a grounded physical barrier.

H. Cable tray system shall be grounded in accordance with J-STD-607-A.

I. Bundle horizontal distribution cables in groups not greater than 50 cables.

3.11 VELCRO STRAPS

A. Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Do not over-cinch cables.

END OF SECTION

SECTION 27 0553
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Administration & Labeling for Communications Systems.

C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide the following submittals:
   1. Product data
   2. Product samples
   3. Label sample showing example and text size for each item
   4. Software program sample

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Perform all Labeling.

PART 2 - PRODUCTS

2.01 LABELS

A. All labels shall be vinyl.

B. All labels shall have an adhesive backing for permanent attachment.

C. All labels shall be of sufficient size. Minimum sizes shall be as follows:
   1. 1-1/2"W x 3/16"H for:
      a. Outlets
      b. Outlet cables
      c. Patch panels
      d. Ground wires
      e. Backbone cable pairs
   2. 4"W x 1"H for:
      a. Backbone cables
      b. Equipment racks
      c. MDF frames
      d. Active hardware and multiplexers
   3. 3” Square Tag mechanically stamped, legible, and permanent affixed. Tag shall be copper, brass, or 1/16” plastic.
      a. Cable Tray
      b. Riser Backbone Conduits
      c. Backbone Conduits

2.02 LABEL HOLDERS

A. Labels attached to backbone cable bundles shall be installed on a label holder of sufficient size. Label holder to be plastic and have tie wrapping provisions.

2.03 SOFTWARE PROGRAM

A. Software program shall be of the following types or similar:
   1. PANDUIT labeling program
   2. Brady labeling program
   3. Thomas & Betts labeling program
   4. Excel, customized

2.04 TEMPORARY LABELS

A. Vinyl labels, hand written, with permanent marker.

2.05 CHARTS

A. Provide printed charts containing required punch down and cross-connect information. Charts to be computer generated. File information shall be turned over to owner in printed and electronic format four (4) weeks prior to job completion.

2.06 AS-BUILT PLAN

A. Description: At the completion of the project, provide an "as-built" floor plan of each floor to the Project Engineer for approval.

PART 3 - EXECUTION

3.01 LABELING REQUIREMENTS

A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA/EIA-606 document, manufacturer's recommendations and best industry practices.

B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.

C. All labels shall be clear with black text.

D. All cables shall be labeled with machine generated, wrap around labels.

E. A total of three (3) labels per horizontal cable are required at the following intervals: 6" from outlet; 18" from outlet' 12" from termination block/patch panel.

F. Labeling scheme shall be alphanumeric.

G. Provide and generate all labeling (no labels will be furnished by the owner).

H. Labels shall be developed and printed using a software program.

I. Software program and all in-puts shall be turned over to the owner at the end of the project.

3.02 INSTALLATION

A. All labels shall be installed straight.

B. Provide labels at locations as indicated on the Drawings and as follows:
   1. Outlet face plates
   2. Inside of outlet boxes
   3. Outlet cable inside box
   4. Outlet cable in ceiling above outlet
   5. Outlet cables at poke through entrance on both sides
   6. Outlet cable at rear of patch panel.
   7. Port at rear of patch panel
   8. Port on front of patch panel
   9. Individual fiber strands at rear of patch panel
   10. Backbone cables & conduits whenever exposed on minimum 10' intervals
   11. Backbone cable & conduit at point of termination
   12. Ends of any cored cable put in place that is not terminated
   13. On front of racks, cabinets frames, active hardware, multiplexers
   14. Cable tray.

3.03 LABELING SCHEME

A. In general the following items shall receive labeling:
   1. Outlets:
      a. Top Label: Present Room–Telecom Room–Box Designation in Room. Ex: 112-119-3
      b. Bottom Label: Port Designation: D=Data Jack; T=Voice Jack – Ex. D1, D2, T1
   2. Outlet cables
   3. Backbone cables - (CVR=139) copper backbone to room 139, 1-25, 26-50, 51-75, etc - 200)
   4. Patch panels - (ex. PP#1, PP#2, etc)
   5. Patch panel ports (each) - Station room #, Box Designation in Room, Port Designation in Room. Ex – 112-3-4. Note – If Telecom Room serves 100 jacks, labels would start at 001 and go to 100.
   6. Equipment racks and cabinets - (EX. Rack 1, rack 2, etc)
   7. Ground wires
   8. Active hardware and multiplexers (by owner)

      Note – Contractor to obtain approval from owner/engineer before beginning labeling task.

B. Patch Panel labeling strip colors:
   1. Voice patch panels shall have port labels in “light blue” strips.
   2. Data patch panels shall have port labels in yellow” strips.

3.04 TEMPORARY LABELS

A. Provide temporary labels on all outlet cable as it is roughed-in. The bid documents will not show outlet/cable labeling at the time of the cable rough-in. Replace temporary labels with permanent labels after contract documents have been revised.

3.05 TEXT SIZE AND INFORMATION

A. Text size should be as large and as bold as possible.

B. Exact text required information is shown on the Drawings.

C. Refer to Drawings for all outlet, outlet cables, and backbone cables labels.

D. Refer to the Cover Drawing for exact labeling coding schemes, where applicable.

3.06 LABELING AND REFERENCE CHARTS

A. Contractor to provide a labeling reference chart(s) indicating the following:
   1. Backbone termination of pairs at the local telecommunication room (TR) and main telecommunications room (MR).
   2. Horizontal outlet cable pair termination at the TR.
   3. Data patch panel outlet port termination.

3.07 AS-BUILT PLAN & FRAME

A. Provide and mount frame with "as-built" on TR wall near the data racks, or as indicated on the plans.

END OF SECTION

SECTION 27 0800
COMMISSIONING FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Commissioning of Communications.

C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Perform all Copper Cabling Testing.
   2. Provide all Documentation, As-Builts, Training and Warranty.

PART 2 - TESTING

2.01 TESTING REQUIREMENTS

A. General
   1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B.1-3. All pairs/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.
   2. Copper Testing
      a. All twisted pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category 6 and Category 6A performance. Horizontal balanced twisted pair cabling shall be tested using a level III test unit for category 6 & 6A compliance (data) and category 6 compliance (voice) and performance up to 350 MHz.
   3. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
   4. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B.1-3 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

B. Fiber Testing
   1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests also include continuity checking of each fiber.

2. Test set-up and performance shall be conducted in accordance with ANSI/TIA/EIA-526-7 and/or ANSI/TIA/EIA-526-14 Standards, and to the manufacturer's application guides.
3. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.
4. Multimode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 850nm and 1300nm. Maximum attenuation dB/Km @ 850nm/1300nm shall be 3.5/1.5. Maximum attenuation per connector pair shall be .75 dB.
5. Singlemode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 1310nm and 1550nm. Maximum attenuation dB/Km @ 1310nm/1550nm shall be 0.5/0.5 for outside plant and 1.0/1.0 for inside plant. Maximum attenuation per connector pair shall be .75 dB.

C. Test Results
1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
2. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B.1-3.
3. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. Alternately, the contractor may furnish this information in electronic form (CD). These diskettes or CDs shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable from Microsoft Word.
4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

PART 3 - DOCUMENTATION, AS-BUILTS, TRAINING AND RECORDS

3.01 DOCUMENTATION & AS-BUILTS

A. As-Built record documentation for telecommunications work shall include:
1. Cable routing and identification
2. System function diagrams
3. Manufacturers' description literature for equipment
4. Connection and programming schedules as appropriate
5. Equipment material list including quantities
6. Spare parts list with quantities
7. Details not on original Contract Documents
8. Test Results
9. Warranties
10. Release of Liens

B. The Contractor shall provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract Drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.

C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of Telecommunications infrastructure work.

D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.

E. Furnish as-built drawings and documentation to the Project Engineer for review and approval. As-built drawings shall be generated in AutoCad 2022 or later. Submit as-built drawings electronically on C.D. and hard copy.

3.02 OPERATIONS AND MAINTENANCE MANUAL

A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.

B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate specification sections.

C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.
   1. Operations manuals for components and for systems as a whole.
   2. Maintenance manuals for components and for system as a whole.
   3. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details.
   4. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
   5. Emergency instructions for operational and maintenance requirements.
   6. Delivery time frame for replacement of component parts from suppliers.
   7. Recommended inspection schedule and procedures for components and for system as a whole.
   8. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
   9. Complete "Reviewed" shop drawings and product data for components and system as a whole.
   10. Troubleshooting procedures for each system and for each major system component.

3.03 TRAINING

A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be for not more than ten (10) people, shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

3.04 WARRANTY

A. General
   1. All equipment is to be new and warranted free of faulty workmanship and damage.
   2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the owner.
   3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Horizontal Structured Cabling
   1. Low voltage contractor shall provide a 25-year manufacturer warranty for components used in the installed Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

C. Pathway & Support Infrastructure
   1. Manufacturer(s) shall provide a 1-year warranty for components used in the installed Pathway & Support Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION

SECTION 27 1100
EQUIPMENT ROOM COMPONENTS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cabinets, Racks & Enclosures.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Equipment Racks.
   2. Furnish and install all Equipment Cabinets.
   3. Furnish and install all Equipment Shelves.
   4. Furnish and install all Backboards.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Rack manufacturer(s):
   1. Panduit
   2. Middle Atlantic
   3. CPI

B. Equipment Racks
   1. The equipment rack shall be constructed of high strength, lightweight aluminum.
   2. The vertical rails of the equipment rack shall be equipped with the EIA hole pattern.
   3. Rack shall be: 7’ tall, standard 19" width floor mounted or wall mount racks, as required by contract documents.
   4. Racks shall provide a minimum 20” interior depth for rack mount equipment and front mount cable management.
   5. Floor mount equipment racks and cabinets shall be provided with adjustable height leveling feet or casters.

C. Cable Guides
   1. Between patch panels - Panduit (front & back channels)
   2. Between racks - Panduit (front & back channels)

PART 3 - EXECUTION

3.01 EQUIPMENT RACKS/CABINETS/SHELVES

A. Where mounted to structure, equipment racks shall be securely attached to the floor or structural wall using four (4) 1/2" diameter bolts and associated hardware (anchors & washers) or as required by local codes.

B. Wall mounted equipment racks shall be provided with fire rated plywood backboard for additional mounting support. Backboard shall be mechanically fastened to CMU wall or framing stud. It shall not be acceptable to support wall mount equipment racks using only drywall or gypsum board.

C. Equipment racks/cabinets/shelves shall be installed as per the requirements specified by the manufacturer's installation guidelines.

D. Equipment racks/cabinets shall be placed with a minimum clearance of 30 inches in the front and 30 inches in the rear or as indicated on Drawings.

E. All equipment racks/cabinets shall be grounded to the telecommunications ground bus bar.

F. Mounting screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

3.02 BACKBOARDS

A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 8' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint (Additive Acceptable).

END OF SECTION

SECTION 27 1123
CABLE MANAGEMENT & LADDER RACK

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cable Management & Ladder Rack.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this specification.

1.02 SUBMITTALS

A. Product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Horizontal Cable Management.
   2. Furnish and install all Vertical Cable Management.
   3. Furnish and install Ladder Rack System.
   4. Furnish and install all Velcro Straps.

PART 2 - PRODUCTS

2.01 CABLE MANAGEMENT – HORIZONTAL

A. Horizontal Cable Management
   1. The horizontal wire manager shall be compatible with 19-inch equipment racks and cabinets.
   2. The horizontal cable manager shall provide support for patch cords at the front of the panel.
   3. The horizontal wire manager shall be equipped with management fingers and covers.
   4. The horizontal cable manager shall be 2 rack-units in height and shall be 2-sided.

2.02 CABLE MANAGEMENT – VERTICAL

A. Vertical Cable Management
   1. The vertical cable manger shall be double-sided.
   2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
   3. The vertical cable manager shall be a minimum width of 6".
      a. Vertical Cable Manager color shall be black.

2.03 TELECOM ROOM LADDER RACKS

A. Ladder Rack System
   1. See Drawings for ladder rack system details.
   2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
   3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.

a. Ladder Rack System color shall be black.

4. Acceptable Manufacturers include:
   a. Hoffman
   b. Chatsworth

2.04 VELCRO STRAPS

A. Velcro Straps
   1. All cables shall be fastened to support structures with Velcro straps.
      a. Velcro Strap color shall be black.

2.05 LADDER RACK DROP-OUT SHIELD

A. Ladder Rack Drop-Out Shield
   1. Ladder rack drop-out shields shall be required to protect cables as they are routed from ladder rack to all vertical wire managers on equipment racks.

B. Acceptable Manufacturers & Products include:
   1. Hoffman #LRD12BLK or LSRDBLK
   2. Chatsworth #12100-712 or 12100-701

PART 3 - EXECUTION

3.01 CABLE MANAGEMENT – HORIZONTAL

A. Horizontal cable managers shall be installed below patch panels in a 1:1 ratio (one horizontal cable manager per patch panel) or as indicated on Drawings.

3.02 CABLE MANAGEMENT – VERTICAL

A. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.

3.03 LADDER RACKS

A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.

B. Ladder racks shall be supported at 5' intervals maximum.

C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.

D. See Drawings for ladder rack system details.

3.04 VELCRO STRAPS

A. Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Do not over-cinch cables.

3.05 LADDER RACK DROP-OUT SHIELD

A. Install in ladder rack above equipment racks to support cables as they are routed from the ladder rack to the equipment rack.

END OF SECTION

SECTION 27 1126
COMMUNICATIONS RACK MOUNTED POWER STRIPS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Rack Mounted Power Strips.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

D. Provide one (1) power strip for each equipment rack. See rack elevation drawings.

1.02 SUBMITTALS

A. Provide product data

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Power Strips.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Power Strip manufacturer(s):
   1. Chatsworth Products, Inc.
   2. Ditek
   3. Geist
   4. ITW Linx

2.02 POWER STRIPS

A. Power Strip
   1. The power strip shall be equipped with a minimum of six (6) 3-prong, 120 VAC outlets, 6' cord and an on/off switch. Outlets shall accept side pole neutral plugs.
   2. The power strip shall be equipped with surge protection with a 20 Amp current limit.
   3. The power strip shall be equipped with a bracket that enables it to be mounted on a 19" rack, cabinet or wall mount bracket without modification.

PART 3 - EXECUTION

3.01 POWER STRIPS

A. Power strips shall be installed as per the requirements specified by the manufacturer's installation guidelines.

B. See Drawings for installation location on rack(s)/cabinet(s).

END OF SECTION

SECTION 27 1500
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Structured Communications Copper Horizontal Cabling.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of horizontal cabling and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Contractor shall provide submittals indicating the following:
   1. Cable description
   2. Use of cable
   3. Product data
   4. Specifications outlining cable
   5. Testing and qualification data
   6. Samples, approximately 12” in length

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Horizontal Copper Cable.

PART 2 - PRODUCTS

2.01 HORIZONTAL DATA, VOICE, & WIRELESS DATA COPPER CABLE

A. CATEGORY 6 BALANCED TWISTED PAIR CABLE – VOICE & DATA
   1. Description: 100-ohm, 4-pair UTP, 350 MHz certified cable, covered with a Blue thermoplastic jacket or as directed by the Owner Representative.
      a. Comply with ICEA S-90-661 for mechanical properties.
      b. Comply with ANSI/TIA/EIA-568-B.1 for performance specifications.
      c. Comply with ANSI/TIA/EIA-568-B.2, Category 6.
      d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types: Communications, Plenum Rated: Type CMP.

B. CATEGORY 6A BALANCED TWISTED PAIR CABLE – WIRELESS DATA
   1. Description: 100-ohm, 4-pair UTP, 500 MHz certified cable, covered with a Blue thermoplastic jacket or as directed by the Owner Representative.
      a. Comply with ICEA S-90-661 for mechanical properties.
      b. Comply with ANSI/TIA/EIA-568-C.1 for performance specifications.
      c. Comply with ANSI/TIA/EIA-568-C.2, Category 6A.
      d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types: Communications, Plenum Rated: Type CMP.

2.02 COPPER PATCH CABLES

A. Provide one patch cable for each terminated Category 6 and Category 6A cable.

B. 50% of patch cables shall be approximately 2 meters in length, 25% of patch cables shall be approximately 3 meters in length, and 25% of patch cables shall be approximately 1 meters in length. Cable used for the construction of patch cables shall be UL or ETL verified to meet Category 6 and Category 6A requirements and the cable jacket shall be labeled to indicate verification.

C. Patch cords shall be color coded by system type to match the Owner's requirements. Basis of design shall be as follows:
   1. Voice/Data Communications:: Blue
   2. Wifi Communications: Green

D. Provide the following:
   1. One RJ45 to RJ45 jacketed Cat 6 patch cable for each data patch panel port.
   2. One RJ45 to RJ45 jacketed Cat 6A patch cable for each white wireless data patch panel port.
   3. For all voice services, provide ten (10) 3-meter hybrid patch cords. Patch cords to be RJ-45 to 2-pin straight connector.
   4. One set of two factory made fiber patch cords of a length and type to be specified by the owner (typically 3 meter Single Mode and Multimode SC-LC) for each fiber run.
   5. Three (3) 500' spools of pair one, 24AWG, cross connect wire for the entire project.

PART 3 - EXECUTION

3.01 HORIZONTAL CABLES

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-A maximum fill for the particular raceway type.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

E. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

G. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

H. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

I. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

J. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

K. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.2 document, manufacturer's recommendations and best industry practices.

L. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow-wall

installations where box-eliminators are used, excess wire can be stored in the wall. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

M. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

N. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support straps. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

O. When creating service loops for copper cables, they should be coiled in a Figure-eight configuration to eliminate adding to the problems of Return Loss and NEXT.

END OF SECTION

SECTION 27 1543

FACEPLATES & CONNECTORS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Faceplates & Connectors.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of horizontal cabling and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide the following submittals:
   1. Product data
   2. Sample of each outlet correctly configured.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Copper Connectivity.
   2. Furnish and install all Faceplates.
   3. Furnish and install all Surface Mount Boxes.

PART 2 - PRODUCTS

2.01 COPPER CONNECTIVITY

A. Horizontal Module
   1. The horizontal module shall accommodate up to four (4) Category 6, 8-position, 8-contact modular jacks.
      a. Each jack shall be power sum rated, with a power sum NEXT performance equal to or better than the ANSI/TIA/EIA-568-C-2 Category 6 pair-to-pair NEXT performance specifications.
      b. Each jack shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
      c. The connector module shall be designed for use at the Work Area, Telecommunications Room and/or Equipment Room without modification.
      d. Each jack shall be T568B wiring configuration.
      e. Each jack shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
      f. Jack colors shall be confirmed by the owner. Unique jack colors shall be required for voice, data, spare and wireless access point outlets. Basis of design for color codes shall be as follows:
         1) Faceplates and Blanks: Electric Ivory
         2) Telephone Communications: Electric Ivory
         3) Data Communications: Blue
         4) Wifi Communication: Green

2. For Category 6A wireless access point circuits, the horizontal module shall accommodate up to four (4) Category 6a, 8-position, 8-contact modular jacks.
    a. Each jack shall be power sum rated, with a power sum NEXT performance equal to or better than the ANSI/TIA/EIA-568-C-1 Category 6A pair-to-pair NEXT performance specifications.
    b. Each jack shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
    c. The connector module shall be designed for use at the Work Area, Telecommunications Room and/or Equipment Room without modification.
    d. Each jack shall be T568B wiring configuration.
    e. Each jack shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
    f. Jack colors shall be confirmed by the owner. Unique jack colors shall be required for voice, data, spare and wireless access point outlets. Basis of design shall be Electric Ivory.

B. F-connectors shall be By Thomas & Betts and of the “Snap N Seal” type model.

2.02 FACEPLATES

A. Faceplates – Straight-Type
1. The faceplate housing the connector modules shall have no visible mounting screws.
2. It shall be possible to install the connector modules in wall-mounted single-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters.
3. The faceplate housing the connector modules shall have the option of being mounted on adapter boxes for surface mount installation.
4. The faceplate housing the connector modules shall have a labeling capability using built-in labeling windows to facilitate outlet identification and ease network management.
5. The faceplate housing the connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present of future network needs.
6. Blank inserts shall be used on faceplates for all unused ports.
7. Basis of design shall be Panduit CFPL4EIY with CMBEI-C blank modules.

2.03 SURFACE MOUNT BOXES

A. The surface mount box shall accommodate horizontal and video connections.

B. The surface mount box shall have internal storage space for slack cabling and a built-in spool for controlling cable bend radius.

C. Color shall be Electric Ivory.

PART 3 - EXECUTION

3.01 COPPER CONNECTIVITY

A. 8-position, 8-contact modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

3.02 FACEPLATES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

C. Faceplates shall be installed straight and level.

D. Faceplates shall be installed at heights as noted on the Drawings.

3.03 SURFACE MOUNT BOXES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

C. Surface mount boxes shall be installed straight and level.

D. Surface mount shall be installed at heights as noted on the Drawings.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 03 4500 - Precast Architectural Concrete: Reinforcement for precast concrete panels.

C. Section 04 2000 - Unit Masonry: Reinforcement for masonry.

D. Section 04 2613 - Masonry Veneer: Spacing for veneer anchor reglets recessed in concrete.

E. Section 26 0526 - Grounding and Bonding for Electrical Systems: Grounding connection to concrete reinforcement.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI MNL-66 - ACI Detailing Manual; 2020.

C. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

D. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2019.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

F. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.

G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

I. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).

J. CRSI (DA4) - Manual of Standard Practice; 2018, with Errata (2019).

K. CRSI (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Comply with requirements of ACI MNL-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301.
   1. Maintain one copy of each document on project site.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.4/D1.4M and no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).

B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.

C. Steel Welded Wire Reinforcement (WWR): Deformed type; ASTM A1064/A1064M.
   1. Form: Flat Sheets.

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.02 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is permitted where indicated or only with the specific approval of Architect. Perform welding in accordance with AWS D1.4/D1.4M.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor barrier.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcing as indicated in drawings.

E. Comply with applicable code for concrete cover over reinforcement.

F. Bond and ground all reinforcement to requirements of Section 26 0526.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 4000 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Concrete for composite floor construction.

C. Floors and slabs on grade.

D. Concrete footings and foundation walls.

E. Joint devices associated with concrete work.

F. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, and flagpole bases.

G. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing.

B. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

C. Section 32 1313 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

C. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.

D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

E. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

F. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

G. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

H. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

I. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

J. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

L. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.

N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.

O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2022a.

P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.

Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

R. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

S. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.

T. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.

U. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

V. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.

W. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

X. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

Y. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

Z. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.

AA. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.

AB. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.

AC. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2021.

AD. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

AE. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.

AF. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2019.

AG. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2018.

AH. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.

AI. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018.

AJ. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.

AK. ASTM D8139 - Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction; 2017.

AL. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

AM. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.

AN. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.

AO. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.

AP. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

AQ. ICC-ES AC380 - Acceptance Criteria for Termite Physical Barrier Systems; 2014, with Editorial Revision (2017).

AR. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
   2. For membrane-forming, moisture emission-reducing, curing and sealing compound, provide manufacturer's installation instructions,.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.
   3. Indicate proposed mix design complies with admixture manufacturer's written recommendations.

D. Samples: Submit samples of underslab vapor retarder to be used.

E. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI PRC-305 when concreting during hot weather.

C. Follow recommendations of ACI PRC-306 when concreting during cold weather.

D. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for first day of placement.

E. For slabs indicated to receive membrane-forming, moisture emission-reducing, curing and sealing compound, do not proceed with application unless manufacturer's representative is present for first day of placement.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches (38 mm) of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 2000.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
   1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.
   1. Acquire aggregates for entire project from same source.

C. Fly Ash: ASTM C618, Class C or F.

D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

G. Accelerating Admixture: ASTM C494/C494M Type C.

H. Retarding Admixture: ASTM C494/C494M Type B.

I. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder:
   1. Sheet Material: ASTM E1745, Class A; 10 mils minimum, stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
   3. Products:
      a. Henry Company; Moistop Ultra 10: www.henry.com/#sle.
      b. Inteplast Group; Barrier-Bac VB-250: www.barrierbac.com/#sle.
      c. ISI Building Products; Viper VaporCheck II 10-mil (Class A): www.isibp.com/#sle.
      d. Poly-America; Husky Yellow Guard Class A 10-mil Vapor Barrier: www.yellowguard.com/#sle.
      e. Stego Industries, LLC; ____: www.stegoindustries.com/#sle.
      f. Tex-Trude, LP; Xtreme Vapor Barrier (10-mil): www.tex-trude.com/#sle.
      g. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com/#sle.
      h. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Height Change, Plastic State; when tested in accordance with ASTM C827/C827M:
      a. Maximum: Plus 4 percent.
      b. Minimum: Plus 1 percent.
   3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch (48 MPa).
   4. Products containing aluminum powder are not permitted.
   5. Flowable Products:
      a. Euclid Chemical Company; NS GROUT: www.euclidchemical.com/#sle.
      b. Five Star Products, Inc; Five Star Fluid Grout 100: www.fivestarproducts.com/#sle.
      c. Kaufman Products Inc; SureGrout: www.kaufmanproducts.net/#sle.
      d. W. R. Meadows, Inc; CG-86: www.wrmeadows.com/#sle.
      e. Substitutions: See Section 01 6000 - Product Requirements.
   6. Low-Slump, Dry Pack Products:
      a. Euclid Chemical Company; DRY PACK GROUT: www.euclidchemical.com/#sle.
      b. Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
      c. SpecChem, LLC; SC Multipurpose Grout: www.specchemllc.com/#sle.

d. Substitutions: See Section 01 6000 - Product Requirements.

2.06 BONDING AND JOINTING PRODUCTS

A. Epoxy Bonding System:
   1. Complying with ASTM C881/C881M and of Type required for specific application.

B. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: 1/2 inch (13 mm) throat, 1/2 inch (13 mm) deep unless otherwise indicated on drawings.

C. Slab Isolation Joint Filler: 1/2-inch (13 mm) thick, height equal to slab thickness, with removable top section forming 1/2-inch (13 mm) deep sealant pocket after removal.
   1. Material: ASTM D1751, cellulose fiber.
   2. Products:
      a. Nomaco, Inc; Nomaflex Expansion Joint Filler with Void Cap Option: www.nomaco.com/#sle.
      b. WE Cork, Inc; Expansion Joints: www.wecork.com/#sle.
      c. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

D. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches (150 mm) on center; ribbed steel stakes for setting.

E. Plate Dowel System: Steel plate dowel and plastic dowel sleeve; with integral fasteners for attachment to formwork.
   1. Manufacturers: As indicated on drawings.
      a. Substitutions: See Section 01 6000 - Product Requirements.

2.07 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
   1. Products:
      a. Dayton Superior Corporation; _____: www.daytonsuperior.com/#sle.
      b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
      c. Kaufman Products Inc; VaporAid: www.kaufmanproducts.net/#sle.
      d. Nox-Crete Inc; Monofilm: www.nox-crete.com/#sle.
      e. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com/#sle.
      f. W. R. Meadows, Inc ; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
      g. Substitutions: See Section 01 6000 - Product Requirements.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
   1. Provide product containing fugitive red dye.

C. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Clear, liquid sealer for application to newly-placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.
   1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
   2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
   3. VOC Content: Less than 100 g/L.
   4. Solids Content: 25 percent, minimum.
   5. Products:
      a. Floor Seal Technology, Inc; VaporSeal 309 System: www.floorseal.com/#sle.
      b. Forta Corporation; _____: www.forta-ferro.com/#sle.
      c. _____.

d. Substitutions: See Section 01 6000 - Product Requirements.

D. Curing and Densifying Compound, Membrane-Forming: Lithium polysilicate-based, clear, liquid densifier for application to newly-placed concrete.
1. Comply with ASTM C309.
2. VOC Content: Less than 50 g/L.
3. Solids Content: 25 percent, minimum.
4. Products:
a. Adhesives Technology Corporation; Pentra-Cure (MH): www.atcepoxy.com/#sle.
b. Green Umbrella Architectural Concrete Systems; SoloCure: www.greenumbrellasystems.com/#sle.
c. Substitutions: See Section 01 6000 - Product Requirements.

E. Moisture-Retaining Sheet: ASTM C171.
1. Curing paper, regular.
2. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch (0.102 mm).
3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard (1.71 kg/sq m).

F. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch (0.102 mm) thick, clear.

G. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
3. Water-Cement Ratio: Maximum 50 percent by weight.
4. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
5. Maximum Slump: 5 inches (___ mm).
6. Maximum Aggregate Size: 3/4 inch (19 mm).

2.09 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Transit Mixers: Comply with ASTM C94/C94M.

C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Prepare existing concrete surfaces to be repaired according to ICRI 310.2R, _____.

E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.

F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

G. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Vapor Retarder Over Drainage Course: Install drainagecourse before placing vapor retarder as indicated on drawings.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI PRC-304.

B. Place concrete for floor slabs in accordance with ACI PRC-302.1.

C. Notify Architect not less than 24 hours prior to commencement of placement operations.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

F. Finish floors level and flat, unless otherwise indicated, within the tolerances specified on the drawings.

3.04 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 1/8" to 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.

F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for compliance with specified tolerances.

B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values: As indicated on the drawings.

C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch (6 mm) or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
   2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.

D. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
   1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI PRC-302.1; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
   2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
   3. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
   2. High early strength concrete: Not less than four days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
      a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
      b. Spraying: Spray water over floor slab areas and maintain wet.
      c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   3. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches (75 mm) and seal with waterproof tape or adhesive; secure at edges.
      b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure four concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed on each day.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 03 4500
PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural precast concrete wall panels with integral insulation.

B. Architectural precast concrete accessories.

C. Grouting under panels.

1.02 RELATED REQUIREMENTS

A. Section 07 2100 - Thermal Insulation: Integral insulation.

B. Section 07 6200 - Sheet Metal Flashing and Trim: Reglets recessed in units.

C. Section 07 9200 - Joint Sealants: Sealing perimeter and intermediate joints.

D. Section 08 1113 - Hollow Metal Doors and Frames.

E. Section 08 9100 - Louvers.

F. Section 23 3000 - Ductwork And Air Outlets: Louvers and Vents.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

G. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2019.

H. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.

I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

J. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2018.

K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.

L. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

M. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

N. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

O. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

P. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2022.

Q. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

R. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2021.

S. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

T. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

U. IAS AC157 - Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete; 2017.

V. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products; 2013.

W. PCI MNL-120 - PCI Design Handbook; 2017, with Errata (2021).

X. PCI MNL-122 - Architectural Precast Concrete: Fully Revised Manual Including New Sections, Extensive Updates, and Detailed Specifications to Meet Today's Construction Needs; 2007.

Y. PCI MNL-123 - Connections Manual: Design and Typical Details of Connections for Precast and Prestressed Concrete; 1988.

Z. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's information on accessory products, including pigments, admixtures, inserts, plates, etc.

C. Shop Drawings: Indicate layout, unit locations, configuration, unit identification marks, reinforcement, integral insulation, insulated panel system connectors, connection details, support items, location of lifting devices, dimensions, openings, and relationship to adjacent materials. Provide erection drawings.
   1. Include details of mix designs.
   2. Include structural design calculations.

D. Samples: Submit two for each type of finish indicated on expoosed surfaces of insulated concrete units., 12x12 inch (____by____ mm) in size, illustrating surface finish, color and texture.

E. Designer's Qualification Statement.

F. Integrally Insulated Panel System Manufacturer's Qualification Statement.

G. Integrally Insulated Panel System Manufacturer's Installation Instructions: Submit manufacturer's current installation instructions for system specified. Certify that copies are available at fabrication site prior to start of precast fabrication

H. Thin Prestressed Panel Manufacturer's Qualification Statement.

I. Fabricator's Qualification Statement: Provide documentation showing precast concrete fabricator is accredited under IAS AC157.

J. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

K. Integrally Insulated Panel System Design Data:
   1. Thermal Resistance: Submit calculations complying with ASHRAE Std 90.1 I-P, isothermal planes method, and demonstrating thermal resistance of integrally insulated panel system.
   2. Dew Point: Submit calculations complying with ASHRAE (FUND). Demonstrate condensation prevention, prevention of frost or ice formation on panels surfaces, and inner wall condensation potential of _____ ounce per day per square foot (_____ ml / day / sq m) or less.

3. Thermal Bowing and Crack Mitigation: Submit drawing details and written procedures for mitigation and repair of bowing and cracking in insulated concrete panels without full-thickness concrete sections or metallic connectors between wythes.

L. Sustainable Design Reporting: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete, mix design(s) used showing the quantity of Portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

M. Maintenance Data: Indicate surface cleaning instructions.

1.06 QUALITY ASSURANCE

A. Design Engineer Qualifications: Design precast concrete units under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.

B. Fabricator Qualifications:
1. Firm having at least 2 years of documented experience in production of precast concrete of the type required.
2. Plant certified under Precast/Prestressed Concrete Institute Plant Certification Program; product group and category A1 - Architectural Precast Concrete.
3. Plant certified under Architectural Precast Association Plant Certification Program for production of architectural precast concrete.
4. Fabricator Qualifications: Precast concrete fabricator accredited by IAS according to IAS AC157.

C. Insulated Panel System Installer Qualifications: Company specializing in fabrication of integrally insulated panel system specified in this section, with not less than three years of experience and approved by system manufacturer.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

E. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handling: Lift and support precast units only from support points.

B. Blocking and Lateral Support During Transport and Storage: Use materials that are clean, non-staining, and non-harmful to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

C. Protect units to prevent staining, chipping, or spalling of concrete.

D. Mark units with date of production in location that will be concealed after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Integrally Insulated Panel System:
1. Basis-of-Design: AltusGroup, Inc; CarbonCast: www.altusprecast.com/#sle.

2.02 PRECAST UNITS, GENERAL

A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI CODE-318.
1. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
2. Calculate structural properties of units in accordance with ACI CODE-318.
3. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

4. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.

B. Finish
   1. Exposed Conditions: Medium Acid Etched on all exposed-to-view surfaces.
   2. Non-Exposed Exterior and Interior Conditions: Steel troweled finish. Finish shall not interfere with the applicaiton of other finishses including signage or paint.

C. Finish Type A: Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance.

2.03 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Deformed billet-steel bars.
   2. Epoxy coated in accordance with ASTM A775/A775M.

B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.
   1. Form: Flat Sheets.

2.04 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal or Type II - Moderate. Portland type.

B. Other Cementitious Materials:
   1. Fly Ash or Natural Pozzolans: Comply with ASTM C618.
   2. Ground Granulated Blast Furnace Slag: ASTM C989/C989M.
   3. Silica Fume: Comply with ASTM C1240.

C. Normal-Weight Aggregates for face and back wythes: Except as modified by PCI MNL 116 or ASTM C 33.

D. Light-Weight Aggregates for back wythes (optional – use if needed to increase panel R-value or reduce superstructure or transportation cost): Except as modified by PCI MNL 116 or ASTM C 33 with absorption less than 11 percent.
   1. If using light-weight back wythe aggregates, similar water-cement and cement-aggregate ratios are recommended for both wythes to limit bowing or warping.

E. Fine and Coarse Structural Aggregates: ASTM C33/C33M.
   1. Fine Aggregate: Light Brown sand.
   2. Course Aggregate: Grey Granite.

F. Surface Finish Aggregate: Complying with sample in office of Architect.

G. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
   1. Color(s): Charcoal.

H. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

I. Fiber Reinforcement: Synthetic fiber shown to be resistant to long-term deterioration when exposed to moisture and alkalis; 1/2 inch (12 mm) length.
   1. Product: CarbonCast manufactured by AltusGroupe, Inc..

J. Air Entrainment Admixture: ASTM C260/C260M.
   1. Water reducing, retarding, accelerating, high range water reducing admixtures: ASTM C494 or C1017.
   2. Viscosity-Modifying Admixture.
   3. Metakaolin Admixture: ASTM C 618, Class N.
   4. Calcium chloride or admixtures containing chlorides shall not be used.

K. Grout:
   1. Non-shrink, non-metallic, minimum 10,000 psi (70 MPa), 28 day strength.

2.05 SUPPORT DEVICES

A. Connecting and Support Devices; Anchors and Inserts: ASTM A36/A36M steel; hot-dip galvanized in accordance with ASTM A153/A153M.

1. Clean surfaces of rust, scale, grease, and foreign matter.

2.06 INSULATION

A. Integral Insulation: Rigid extruded polystyrene (XPS) board insulation.
   1. Design and construct panels to maintain overall u-value of 0.123, with less than one percent change due to penetrations and connections, when calculated in accordance with ASHRAE Std 90.1 I-P, isothermal planes method.

B. Non-Conduction Connectors for Integral Insulation: Corrosion- and alkali-resistant connectors designed and manufactured for use in insulated composite panels.

2.07 FABRICATION

A. Fabricate in compliance with PCI MNL-117 and PCI MNL-135.

B. Fabricate and handle epoxy-coated reinforcing bars in accordance with ASTM D3963/D3963M.

C. Place recessed flashing reglets continuous and straight.

2.08 ACCESSORIES

A. Bearing Pads: High density plastic; Shore A Durometer ____; 1/8 inch (3 mm) thick, smooth both sides.

B. Reglets: Specified in Section 07 6200.

C. Cast-In Structural Thermal Break for Continuously Insulated Panels: Rigid, closed-cell PVC foam connectors; provides thermal break at panel edges as well as door and window openings in panels.

2.09 SOURCE QUALITY CONTROL

A. Provide testing and analysis of concrete mix.

B. Take water absorption test in accordance with PCI MNL-117.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

3.02 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

3.03 ERECTION

A. Erect units without damage to shape or finish. Replace or repair damaged panels.

B. Erect units level and plumb within allowable tolerances.

3.04 TOLERANCES

A. Erect members level and plumb within allowable tolerances. Comply with PCI MNL-135.

3.05 CLEANING

A. Clean exposed surfaces..

B. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.06 PROTECTION

A. Protect installed precast architecural concrete from subsequent construction operations.

END OF SECTION

SECTION 04 2000
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.
B. Concrete building brick.
C. Mortar and grout.
D. Reinforcement and anchorage.
E. Flashings.
F. Lintels.
G. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
B. Section 03 3000 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.
C. Section 04 4313 - Stone Masonry Veneer: Stone bonded to masonry back-up.
D. Section 04 7200 - Cast Stone Masonry. Cast stone cladding.
E. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
F. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2022b.
C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
F. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2022.
G. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
H. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2022.
I. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2022c.
J. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
K. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
L. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
M. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
O. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2020.
P. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

Q. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

R. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, jambs, sashes, movement joints, headers, bonding, and other special conditions.
      a. Provide CMU bullnose corners at exterior corners on interior of building, at locations designated by Architect.
   3. Load-Bearing Units: ASTM C90, lightweight.
      a. Unit Compressive Strength: Provide units with minimum average net area compressive strength of 2000 psi.
      b. Exposed Faces: Special color and texture where indicated, as follows: Standard pattern, ground finish..
      c. Manufacturers:
         1) Basis-of-Design: Johnson Concrete Company.
         2) Oldcastle

2.02 MASONRY LINTELS

A. Masonry Lintels: Made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.

2.03 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type S.
   1. Colored Mortar: Premixed cement as required to match Architect's color sample.

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Grout Aggregate: ASTM C404.

F. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): As selected by Architect from manufacturer's full range.

G. Water: Clean and potable.

2.04 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings; uncoated finish.

B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
   1. Type: Truss or ladder.
   2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3.
   3. Size: 0.1875 inch (4.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

D. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
   3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

2.05 FLASHINGS

A. Metal Flashing Materials: Stainless Steel, as specified in Section 07 6200.

B. Combination Non-Asphaltic Flashing Materials - Stainless Steel:
   1. Stainless Steel Flashing - Self-adhering: ASTM A240/A240M; 2 mil (0.05 mm) type 304 stainless steel sheet with 8 mil (0.20 mm) of butyl adhesive and a removable release liner.
      a. Manufacturers:
         1) Substitutions: See Section 01 6000 - Product Requirements.
   2. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil (0.05 mm) type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
      a. Manufacturers:
         1) Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing: www.h-b.com/#sle.
         2) WIRE-BOND; _____: www.wirebond.com/#sle.
         3) York Manufacturing, Inc; Multi-Flash SS: www.yorkmfg.com/#sle.
         4) Substitutions: See Section 01 6000 - Product Requirements.
   3. Stainless Steel/Polymer Fabric Flashing - Self-adhering: ASTM A240/A240M; 2 mil (0.05 mm) type 304 stainless steel sheet bonded on inward facing side to a sheet of polymer fabric that has a clear adhesive with a removable release liner.
      a. Manufacturers:
         1) Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.
         2) Substitutions: See Section 01 6000 - Product Requirements.
   4. Stainless Steel/Polymer Fabric Drainage Plane Flashing: ASTM A240/A240M; 2 mil (0.05 mm) type 304 stainless steel sheet bonded between one sheet of polymer fabric and one sheet of non-woven drainage material.
      a. Manufacturers:
         1) STS Coatings, Inc; _____: www.stscoatings.com/#sle.
         2) York Manufacturing, Inc; ____: www.yorkmfg.com/#sle.

3) Substitutions: See Section 01 6000 - Product Requirements.

C. Membrane Asphaltic Flashing Materials:
1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) (1.0 mm) minimum total thickness; 8 mil (0.20 mm) cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.
a. Manufacturers:
1) Advanced Building Products, Inc; Strip-N-Flash: www.advancedbuildingproducts.com/#sle.
2) Heckmann Building Products, Inc; ____: www.heckmannbuildingprods.com/#sle
3) WIRE-BOND; _____: www.wirebond.com/#sle.
4) York Manufacturing, Inc; York Seal: www.yorkmfg.com/#sle.
5) Substitutions: See Section 01 6000 - Product Requirements.

2.06 ACCESSORIES

A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.

B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.07 LINTELS

A. Prefabricated Steel Lintels:

2.08 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type S.
2. Exterior, loadbearing masonry: Type N.
3. Exterior, non-loadbearing masonry: Type N.
4. Interior, loadbearing masonry: Type N.
5. Interior, non-loadbearing masonry: Type O.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
1. Coursing and Bond: As indicated for different locations.

2. Mortar Joints: Concave.

3.05 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar and mortar smears as work progresses.

D. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.07 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry Back-Up: Embed anchors in masonry back-up to bond veneer at maximum 1.77 sq ft (0.16 sq m) of wall surface per anchor. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

3.08 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on drawings.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.

3.09 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

B. Extend metal flashings to within 1/2 inch (12 mm) of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

C. Extend plastic, laminated, EPDM, and _____ flashings to within 1/2 inch (12 mm) of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

3.10 LINTELS

A. Maintain minimum ____ inch (____ mm) bearing on each side of opening.

3.11 CLEANING

A. Clean soiled surfaces with cleaning solution.

3.12 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

3.13 SCHEDULES

A. Exterior and Interior Curved Wall: Composite masonry,sizes and patterned as indicated on drawings and Finish Legend:
   1. MV-01: Groundface: Noimal 4"x12"x24". Corner,and special pieces as required at openings and ends of wall and as indicated.
   2. MV-02: Rockface: Noimal 4"x12"x24". Corner,and special pieces as required at openings and ends of wall and as indicated.
   3. MV-03: Chiselface: Nominal 12"x24", 4"x24", 8"x24". Corner,and special pieces as required by drawings.
   4. MV-04 Wall Cap: Finish to be selected by architect. Dimenions as indicated on drawings. Corner,and special pieces as required at openings and ends of wall and as indicated

5. MV-05: refer to, related specification section 04 7200-Cast Stone Masonry. Veneer cladding.
6. MV-06: refer to, related specification section 04 7200-Cast Stone Masonry.Wall Cap/Coping.

END OF SECTION

SECTION 04 2613
MASONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.
B. Concrete facing brick.
C. Mortar and grout.
D. Reinforcement and anchorage.
E. Flashings.
F. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
B. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2022b.
C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
D. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2022.
E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
F. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.
C. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

1.07 MOCK-UP

1.08 FIELD CONDITIONS

PART 2 PRODUCTS

2.01 UNIT MASONRY - GENERAL

2.02 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
    1. Load-Bearing Units: ASTM C90, see section 04 2000-Unit Masonry.
    2. Pre-Faced Units: ASTM C90, solid block, with smooth resinous facing complying with ASTM C744.

B. Manufacturer:
   1. Manufacturer.
      a. Oldcastle, Echelon.
      b. Colors and Styles: [Cordova Stone, Alabaster]. Surface finish as listed below:
         1) MV-01: Chisel Face:
            (a) Size: 4-inch x 12-inch x 24 -inch.
            (b) Corner,and special pieces as required at openings and ends of wall and as indicated.
         2) MV-02: Rockface:
            (a) Size: 4-inch x 12-inch x 24 -inch.
            (b) Corner,and special pieces as required at openings and ends of wall and as indicated.
         3) MV-03: Ground Face:
            (a) Size: 4-inch x 12-inch x 24 -inch.
            (b) Corner,and special pieces as required at openings and ends of wall and as indicated.
         4) MV-04: Coping / Wall Cap: Finiish as indicated on drawings.
            (a) Size: as indicated on drawings.
            (b) Corner,and special pieces as required at openings and ends of wall and as indicated.
      c. Locations indicated on drawings.
      d. Substitutions: Not permitted.

2.03 MORTAR AND GROUT MATERIALS

2.04 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa) yield strength, deformed billet bars; galvanized.

B. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
   3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

2.05 FLASHINGS

A. Metal Flashing Materials: Copper, as specified in Section 07 6200.

B. Combination Non-Asphaltic Flashing Materials - Copper:
   1. Copper/Polymer Film or Fabric Flashing: 3 oz/sq ft (0.915 kg/sq m) copper sheet laminated between two sheets of polymer or fiberglass fiber-reinforced film.
   2. Copper/Polymer Film or Fabric Flashing - Self-Adhering: 3 oz/sq ft (0.915 kg/sq m) copper sheet bonded on inward facing side to a sheet of polymer or fiberglass fabric that has a clear adhesive with a removable release liner.
   3. Copper/Polymer Fabric Drainage Plane Flashing System: 3 oz/sq ft (0.915 kg/sq m) copper sheet bonded with rubber-based adhesive between one sheet of polymer fabric and one sheet of non-woven drainage material.

C. Combination Non-Asphaltic Flashing Materials - Stainless Steel:
   1. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil (.05 mm) type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
      a. Manufacturers:
         1) Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.
         2) WIRE-BOND; _____: www.wirebond.com/#sle.
         3) York Manufacturing, Inc; Multi-Flash SS: www.yorkmfg.com/#sle.
         4) Substitutions: See Section 01 6000 - Product Requirements.

2. Stainless Steel/Polymer Fabric Flashing - Self-Adhering: ASTM A240/A240M; 2 mil (.05 mm) type 304 stainless steel sheet bonded on inward facing side to a sheet of polymer fabric that has a clear adhesive with a removable release liner.
   a. Manufacturers:
      1) Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.
      2) Substitutions: See Section 01 6000 - Product Requirements.
3. Stainless Steel/Polymer Fabric Drainage Plane Flashing: ASTM A240/A240M; 2 mil (.05 mm) type 304stainless steel sheet bonded between one sheet of polymer fabric and one sheet of non-woven drainage material.
   a. Manufacturers:
      1) STS Coatings, Inc; _____: www.stscoatings.com/#sle.
      2) York Manufacturing, Inc; Flash-Vent SS: www.yorkmfg.com/#sle.
      3) Substitutions: See Section 01 6000 - Product Requirements.
4. Stainless Steel/Polymer Fabric Drainage Plane Flashing - Self-Adhering: ASTM A240/A240M; 2 mil (.05 mm) type 304 stainless steel sheet with 8 mil (0.20 mm) of butyl adhesive and a removable release liner on one side and a sheet of non-woven drainage material bonded to the other side.
   a. Manufacturers:
      1) York Manufacturing, Inc; _____: www.yorkmfg.com/#sle.
      2) Substitutions: See Section 01 6000 - Product Requirements.

D. Membrane Asphaltic Flashing Materials:
   1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) (1.0 mm) minimum total thickness; 8 mil (0.20 mm) cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.
      a. Manufacturers:
         1) Advanced Building Products, Inc; _____: www.advancedbuildingproducts.com/#sle.
         2) Heckmann Building Products, Inc; ____: www.heckmannbuildingprods.com/#sle
         3) Substitutions: See Section 01 6000 - Product Requirements.

2.06 ACCESSORIES

A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.

B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.07 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, Proportion Specification.
   1. Masonry below grade and in contact with earth; Type S.
   2. Exterior, non-loadbearing masonry; Type N.
   3. Interior, non-loadbearing masonry; Type O.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Coursing and bond as indicated on drawings.
   2. Mortar Joints: Concave.

3.03 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar as work progresses.

D. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

E. Isolate top joint of masonry veneer from horizontal structural framing members or support angles with compressible joint filler.

3.04 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.

D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.05 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

3.06 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

3.07 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

3.08 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.

3.09 CUTTING AND FITTING

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.10 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Clean soiled surfaces with cleaning solution.

C. Use non-metallic tools in cleaning operations.

3.11 PROTECTION

3.12 SCHEDULES

A. Exterior and Interior Curved Wall: Composite masonry sizes and locations as patterned and indicated on drawings and Finish Legend.
   1. MV-01: Chisel Face: Noimal 4"x12"x24". Corner,and special pieces as required at openings and ends of wall and as indicated.
   2. MV-02: Rock Face: Noimal 4"x12"x24". Corner,and special pieces as required at openings and ends of wall and as indicated.
   3. MV-03A: Ground Face: Nominal 12"x24", 4"x24", 8"x24". Corner,and special pieces as required by drawings.

4. MV-03B: Ground Face: Nominal 12"x24", 4"x24", 8"x24". Corner,and special pieces as required by drawings.
5. MV-03C: Ground Face: Nominal 12"x24", 4"x24", 8"x24". Corner,and special pieces as required by drawings.
6. MV-04 Wall Cap: Finish to be selected by architect. Dimenions as indicated on drawings. Corner,and special pieces as required at openings and ends of wall and as indicated.
7. MV-05: refer to, related specification section 04 7200-Cast Stone Masonry.
8. MV-06: refer to, related specification section 04 7200-Cast Stone Masonry.

END OF SECTION

SECTION 04 7200
CAST STONE MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural cast stone.

B. Units required are indicated on drawings as "cast stone".

C. Units required are:
   1. Exterior and interior wall cladding..

1.02 RELATED REQUIREMENTS

A. Section 04 0511 - Masonry Mortaring and Grouting: Mortar for setting cast stone.

B. Section 04 2000 - Unit Masonry: Installation of cast stone in conjunction with masonry.

C. Sectuib 05 4000 - Cold Formed Metal Framing: Framing for exterior and interall walls.

D. Section 07 9200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2019.

D. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2019, with Editorial Revision (2020).

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.

G. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

J. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete; 2021.

K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

L. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Test results of cast stone components made previously by the manufacturer.
   1. Include one copy of ASTM C1364 for Architect's use.

C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.

D. Verification Samples: Pieces of actual cast stone components not less than 6 inches (152 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.

E. Source Quality Control Test Reports.

F. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

1.05 QUALITY ASSURANCE

1.06 MOCK-UPS

A. Provide full size cast stone components for installation in mock-up of exterior wall.

B. See Section 01 4000 - Quality Requirements for additional requirements.

C. Approved mock-up will become standard for appearance and workmanship.

D. Mock-up may remain as part of the completed work.

E. Remove mock-up not incorporated into the work and dispose of debris.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.

B. Number each piece individually to match shop drawings and schedule.

C. Store cast stone components and installation materials in accordance with manufacturer's instructions.

D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.

E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.

F. Store mortar materials where contamination can be avoided.

G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Architectural Cast Stone:
   1. Any current producer member of the Cast Stone Institute.
   2. Basis-Of Design: RockCast Pewter GP-C, by Reading Rock, Inc..
   3. Dimensions as indicated on drawings.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ARCHITECTURAL CAST STONE

A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural granite, complying with ASTM C1364.
   1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
   2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
   3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
   4. Color: Selected by Architect from manufacturer's full range.
   5. Remove cement film from exposed surfaces before packaging for shipment.

B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.
      c. Raised fillets at back of sills and at ends to be built in.

C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.

2.03 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. For Units: Type I or II, white.
   2. For Mortar: Type I or II, except Type III may be used in cold weather.

B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.

C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.

D. Pigments: ASTM C979, inorganic iron oxides; do not use carbon black.

E. Admixtures: ASTM C494/C494M.

F. Water: Potable.

G. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed bars, galvanized.
   1. Galvanized in accordance with ASTM A767/A767M, Class I.

H. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.

I. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.

J. Mortar: Portland cement-lime, as specified in Section 04 0511; do not use masonry cement.

K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.04 SOURCE QUALITY CONTROL

A. Test compressive strength and absorption of specimens selected at random from plant production.
   1. Test in accordance with ASTM C642.
   2. Select specimens at rate of 3 per 500 cubic feet (3 per 14 cubic m), with a minimum of 3 per production week.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 2000.

B. Mechanically anchor cast stone units indicated; set remainder in mortar.

C. Setting:
   1. Drench cast stone components with clear, running water immediately before installation.
   2. Set units in a full bed of mortar unless otherwise indicated.
   3. Fill vertical joints with mortar.
   4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.03 TOLERANCES

A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
   1. Rake mortar joints 3/4 inch (19 mm) for pointing.
   2. Remove excess mortar from face of stone before pointing joints.

3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
4. Leave the following joints open for sealant:
   a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
   b. Joints in projecting units.
   c. Joints between rigidly anchored units, including soffits, panels, and column covers.
   d. Joints below lugged sills and stair treads.
   e. Joints below ledge and relieving angles.
   f. Joints labeled "expansion joint".

B. Installation Tolerances:
1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.04 REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).

B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.

C. Repair methods and results subject to Architect 's approval.

3.05 CLEANING

A. Keep cast stone components clean as work progresses.

B. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.06 PROTECTION

A. Protect completed work from damage.

B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

3.07 SCHEDULE

A. MV-05: RockCast: Noimal 4""x16"x24". Corner,and special pieces as required by drawings.

B. MV-06: RockCast: Wall Cap/Coping as indicated on drawings. Corner,and special pieces as required by drawings.

END OF SECTION

SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members.

B. Structural steel support members and struts.

C. Base plates, shear stud connectors.

D. Grouting under base plates.

1.02 RELATED REQUIREMENTS

A. Section 05 1213 - Architecturally-Exposed Structural Steel Framing: Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

B. Section 05 2100 - Steel Joist Framing.

C. Section 05 3100 - Steel Decking: Support framing for small openings in deck.

D. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

E. Section 07 8100 - Applied Fire Protection: Fireproof protection to framing systems.

1.03 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; 2017.

B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

I. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2014 (Reapproved 2020).

J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.

K. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

M. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

N. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

O. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.

P. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.

Q. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.

R. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2018.

S. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.

T. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.

U. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series; 2017a.

V. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

W. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.

X. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

Y. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

Z. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

AA. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

AB. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.

AC. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

AD. SSPC-SP 2 - Hand Tool Cleaning; 2018.

AE. SSPC-SP 3 - Power Tool Cleaning; 2018.

AF. SSPC-SP 7 - Brush-Off Blast Cleaning; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

D. Fabricator Test Reports: Comply with ASTM A1011/A1011M.

E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 1213.

C. Maintain one copy of each document on site.

D. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

F. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

G. Erector: Company specializing in performing the work of this section with minimum _____ years of documented experience.

H. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles, Plates, and Channels: ASTM A36/A36M.

B. Steel W Shapes and Tees: ASTM A992/A992M.

C. Rolled Steel Structural Shapes: ASTM A992/A992M.

D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.

E. Pipe: ASTM A53/A53M, Grade B, Finish black.

F. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.

H. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.

I. Headed Anchor Rods: ASTM F1554, Grade 36, plain.

J. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.

K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

L. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).
   3. Height Change, Plastic State; when tested according to ASTM C827/C827M:
      a. Maximum: Plus 4 percent.
      b. Minimum: Plus 1 percent.

M. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

N. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Fabricate connections for bolt, nut, and washer connectors.

2.03 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 3.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

2.04 SOURCE QUALITY CONTROL

A. Welded Connections: Visually inspect all shop-welded connections and test as indicated in the drawings.____

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

E. Do not field cut or alter structural members without approval of Architect.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections as indicated in the drawings and in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts," ____

C. Welded Connections: Visually inspect all field-welded connections and test as indicated on the drawings. ____

END OF SECTION

SECTION 05 1213

ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: General requirements for structural steel members, including AESS framing specified in this section.

B. Section 05 2100 - Steel Joist Framing: Alignment and location of bridging where joists are visible.

C. Section 05 3100 - Steel Decking: Erection requirements relating to exposed steel decking and its connections.

D. Section 05 5000 - Metal Fabrications: Loose steel bearing plates and miscellaneous steel framing.

E. Section 07 8100 - Applied Fire Protection: Fireproof protection to framing and metal deck systems.

F. Section 09 9113 - Exterior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.

G. Section 09 9123 - Interior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.

H. Section 09 9600 - High-Performance Coatings: Finish coat requirements and coordination with primer and surface preparation specified in this section.

1.03 DEFINITIONS

A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.

1.04 REFERENCE STANDARDS

A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022.

B. AISC 325 - Steel Construction Manual; 2017.

C. AISC 360 - Specification for Structural Steel Buildings; 2022.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.

F. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2022.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.

I. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

J. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2015.

K. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum

Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.

M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

P. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

Q. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 ADMINISTRATIVE REQUIREMENTS

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product data for each type of product specified. Submit paint systems in accordance with Section 09 9113.

C. Shop Drawings: Detailing for fabrication of AESS components.
   1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
   2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
   3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.
   4. Indicate orientation of hollow structural section (HSS) seams and mill marks (where applicable).
   5. Indicate type, size, finish and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Indicate orientation of bolt heads.
   6. Indicate which surfaces or edges are exposed and what class of surface preparation is being used.
   7. Indicate special tolerances and erection requirements as noted on drawings or defined by the designated AESS category.
   8. Indicate vent or drainage holes for HSS members.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.07 QUALITY ASSURANCE

A. Fabricator Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.

B. Erector Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.

C. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work..

D. Comply with applicable provisions of AISC 303, Section 10 for the designated AESS category.

E. Owner to engage a quality assurance agency per requirements of AISC 360, Chapter N and AISC 303, Section 10.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Comply with Section 05 1200, except as amended in this section for aesthetic purposes.

B. Comply with AISC 303, Section 10 for specific AESS category designated on drawings.

2.02 FABRICATION

A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.

B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.

C. For curved structural members, whether composed of a single standard structural shape or built-up, the as-fabricated variation from theoretical curvature to be equal to or less than standard camber and sweep tolerances permitted for straight members in applicable ASTM standard.

D. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.

E. Bolted Connections:

F. Welded Connections:
   1. Comply with AWS D1.1/D1.1M and Section 05 1200.
   2. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerances of this section.

G. Surface Preparation:
   1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
   2. Remove backing and run out tabs.

H. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
   1. AESS 1: Basic elements.
   2. AESS 2: Feature elements viewed at a distance greater than 20 feet (6 m) (feature elements not in close view).

2.03 PAINT SYSTEM

A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Sections 09 9113, 09 9123, and 09 9600. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.

B. Primer: As specified in Sections 09 9113, 09 9123, and 09 9600. Primer to comply with all federal standards for VOC, lead and chromate levels.

C. Finish Coating: Field apply intermediate and top coats per Sections 09 9113, 09 9123, and 09 9600.

2.04 SHOP PRIMING

A. Surface Preparation:
   1. Provide surface preparations to meet SSPC-SP 6.
   2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
   3. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
   4. Remove weld spatter, slivers and similar surface discontinuities.
   5. Ease sharp corners resulting from shearing, flame cutting or grinding.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted with slip-critical connections.
   1. Extend priming of members partially embedded in concrete or mortar to a depth of 2 inches (50.8 mm).

C. Priming: Immediately after surface preparation, apply primer according to manufacturer92s instructions to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

2.05 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to ASTM A123/A123M. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

2.06 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Structural Requirements:
   1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 1200 for additional requirements.
   2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.

C. AESS 1 and 2 Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.02 PREPARATION

A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.

B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

A. AESS 1 and 2: Basic elements; feature elements not in close view:
   1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.

2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
6. Remove all backing and run out tabs.
7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
9. Welded Connections: Comply with AWS D1.1/D1.1M and Section 05 1200. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
10. Remove weld spatter exposed to view.
11. Grind off projections larger than 1/16 inch (1.5875 mm) at field butt and plug welds.
12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.
13. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
14. Splice members only where indicated.
15. Obtain permission for any torch cutting or field fabrication from Architect. Finish sections thermally cut during erection to a surface appearance consistent with mock-up.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Structural Requirements:
   1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 1200 for additional requirements.
   2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.

C. AESS 1 and 2 Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.05 CLEANING

A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 09 9113, 09 9123, and 09 9600.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas. Repair galvanized surfaces in accordance with ASTM A780/A780M.

C. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION

SECTION 05 2100
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.

B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.

C. Supplementary framing for floor and roof openings greater than 18 inches (450 mm).

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.

B. Section 05 1200 - Structural Steel Framing: Superstructure framing.

C. Section 05 3100 - Steel Decking: Bearing plates and angles.

D. Section 05 3100 - Steel Decking: Support framing for openings less than 18 inches (450 mm) in decking.

E. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

E. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

F. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.

G. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.

H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

K. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders; 2020.

L. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; 2008.

M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

N. SSPC-SP 2 - Hand Tool Cleaning; 2018.

O. SSPC-SP 3 - Power Tool Cleaning; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

D. Designer's Qualification Statement.

E. Manufacturer's Qualification Statement.

F. Erector's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI 100 Standard Specifications Load Tables and SJI Technical Digest No. 9.
   1. Maintain one copy of document on site.

C. Manufacturer Qualifications: Steel Joist Institute member company specializing in performing the work of this section with minimum 5 years documented experience.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.

E. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

F. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Joists:
   1. New Millennium Building Systems: www.newmill.com/#sle.
   2. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Open Web Joists: SJI Type K Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
   3. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
   4. Finish: Shop primed.

B. Anchor Bolts, Nuts and Washers: ASTM A307, hot-dip galvanized per ASTM A153/A153M, Class C.

C. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.

D. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.03 FINISH

A. Shop prime joists as specified.

B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 ERECTION

A. Erect joists with correct bearing on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.

D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

E. Install supplementary framing for roof openings greater than 18 inches (450 mm).

F. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

G. Do not field cut or alter structural members without approval of joist manufacturer.

H. After erection, prime welds, damaged shop primer, and surfaces not shop primed, except surfaces specified not to be primed.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm).

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

END OF SECTION

SECTION 05 3100
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof deck.

B. Composite floor deck.

C. Supplementary framing for openings up to and including 18 inches (450 mm).

D. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing.

B. Section 03 3000 - Cast-in-Place Concrete: Concrete topping over metal deck.

C. Section 03 4100 - Precast Structural Concrete: Placement of embedded steel anchors, dovetail slots, bearing plates, joist seats and other steel connectors in precast concrete.

D. Section 04 2000 - Unit Masonry: Placement of anchors for bearing plates embedded in unit masonry assemblies.

E. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches (450 mm).

F. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.

G. Section 05 2100 - Steel Joist Framing: Support framing for openings larger than 18 inches (450 mm).

H. Section 05 2100 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.

I. Section 05 5000 - Metal Fabrications: Steel angle concrete stops at deck edges.

J. Section 26 0533.16 - Boxes for Electrical Systems: Electrical, telephone, and _____ floor outlets, sleeves, and gaskets.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

D. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

G. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

K. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

L. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; 2022.

M. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

D. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:
1. New Millennium Building Systems; ____: www.newmill.com/#sle.
2. Nucor-Vulcraft Group; ____: www.vulcraft.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
1. Calculate to structural working stress design and structural properties specified.
2. Maximum Vertical Deflection of Floor Deck: 1/360 of span.

B. Roof Deck: Non-composite type, fluted steel sheet:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
2. Minimum Base Metal Thickness: 22 gauge, 0.0299 inch (0.76 mm).
3. Nominal Height: 1-1/2 inch (38 mm) and 3 inch.
4. Profile: Fluted; SDI WR.
5. Formed Sheet Width: 24 inch (600 mm) for 3" deck and 36" for 1 1/2" deck.

6. Side Joints: Lapped, mechanically fastened.
7. End Joints: Lapped, welded.

C. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
2. Span Design: Double.
3. Minimum Base Metal Thickness: 20 gauge, 0.0359 inch (0.91 mm).
4. Nominal Height: 3 inches (76 mm).
5. Formed Sheet Width: 36 inch (900 mm).
6. Side Joints: Lapped, mechanically fastened.

2.03 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.

B. Welding Materials: AWS D1.1/D1.1M.

C. Fasteners: Galvanized hardened steel, self tapping.

D. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM)SDI design method for roof deck and floor deck applications and ICC-ES AC43.

E. Flute Closures: Closed cell foam rubber, 1 inch (25 mm) thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gauge, 0.0299 inch (0.76 mm) thick sheet steel; of profile and size as indicated; finished same as deck.

B. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch (1.90 mm) minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches (38 mm) below roof deck surface, bearing flange 3 inches (75 mm) wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch (100 mm) bearing.

C. On steel supports provide minimum 1-1/2 inch (38 mm) bearing.

D. Fasten deck to steel support members at ends and intermediate supports at 12 inches (300 mm) on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
1. Welding: Use fusion welds through weld washers.

E. At mechanically fastened male/female side laps fasten at 24 inches (600 mm) on center maximum unliess indicated otherwise on the drawings.

F. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

G. At welded male/female side laps weld at 18 inches (450 mm) on center maximum.

H. Weld deck in accordance with AWS D1.3/D1.3M.

I. At deck openings from 6 inches (150 mm) to 18 inches (450 mm) in size, provide 2 by 2 by 1/4 inch (50 by 50 by 6 mm) steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

J. At deck openings greater than 18 inches (450 mm) in size, provide steel angle reinforcement. as specified in Section 05 1200.

K. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

L. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

M. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

N. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

O. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION

SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud exterior wall and interior wall framing.

B. Exterior wall sheathing.

C. Formed steel joist and purlin framing and bridging.

D. Water-resistive barrier over sheathing.

1.02 RELATED REQUIREMENTS

A. Section 04 2613 - Masonry Veneer: Veneer masonry supported by wall stud metal framing.

B. Section 05 3100 - Steel Decking.

C. Section 07 2100 - Thermal Insulation: Insulation within framing members.

D. Section 07 6200 - Sheet Metal Flashing and Trim: Head and sill flashings.

E. Section 07 9200 - Joint Sealants.

F. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

G. Section 09 5100 - Acoustical Ceilings: Ceiling suspension system.

1.03 DEFINITIONS

A. General: See AISI S240 for definitions of terms used in this section.

B. Connection: A combination of structural elements and joints used to transmit forces between two or more members.

C. Connector: A device used to transmit forces between cold-formed steel structural members or between a cold-formed steel structural member and another structural element.

1.04 REFERENCE STANDARDS

A. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

H. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

I. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; 2016, with Editorial Revision (2021).

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on cold-formed steel structural members; include material descriptions and base steel thickness.

C. Product Data: Provide manufacturer's data on factory-made connectors and mechanical fasteners, showing compliance with requirements.

D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
   1. Indicate stud and ceiling joist layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
   3. Design Data:
      a. Shop drawings signed and sealed by a professional structural engineer.

E. Steel Framing Industry Association (SFIA) Certification:
   1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.
   2. Submit current documentation of contractor accreditation and installer certification. Keep copies of each on-site during and after installation, and present upon request.
   3. Design Data:
      a. Shop drawings signed and sealed by a professional structural engineer.
   4. Design calculations sufficient to demonstrate compliance with design criteria; signed and sealed by a professional structural engineer.
   5. Details and calculations for factory-made connectors, signed and sealed by a professional structural engineer.

F. Evaluation Service Reports: Provide reports indicating compliance with specified requirements for cold-formed steel structural members.

G. Inspection Reports: Provide material verification Inspection Reports in accordance with requirements of AISI S240.

H. Inspection Reports: Provide Inspection Reports for welding, mechanical fastening, and cold-formed steel light-frame construction in accordance with requirements of AISI S240.

I. Manufacturer's Installation Instructions: Provide installation instructions for connections. Indicate special procedures, conditions requiring special attention. .

J. Installation Drawings: Indicate dimensioned locations of cold-formed steel structural framing.

K. Designer's Qualification Statement.

L. Manufacturer's Qualification statement.

M. SSMA Manufacturer Qualification: Submit documentation of manufacturer association membership.

N. SSFSA Manufacturer Qualification: Submit documentation of manufacturer association membership.

1.07 QUALITY ASSURANCE

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Designer Qualifications: Design framing system under direct supervision of a professional structural engineer experienced in designing this work and licensed in the State in which the Project is located.

C. SFIA Code Compliance Certification Program: www.CFsteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.

D. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

E. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

F. Manufacturer Qualifications: Member of Supreme Steel Framing System Association (SSFSA): www.ssfsa.com/#sle.

G. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.

H. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
   1. ClarkDietrich; _____: www.clarkdietrich.com/#sle.
   2. MarinoWARE; ____: www.marinoware.com/#sle.
   3. The Steel Network, Inc; _____: www.SteelNetwork.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Connectors:
   1. Same manufacturer as metal framing.

2.02 PERFORMANCE REQUIREMENTS

A. Comply with requirements for Contractor's design-related professional design services indicated in Section 01 4000 - Quality Requirements.

B. Design Criteria: As indicated on drawings and in accordance with applicable codes..
   1. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   2. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Fabrication:
   1. Shop-fabricate cold-formed framing systems and connectors to the greatest extent possible.
   2. Deliver to project site in largest practical sections.

2.03 MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: CP 60 in accordance with AISI S240.

2.04 STRUCTURAL FRAMING COMPONENTS

A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.
   1. Thickness and Depth: Depth as indicated on the drawings; thickness and structural grade as required to meet design criteria. Exterior wall and soffit components shall have a minimum thickness of 43 mils.

B. Jamb Studs: AISI S240; manufactured, engineered, c-shaped with wide flanges, designed to replace conventional double-stud framing at openings.

C. Headers: AISI S240; manufactured, engineered one-member or two-member assemblies, with wide flanges, designed to replace conventional box or nested header framing at openings.
   1. Jamb Mounting Clips: Manufacturer's standard.
   2. Cripple Stud Clips: Manufacturer's standard.

D. Purlins: AISI S240; manufactured c-shaped sections.

2.05 CONNECTIONS

A. Performance Requirements: Provide connections in compliance with requirements of AISI S240.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: CP 60 in accordance with AISI S240.

C. Structural Performance: Maintain load and movement capacity required by applicable building code and specified design criteria.

D. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
   1. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch (13 mm).
   2. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch (13 mm).
   3. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet (3048 mm).

E. Fixed Connections: Provide nonmovement devices for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

F. Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connectors where indicated on the drawings.

2.06 MISCELLANEOUS CONNECTIONS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: Powder actuated.

C. Welding: Comply with AWS D1.1/D1.1M.

2.07 SHEATHING

A. Gypsum Board Wall Sheathing: See Section 09 2116.

2.08 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.

C. Water-Resistive Barrier: ICC-ES AC38 Grade D and 60-minute plastic sheet.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

A. Structural Wall Foundations: For gaps between wall bottom track and top of foundation 1/4 inch (6.4 mm) or greater, level substrate with loadbearing shims or grout between track and foundation.

3.03 INSTALLATION - GENERAL

A. Install structural members and connections in compliance with ASTM C1007.

3.04 INSTALLATION OF STUDS

A. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

B. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.

C. Install load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.

D. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

E. Install intermediate studs above and below openings to align with wall stud spacing.

F. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.

G. Attach cross studs to studs for attachment of fixtures anchored to walls.

H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

I. Touch-up field welds and damaged corrosion-protected surfaces zinc-rich paint in compliance with ASTM A780/A780M.

3.05 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.

D. Touch-up field welds and damaged galvanized surfaces with primer.

3.06 INSTALLATION OF WALL SHEATHING

A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.

3.07 FIELD QUALITY CONTROL

A. Provide material verification inspections in accordance with requirements of AISI S240.

B. Provide inspections for welding, mechanical fastening, and cold-formed steel light-frame construction in accordance with requirements of AISI S240.

3.08 TOLERANCES

A. Studs - Vertical Alignment (Plumbness): 1/960 of span, or 1/8 inch in 10 ft (3.2 mm in 3000 mm), in accordance with ASTM C1007.

B. Stud Spacing: 1/8 inch (3.2 mm) from the designated spacing, provided that the cumulative error does not exceed the requirements of the finishing materials in accordance with ASTM C1007.

END OF SECTION

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim

B. Section 08 4413 - Aluminum-Framed Storefront: Coordinated adjacent construction and finish.

C. Section 08 4413 - Glazed Curtain Walls: Coordinated adjacent construction and finish.

1.02 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2200 - Unit Prices, for additional requirements.

1.03 REFERENCE STANDARDS

A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

G. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.

M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

O. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

C. Samples:Submit two samples of each accessory, illustrating color and finish.
1. Provide two samples indicating each metal thickness.
2. Provide two samples each color and finish.

D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Stainless Steel, General: ASTM A666, Type 304.

F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch (1.59 mm) minimum metal thickness, 1-1/2 inch (38 mm) diameter.

G. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

H. Slotted Channel Fittings: ASTM A1011/A1011M.

I. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

J. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

K. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

M. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

N. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Aluminum Corner Column Covers: As part of exterior at corners of exterior glazed aluminum curtain walls

B. Dimenions: As indicated on drawings and as required to in coordination design of aluminum glazed curatin wall design.

C. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

D. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.05 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Same, to match, adjacent aluminum glazed curtain wall..

B. Interior Aluminum Surfaces: Same, to match, adjacent aluminum glazed curtain wall..

2.06 FABRICATION TOLERANCES

A. Items to be part of assembled alumiunum curtain wall
   1. Corner angles are specific, atypical, and vary by location specific. See details.
   2. Coordinate alignment and dimensions with aluminum curtain wall system.

B. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.

C. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

D. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).

E. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

F. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/8 inch (3 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/8 inch (3 mm).

C. Maximum Out-of-Position: 1/8 inch (3 mm).

END OF SECTION

SECTION 05 5100
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.

B. Structural steel stair framing and supports.

C. Handrails and guards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete fill in stair pans.

B. Section 03 3000 - Cast-in-Place Concrete: Placement of metal anchors in concrete.

C. Section 04 2000 - Unit Masonry: Placement of metal fabrications in masonry.

D. Section 05 5000 - Metal Fabrications.

E. Section 05 5213 - Pipe and Tube Railings: Metal handrails for the stairs specified in this section.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2022.

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.

J. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

K. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

L. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

N. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.

O. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

P. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

R. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

S. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

T. NAAMM AMP 510 - Metal Stairs Manual; 1992.

U. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

V. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

W. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Design Data: As required by authorities having jurisdiction.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
   2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
   3. Structural Design: Provide complete stair and railing assemblies that comply with the following:
      a. Stair Capacity: Uniform live load of 100 lb/sq ft (4.7 kPa) and a concentrated load of 300 lb (14.4 kg) with deflection of stringer or landing framing not to exceed 1/360 of span.
      b. Railing Assemblies: Comply with applicable local code.

4. Dimensions: As indicated on drawings.
5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
7. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
a. Welded Joints: Continuously welded and ground smooth and flush.
b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
c. Exposed Edges and Corners: Eased to small uniform radius.
d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
1. Concrete Depth: 1-1/2 inches (38 mm), minimum.
2. Tread Pan Material: Steel sheet.
3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch (1.9 mm) minimum.
4. Concrete Reinforcement: Welded wire mesh.
5. Concrete Finish: For resilient floor covering.

D. Risers: Same material and thickness as tread pans.
1. Nosing Depth: Not more than 1-1/2 inch (38 mm) overhang.
2. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch (12 mm) wide.

E. Stringers: Rolled steel channels.
1. Stringer Depth: 10 inches (250 mm).
2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Railings: Steel pipe railings.

G. Finish: Shop- or factory-prime painted.

2.03 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
1. Outside Diameter: 1-1/4 inch (32 mm), minimum, to 1-1/2 inches (38 mm), maximum.

B. Guards:
1. Top Rails: Round pipe or tube rails unless otherwise indicated.
a. Outside Diameter: 1-1/4 inch (32 mm), minimum, to 1-1/2 inches (38 mm), maximum.
2. Infill at Pipe Railings: Pipe or tube rails sloped parallel to stair.
a. Outside Diameter: 1 inch (25 mm).
b. Material: Steel pipe or tube, round.
c. Vertical Spacing: Maximum 4 inches (100 mm) on center.
d. Jointing: Welded and ground smooth and flush.
3. End and Intermediate Posts: Same material and size as top rails.
a. Horizontal Spacing: As indicated on drawings.
b. Mounting: Welded to top surface of stringer.

2.04 MATERIALS

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.

C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).

E. Concrete Reinforcement: Mesh type as detailed, galvanized.

2.05 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.

B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, and comply with VOC limitations of authorities having jurisdiction.

2.06 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
   2. Number of Coats: One.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.

B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

E. Obtain approval prior to site cutting or creating adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

END OF SECTION

SECTION 05 5133
METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop-fabricated metal ladders.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

C. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

D. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

E. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

A. Design roof ladder under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
   1. Side Rails: 3/8 by 2 inches (9 by 50 mm) members spaced at 20 inches (500 mm).
   2. Rungs: One inch (25 mm) diameter solid round bar spaced 12 inches (300 mm) on center.
   3. Space rungs 7 inches (175 mm) from wall surface.

B. Ladder to accomdate fall arrest system in complaince with current OSHA requirements.

2.04 FINISHES - STEEL

A. Prime paint steel items.
   1. Do not prime surfaces where field welding is required.
B. Prepare surfaces to be primed in accordance with SSPC-SP2.
C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
D. Factory prime and field paint interior ladders.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

SECTION 05 5213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted handrails.

B. Stair railings and guardrails.

C. Free-standing railings at steps.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.

E. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

F. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.

G. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

H. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications; 2021.

I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.04 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Allow for expansion and contraction of members and building movement without damage to connections or members.

C. Dimensions: See drawings for configurations and heights.

D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

E. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.03 ALUMINUM MATERIALS

A. Aluminum Tube: Minimum wall thickness of 0.127 inch (3.2 mm); ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.

B. Solid Bars and Flats: ASTM B211/B211M.

C. Non-Weld Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

D. Exposed Fasteners: No exposed bolts or screws.

2.04 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M, Grade B Schedule 80, black finish.

C. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

E. Exposed Fasteners: No exposed bolts or screws.

F. Galvanizing: In accordance with requirements of ASTM A123/A123M.
   1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.05 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

2.06 ALUMINUM FINISHES

A. Color: To be selected by Architect from manufacturer's standard line.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SECTION 05 7000
DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal surfaces at reception desk.

1.02 RELATED REQUIREMENTS

A. Section 06 2000 - Finish Carpentry: Wood handrail.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.

C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

D. Prior to installation, store materials and components under cover in a dry location.

1.06 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).

B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

PART 2 PRODUCTS

2.01 PRODUCT AND MANUFACTURER

A. Basis-Of-Design: Forms + Surfaces
   1. Manufacturerer: Forms + Surfaces
   2. Material: Stainless Steel.
   3. Thickness: 0.8mm
   4. Style/Finish: Linen.
   5. Color: Stainless Steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

E. Furnish components to be installed in other work to installer of that other work, including but not supports and attachments.

3.02 PREPARATION

A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.

B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

A. Comply with manufacturer's drawings and written instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.04 PROTECTION

A. Protect installed components and finishes from damage after installation.

B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.

1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 06 1053
MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preservative treated wood materials.

B. Fire retardant treated wood materials.

C. Communications and electrical room mounting boards.

D. Concealed wood blocking, nailers, and supports.

E. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).

C. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).

D. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2023.

G. PS 1 - Structural Plywood; 2019.

H. PS 20 - American Softwood Lumber Standard; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No.2 or Standard Grade.
   2. Boards: Standard or No.3.

2.03 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1, A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

B. Gallery Walls for Exhibition Mounting as indicated on drawings: PS 1, A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

B. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Do not use treated wood in direct contact with ground.
   2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature, low hygroscopic type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Interior rough carpentry items are to be fire retardant treated.
      c. Treat rough carpentry items as indicated.
      d. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to .10 lb/cu ft retention (to .31 kg/cu m retention).

a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
b. Treat lumber exposed to weather.
c. Treat lumber in contact with roofing, flashing, or waterproofing.
d. Treat lumber in contact with masonry or concrete.
e. Treat lumber less than 18 inches (450 mm) above grade.

PART 3 EXECUTION

3.01 PREPARATION

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.06 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.07 CLEANING

A. Waste Disposal: See Section 01 7419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 2000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

1.02 RELATED REQUIREMENTS

A. Section 01 6200 - Architectural Wood Casework, Wood Faced Cabinet.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).

B. ANSI A208.1 - American National Standard for Particleboard; 2022.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

D. BHMA A156.9 - Cabinet Hardware; 2020.

E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

F. PS 1 - Structural Plywood; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, installation of associated and adjacent components, and _____.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.
   2. Provide data on fire retardant treatment materials and application instructions.

C. Samples: Submit two samples of material of dimension to represent thickness, board width and variences in grain and color. Sample to illustrate finish and construction joints.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Locate where directed.

C. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.

B. Protect from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Interior Woodwork Items:

1. Exposed surfaces for custom cabinetry.
2. Plywood for custom cabinetry.
3. Wood Base Trim.
4. Miscellaneous finish carpentry as required.

2.02 LUMBER MATERIALS

A. Salvaged Wood: Sinker Cypress.
   1. Salvaged Wood - WD-01:Sinker Cypress.
      a. Air dried prior to klin drying.
      b. Board Thickness: 1-inch thick, planed to 3/4" thick.
      c. Board Dimensions, width and length: 9"x108"
      d. Basis-Of-Design Supplier: Virgin Heart Sinker Cypress, LLC.
   2. Locations: Reception Desk as indicated on drawings. Coordinate with Architectural Wood Casework.

B. Softwood Lumber: dimensional species, _____ sawn, maximum moisture content of 6 percent, of quality suitable for opaque painted finish..
   1. Grading: In accordance with rules certified by ALSC; www.alsc.org.

2.03 SHEET MATERIALS

A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.

B. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1, Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

C. Particleboard: ANSI A208.1; Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

2.04 PANEL CORE MATERIALS

A. Basic Hardboard: Panel manufactured from inter-felted lignocellulosic fibers consolidated under heat and pressure; comply with ANSI A135.4.

2.05 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Adhesive for factory-fabricated units: Manufacturer's recommended adhesive for application.

C. Fasteners: Of size and type to suit application; suitable finish in concealed locations and see drawings or consult architect for finish in exposed locations.

D. Concealed Joint Fasteners: Threaded steel.

2.06 ACCESSORIES

A. Exposed metal specialty componets: As inddicated drawings. Consult architect where finish is not indicated..

2.07 HARDWARE

A. Hardware: Comply with BHMA A156.9.

2.08 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.

B. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.

C. Provide identification on fire retardant treated material.

D. Redry wood after pressure treatment to maximum ____ percent moisture content.

2.09 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION

SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

1.02 RELATED REQUIREMENTS

A. Section 01 6200 - Finish Carpentry: Lumber Materials, Salaveged Wood.

B. Section 12 3600 - Countertops.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

C. BHMA A156.9 - Cabinet Hardware; 2020.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Salvaged Wood Faced Reception Desk:
   1. Exposed Exterior Surfaces: Sinker Cypress.
   2. Exposed Interior Surfaces: Decorative Laminate.
   3. Concealed Surfaces: Manufacturer's option.

C. Plastic Laminate Faced Cabinets: Custom grade.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

C. Products:
   1. Salvaged Wood - WD-01:Sinker Cypress.
      a. See Product information in specifcation section 06-2000 Finish Carpentry.

2.03 LAMINATE MATERIALS

A. Manufacturers:
   1. Basis-OF-Desgin: As indicated on Finish Legend ond drawings.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as required and indicated on drawings.
   1. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness, through color, _____ color, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness, through color, _____ color, finish as indicated.
   3. Laminate Backer: BKL, 0.020 inch (0.51 mm) nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 COUNTERTOPS

A. Countertops: See Section 12 3600.

2.05 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

D. Concealed Joint Fasteners: Threaded steel.

E. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.06 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch (25 mm) spacing adjustments.

C. Fixed American with Disabilities Act (ADA)-Compliant Vanity and Countertop Brackets:
   1. Materials: Steel,
      a. Finish: Manufacturer's standard, factory-applied, powder coat.
      b. Color: Black.

D. Drawer and Door Pulls: as indicated on drawings..

E. Cabinet Catches and Latches:

F. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Features: Provide self closing/stay closed type.

G. Hinges: European style concealed self-closing type, steel with satin finish.

2.07 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 mm) from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 06 8316
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

1.02 REFERENCE STANDARDS

A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Samples: Submit two samples ____by____ inch (____by____ mm) in size illustrating material and surface design of panels.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Marlite, Inc; Smooth FRP.: www.marlite.com/#sle.

2.02 PANEL SYSTEMS

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 75 and smoke developed index of 450; when system tested in accordance with ASTM E84.

B. Adhesive: Type recommended by panel manufacturer.

C. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

G. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 1300
SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

1.03 ABBREVIATIONS

1.04 REFERENCE STANDARDS

A. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

B. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for membrane.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

1.06 QUALITY ASSURANCE

1.07 FIELD CONDITIONS

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 SHEET WATERPROOFING APPLICATIONS

2.02 SHEET WATERPROOFING MATERIALS

2.03 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

3.02 PREPARATION

3.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Overlap edges and ends, minimum 3 inches (76 mm), seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

D. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

E. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

F. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

G. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

3.06 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 1400
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cold-applied rubberized asphalt waterproofing.

1.02 REFERENCE STANDARDS

A. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

B. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 QUALITY ASSURANCE

1.04 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until cured.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Installer Warranty: Provide 2-year warranty for waterproofing failing to resist penetration of water commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cold-Applied Rubberized Asphalt Waterproofing:

2.02 FLUID-APPLIED WATERPROOFING APPLICATIONS

2.03 FLUID-APPLIED WATERPROOFING MATERIALS

A. Cold-Applied Rubberized Asphalt Waterproofing: Rubberized asphaltic compound, suitable for installation on concrete and concrete masonry.
   1. Capable of resisting water head of _____ feet (_____ m) and preventing moisture migration to interior.
   2. Cured Thickness: 60 mil, 0.060 inch (1.52 mm), minimum.
   3. Water Vapor Permeance: 1 perm (57 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M.

2.04 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

3.02 PREPARATION

3.03 INSTALLATION

A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.

B. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing.

C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

3.06 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at cavity wall construction, perimeter foundation wall, and underside of floor slabs.

B. Batt insulation in exterior wall construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 07 5400 - Thermoplastic Membrane Roofing: Insulation and installation requirements for board insulation over low slope roof deck.

B. Section 09 8430 Sound-Absorbing Wall and Ceiling Units: Acoustical insulation.

C. Division 23 Heating, Ventilating and Air-Contintioning: Acoustical insulation and duct lining.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2022a.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

C. Insulation Inside Masonry Cavity Walls: Expanded polystyrene (EPS) board.

D. Insulation Inside Prefabricated Wall Panels: Extruded polystyrene (XPS) board.

E. Insulation Over Roof Deck: Polyisocyanurate board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Expanded Polystyrene (EPS) Board Insulation: Comply with ASTM C578.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

B. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.

2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.

C. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Comply with ASTM C578, and manufactured using carbon black technology.
1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.6 (0.98), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
5. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
6. Board Thickness: ___ inch (___ mm).
7. Board Edges: Shiplap, at long edges.

D. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.
1. Roof insulation specified in section 07 5400 - Thermoplastic Membrane Roofing:
2. Classifications:
3. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
4. Board Thickness: 1.5 inch (37.5 mm).

2.03 MINERAL FIBER BLANKET ACOUSTICAL INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
2. Formaldehyde Content: Zero.

B. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

2.04 MINERAL FIBER BOARD ACOUSTICAL INSULATION MATERIALS

A. Duct Liners: Rigid, resin bonded fibrous glass blankets or board with a damage-resistant, flame retardant veil faced airstream surface.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
3. Materials shall conform to ASTM C 423 standard for "Sound Absorbtion".
   a. Noise Reduction Coefficient (NRC): 0.80
4. Color: Black.
5. Mounting: Type A.

B. Products:
1. Owens Corning: QuietR Duct Liner Baord.
2. CertainTeed: AscoustaBoard.
3. Sustitutions note permitted.

C. Adhesives as acceptable to the manufactuer for applications as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT CAVITY WALLS

A. Install boards to fit snugly between wall ties.

B. Install boards horizontally on walls.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.05 ACOUSTICAL INSULATION, BLANKET AND BOARD

A. Install at locations indicated on drawings, in coordination with acoutical insulation specified in section 09 8430 Sound-Absorbing Wall and Ceiling Units.

B. Install duct lining insulation in coordination with mechanical requirements as indicated on drawings and specified in Division 23.

3.06 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

3.08 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2400
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drainage and water-resistive barriers behind insulation board.

1.02 REFERENCE STANDARDS

A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

B. ASTM C297/C297M - Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions; 2016.

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.

D. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2022a.

E. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).

F. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.

G. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2015 (Reapproved 2020).

H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

J. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2018.

K. ASTM E2486/E2486M - Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS); 2022.

L. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).

M. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.

N. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).

O. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2015, with Editorial Revision (2022).

P. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2023, with Errata.

Q. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.

R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

C. Shop Drawings: Indicate wall and soffit joint patterns, joint details, and molding profiles.

D. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.

E. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.04 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.

B. Storage: Store materials as directed by manufacturer's written instructions.

1.06 FIELD CONDITIONS

A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.

B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.

C. Do not install coatings or sealants when ambient temperature is below 40 degrees F (5 degrees C).

D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design:
   1. Dryvit Systems, Inc; Dryvit Outsulation Plus MD EIFS, Class PB with Moisture Drainage: www.dryvit.com/#sle.

B. Other Acceptable Exterior Insulation and Finish Systems Manufacturers:
   1. Master Builders Solutions; Senergy Channeled Adhesive CI (Continuous Insulation) Design with MaxGrip Veneer Mortar: www.senergy.master-builders-solutions.com/en/#sle.
   2. Parex USA, Inc; Standard WaterMaster EIFS with Moisture Drainage: www.parex.com/#sle.
   3. Sto Corp; StoTherm ci: www.stocorp.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM

A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on flat-backed insulation board adhesive-applied directly to water-resistive coating over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.

B. Allowable Wind Loading: At least _____ psf (_____ Pa), positive and negative, determined in accordance with ICC-ES AC219 or ICC-ES AC235, using factor of safety of 3.0.

C. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
   2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
   3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot (mJ/sq m).

D. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum flatwise tensile bond strength of 15 psi (105 kPa), when tested in accordance with ASTM C297/C297M.

E. Adhesion to Water-Resistive Coating: For each combination of insulation board and substrate, when tested in accordance with ASTM C297/C297M, maximum adhesive failure of 25 percent unless flatwise tensile bond strength exceeds 15 psi (105 kPa) in all samples.

F. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf (299 Pa) differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

G. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.

H. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches (100 by 150 mm) in size.

I. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.

J. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.

K. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.

L. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

M. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons (500 liters) of sand.

N. Impact Resistance: Construct system to provide the following impact resistance without exposure of broken reinforcing mesh, when tested in accordance with ASTM E2486/E2486M:
   1. Standard: 25 to 49 in-lb (2.83 to 5.54 J), for areas not indicated as requiring higher impact resistance.

2.03 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.

B. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.

C. Water-Resistive Barrier Coating: Fluid-applied air and water barrier membrane; applied to sheathing; furnished or approved by EIFS manufacturer.

2.04 ACCESSORIES

A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.

B. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

C. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in (6 mm) when tested with a 10 ft (3 m) straightedge.

3.02 PREPARATION

A. Install self-furring metal lath over solid substrates that are deemed unacceptable to receive adhesively applied insulation. Install in accordance with ASTM C1063, except for butt-lapping instead of overlapping.

1. Attach to concrete and concrete masonry using corrosion-resistant power or powder actuated fasteners or hardened concrete stub nails not less than 3/4 inch (19 mm) long and with heads not less than 3/8 inch (9.5 mm) wide. Ensure that fasteners are securely attached to substrate and spaced at maximum 16 inches (406 mm) on center horizontally and 7 inches (178 mm) vertically.

3.03 INSTALLATION - GENERAL

A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.

1. Where different requirements appear in either document, comply with the most stringent.
2. Neither of these documents supercedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER

A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.

B. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.

C. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.

D. Lap flexible flashing or flashing tape at least 2 inches (50 mm) on each side of joint or transition.

3.05 INSTALLATION - INSULATION

A. Install in accordance with manufacturer's instructions.

B. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.

C. On wall surfaces, install boards horizontally.

D. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch (1.6 mm).

E. Fill gaps greater than 1/16 inch (1.6 mm) with strips or shims cut from the same insulation material.

F. Rasp irregularities off surface of installed insulation board.

3.06 PROTECTION

A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION

SECTION 07 2500
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water-resistive barriers.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.

B. Section 05 4000 - Cold-Formed Metal Framing: Exterior metal stud walls.

C. Section 04 2000 - Unit Masonry. Concrete masonry.

D. Section 07 2400 - Exterior Insulation and Finish Systems: Water-resistive barrier under exterior insulation.

E. Section 07 4213.23 - Metal Composite Material Wall Panels:

F. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

G. Section 07 9200 - Joint Sealants: Sealants applied to adjacent work.

H. Section 09 2116 - Gypsum Board Assemblies: Sheathing.

1.03 DEFINITIONS

A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

1.04 REFERENCE STANDARDS

A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

B. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

F. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; 2017, with Editorial Revision (2021).

G. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; 2015, with Editorial Revision (2020).

H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on material characteristics.

1.06 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 WATER-RESISTIVE BARRIER MATERIALS

A. Water-Resistive Barrier: For use in Construction Types I, II, III, and IV on buildings greater than 40 feet (12.2 m) in height.
   1. Comply with NFPA 285 wall assembly requirements in accordance with local building code and authorities having jurisdiction (AHJ).

B. Water-Resistive Barrier Coating: Fluid applied, UV-resistant coating for use over various types of exterior sheathing, CMU, and precast concrete in accordance with ICC-ES AC212.
   1. Air Permeance, Building Material Air Leakage Rate: 0.004 cfm/sq ft (0.02 L/sec sq m) maximum leakage when tested at 1.57 psf (75 Pa) pressure difference in accordance with ASTM E2178.
   2. Water-Resistive Barrier over Sheathing Compliance: Complying with ICC-ES AC212.
   3. Water Vapor Permeance: Tested in accordance with ASTM E96/E96M.
      a. Procedure A: Greater than 5 perms (287 ng/(Pa s sq m)).
      b. Procedure B: Greater than 14 perms (804 ng/(Pa s sq m)).
   4. Dry Film Thickness (DFT): 10 mils, ___ inch (___ mm), minimum.
   5. Water Vapor Permeance: 10 perms (572 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method.
   6. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 120 days of weather exposure.
   7. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
   8. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
   9. Joint Preparation Treatment: As recommended by coating manufacturer.
   10. Products:
      a. PROSOCO, Inc; Spray Wrap MVP: www.prosoco.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES

A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.

B. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and weather barrier materials.
   1. Application: Apply at 30 to 40 mil, 0.030 to 0.040 inch (0.76 to 1.02 mm) nominal thickness.

C. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.

D. Flexible Flashing: Self-adhering or mechanically attached flashing used for wall penetrations in accordance with ICC-ES AC148 requirements.

E. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
   1. Width: 5-1/2 inches (140 mm).
   2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.

F. Preformed Transition Membrane: Semi-rigid silicone or polyester composition, tapered edges, and tear resistant.

G. Stainless Steel Flashing: Flexible flashing with 2 mil, 0.002 inch (0.051 mm) thick Type 304 stainless steel sheet, 8 mil, 0.008 inch (0.203 mm) of butyl adhesive and siliconized release liner.
   1. Width: 4 inches (102 mm) wide.

H. Weather Barrier Self-Sealing Flat Attachment Washers: Solid plastic flat cap washers with flexible perimeter seal attached with screws to substrate for attachment of weather barrier to help seal against air and moisture penetration through weather barrier assembly.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions comply with requirements of this section.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Water-Resistive Barriers: Install continuous water-resistive barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.

C. Mechanically Fastened Exterior Sheets:
   1. Install sheets shingle-fashion to shed water, with seams aligned horizontal.
   2. Overlap seams as recommended by manufacturer, 6 inches (152 mm), minimum.
   3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches (305 mm), minimum.
   4. For applications indicated to be airtight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners as recommended by manufacturer.
   5. Where stud framing rests on concrete or masonry substrate, extend lower edge of barrier sheets at least 4 inches (102 mm) below bottom of framing and seal to substrate with sealant or approved mounting tape.
   6. Install water-resistive barrier over jamb flashings.
   7. Install head flashings under water-resistive barrier.
   8. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.

D. Self-Adhered Sheets:
   1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle-fashion to shed water and seal laps airtight.
   3. Upon placement of sheets, firmly press onto substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
   4. Use same material, or other material approved by sheet manufacturer, to seal sheets to adjacent substrates, and as flashing.
   5. At expansion joints, provide transition to joint assemblies approved by sheet manufacturer.

E. Coatings:
   1. Prepare substrate in accordance with coating manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
   2. Where exterior masonry veneer is being applied, install masonry anchors prior to placement of water-resistive barrier over masonry substrate; seal airtight around anchors.
   3. Apply bead or trowel coat of mastic sealant with minimum thickness of 1/4 inch (6 mm) along coating seams, rough cuts, and as recommended by manufacturer.
   4. Apply flashing to seal with adjacent construction and to bridge joints in coating substrate.

F. Openings and Penetrations in Exterior Water-Resistive Barriers:
   1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto water-resistive barrier and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.

2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches (50 mm) beyond face of jambs; seal water-resistive barrier to flashing.
5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner92s Inspection and Testing: Cooperate with Owner92s testing agency.
1. Allow access to work areas and staging.
2. Notify Owner92s testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection.
3. Do not cover work of this section until testing and inspection is accepted.

3.04 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 4113
METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal roof panel system of preformed steel panels.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Roof framing and purlins.

B. 07 7123 Manufactured gutters and downspouts.

C. Section 07 9200 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM A463/A463M - Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process; 2022.

C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2022.

D. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2017).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Storage and handling requirements and recommendations.
   2. Installation methods.

C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
   1. Show work to be field-fabricated or field-assembled.

D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Test Reports: Indicate compliance of metal roofing system to specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.06 FIELD CONDITIONS

A. Do not install metal roof panels, eave protection membrane, underlayment, or _____ when surface, ambient air, or wind chill temperatures are below 45 degrees F (7 degrees C).

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:

1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F (56 degrees C).

2.02 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.
1. Steel Panels:
a. Aluminum-zinc alloy-coated steel complying with ASTM A792/A792M; minimum AZ50 (AZM150) coating.
b. Aluminum-coated steel complying with ASTM A463/A463M; minimum Type 2 T2-65 (T2M-200) coating.
c. Steel Thickness: Minimum 22 gauge, .028 inch (___ mm).
2. Texture: Smooth.
3. Length: Full length of roof slope, without lapped horizontal joints.
4. Width: Maximum panel coverage of 24 inches (610 mm).

2.03 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.04 FABRICATION

A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

2.05 FINISHES

A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat metal coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss to match sample.

2.06 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

B. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

C. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
   1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
   2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 4213.23

METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior cladding consisting of formed metal composite material (MCM) sheet, secondary supports, and anchors to structure, attached to solid backup.

B. Matching flashing and trim.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Panel support framing.

B. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.

C. Section 07 9200 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

D. Section 08 4413 Glazed Aluminum Curtain Wall: Adjacent contstuction. Finish coordination.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

F. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

G. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2022a.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

J. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).

K. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2020.

L. ASTM D4145 - Standard Test Method for Coating Flexibility of Prepainted Sheet; 2010 (Reapproved 2022).

M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

N. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

O. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

P. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
   1. Require attendance by the installer and relevant sub-contractors.
   2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
   3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
   4. Review procedures for protection of work and other construction.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

C. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.
   4. Specimen warranty for wall system, as specified herein.

D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, support clips, exposed fasteners, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches (1:10).
   6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

E. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.

F. Test Report: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.

G. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.

H. Designer's qualification statement.

I. Installer's qualification statement.

J. Testing agency's qualification statement.

K. Maintenance Data: Care of finishes and warranty requirements.

1.06 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.

B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing wall panel systems specified in this section.
   1. With not less than three years of documented experience.
   2. Approved by MCM sheet manufacturer.

D. Installer Qualifications: Company specializing in performing work of type specified in this section.
   1. With minimum three years of documented experience.
   2. Approved by wall panel system manufacturer.

E. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide a mock-up for evaluation of fabrication workmanship.

C. Locate where directed.

D. Provide specified finish on panels.

E. Mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy-duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing, and installing panels to prevent bending, warping, twisting, and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well-ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of accumulated water.
   4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).
   5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.09 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.10 WARRANTY

A. Special Warranty: Provide 2-year warranty covering water tightness and integrity of seals of wall panels. Complete forms in Owner's name and register with warrantor.

B. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-Of-Design: ALPOLIC PE; ALPOLIC: www.alpolic-americas.com/#sle.

B. Metal Composite Material (MCM) Sheet Manufacturers:
   1. ALUCOBOND by 3A Composites USA: www.alucobondusa.com/#sle.
   2. Arconic Architectural Products: Reynobond.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage, or failure.
   1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
      a. See Design Criteria on structural drawings.
   2. Provide panel jointing and weatherseal using a "wet", sealant-sealed system.
   3. Anchor panels to supporting framing without exposed fasteners.

2.03 PERFORMANCE REQUIREMENTS

A. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F (minus 29 degrees C) to 180 degrees F (82 degrees C) without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.

B. See Design Criteria on structural drawings.
   1. Blast Design Pressure: 120 psf. Provide system tested in accordance with ASTM F2248-19.
      a. Connectors to comply with ASTM F2248 and ASTM E1300.
   2. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
   3. Design Wind Pressure: 147 MPH, Exposure B. In accordance cladding wind pressures from ASCE 7-16.
   4. Inward Design Wind Pressure: ___ psf (___ kPa).
   5. Outward Design Wind Pressure: ___ psf (___ kPa).
   6. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
   7. Maximum anchor deflection in any direction of 1/16 inch (1.6 mm) at connection points of framing members to anchors.

C. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.27 psf (300 Pa) minimum, after 15 minutes.
   1. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
   2. Design to drain leakage and condensation to the exterior face of the wall.

D. Fire Performance: Use test method complying with NFPA 285.

E. Building Envelope Performance: Comply with ASHRAE Std 90.1 I-P when tested as part of building envelope assembly.

2.04 PANELS

A. Panels: 1 inch (25.4 mm) deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
   1. Reinforce corners with riveted aluminum angles.

2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
5. Fabricate panels under controlled shop conditions.
6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
   a. Make panel lines, breaks, curves, and angles sharp and true.
   b. Keep plane surfaces free from warp or buckle.
   c. Keep panel surfaces free of scratches or marks caused during fabrication.
8. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.

2.05 MATERIALS

A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
   1. Overall Sheet Thickness: 0.118 inch (3 mm), minimum.
   2. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch (100 N-mm/mm) with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F (21 degrees C).
   3. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   4. Flammability: Self-ignition temperature of 650 degrees F (343 degrees C) or greater when tested in accordance with ASTM D1929.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
   1. Provide material strength, dimensions, configuration as required to meet applied loads and in compliance with applicable building code.

2.06 FINISHES

A. Factory Finish: Three coat fluoropolymer resin coating, approved by coating manufacturer for length of warranty specified for project, and applied by coil manufacturing facility that specializes in coil applied finishes.
   1. Coating Flexibility: Pass ASTM D4145 minimum 1T Bend at time of manufacturing.
   2. Long-Term Performance: Not less than that specified under WARRANTY in PART 1.

B. Finish: Factory finished highly polished Class I natural anodized finish; AAMA 611 AA-M12C22A41, anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.

C. Color/Texture: As selected by Architect from manufacturer's full range. Location of colored panels indicated on drawings.
   1. Anondized Color Chart.
   2. Architectural Color Chart.

2.07 ACCESSORIES

A. Flashing: Sheet aluminum; 0.040 inch (1.0 mm) thick, minimum; finish and color to match MCM sheet; see Section 07 6200 for additional requirements.

B. Support for Cladding and Continuous Insulation: Thermal clips.
   1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.

2. Fasteners: As recommended by clip manufacturer.

C. Support for Cladding and Continuous Insulation: Continuous thermal Z-girts.
1. Fiberglass reinforced plastic (FRP) girts that provide cladding attachment support for exterior wall cladding, brick veneer, CMU veneer, metal wall panels, siding, and _____.
2. Fasteners: As recommended by clip manufacturer.

D. Anchors, Clips, and Accessories: Use one of the following:
1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
2. Steel complying with ASTM A36/A36M and hot-dip zinc coating to ASTM A153/A153M.
3. Steel complying with ASTM A36/A36M and hot-dip galvanized to ASTM A123/A123M, with Coating Thickness Grade of 100.

E. Fasteners:
1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
3. Bolts: Stainless steel.
4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

F. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15-mil (0.38 mm) dry film thickness per coat.

G. Joint Sealer: Provide color to match wall panels silicone sealant of type approved by MCM sheet manufacturer, and in compliance with ASTM C920.

H. Provide panel system manufacturer's and installer92s standard corrosion resistant accessories, including fasteners, clips, anchorage devices, and attachments.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine dimensions, tolerances, and interfaces with other work.

B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

G. Where joints are designed for field-applied sealant, seal joints completely with specified sealant.

H. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.

I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2 inch in 30 feet (10 mm in 10 m) of length and up to 3/4 inch in 300 feet (20 mm in 100 m), maximum.
   2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet (3 mm in 9 m) run, maximum.
   3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet (3 mm in 9 m) run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch (0.75 mm), maximum.

J. Replace damaged products.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.

3.05 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION

SECTION 07 5400
THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.

B. Deck sheathing.

C. Cover boards.

D. Flashings.

1.02 RELATED REQUIREMENTS

A. Section 05 3100 - Steel Decking: Placement of acoustical insulation for deck flutes.

B. Section 07 7100 - Roof Specialties: Prefabricated roofing expansion joint flashing.

1.03 REFERENCE STANDARDS

A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.

B. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.

D. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.

E. ASTM C728 - Standard Specification for Perlite Thermal Insulation Board; 2017a (Reapproved 2022).

F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

G. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2022a.

H. ASTM C1484 - Standard Specification for Vacuum Insulation Panels; 2010 (Reapproved 2018).

I. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.

J. FM (AG) - FM Approval Guide; Current Edition.

K. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2022).

L. NRCA (RM) - The NRCA Roofing Manual; 2023.

M. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 45 degrees F (____ degrees C) or above 100 degrees F (____ degrees C).

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
   1. Carlisle SynTec Systems; Sure-Weld TPO: www.carlisle-syntec.com/#sle.
   2. GAF; _____ 60 mil: www.gaf.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation:
   1. BASF Corporation; BASF Neopor GPS: www.neopor.basf.us/#sle.
   2. Carlisle SynTec Systems; SecurShield Insulation: www.carlisle-syntec.com/#sle.
   3. GAF; _____: www.gaf.com/#sle.
   4. Owens Corning Corporation; _____: www.ocbuildingspec.com/#sle.

2.02 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.

B. Acceptable Insulation Types - Constant Thickness Application: Any of types specified.
   1. Minimum 2 layers of polyisocyanurate board.
   2. Bottom layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, composite, or cellular glass board covered with single layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, or composite board.

C. Acceptable Insulation Types - Tapered Application: Any of types specified.
   1. Tapered polyisocyanurate board.
   2. Tapered polyisocyanurate, perlite, extruded polystyrene, or cellular glass board covered with uniform thickness cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, or composite board.
   3. Uniform thickness cellulose, perlite, composite, polyisocyanurate, extruded polystyrene, molded polystyrene, glass fiber, or cellular glass board covered with tapered polyisocyanurate, extruded polystyrene, or perlite board.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:

1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
   a. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
2. Sheet Width:

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.

2.04 DECK SHEATHING

A. Deck Sheathing: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
1. Thickness: 5/8 inch (15.9 mm), Type X, fire-resistant.

2.05 COVER BOARDS

A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
1. Thickness: 5/8 inch (15.9 mm), Type X, fire-resistant.

2.06 INSULATION

A. Cellulose Fiber Board Insulation: ASTM C208, Type II; natural finish.

B. Perlite Board Insulation: Expanded perlite mineral aggregate, complying with ASTM C728.
1. Board Size: 24 by 48 inches (619 by 1220 mm).
2. Board Thickness: 1/2 inch (12.7 mm).
3. Tapered Board: Slope as indicated; minimum thickness ____ inch (____ mm); fabricate of fewest layers possible.

C. Expanded Polystyrene (EPS) Board Insulation: Comply with ASTM C578, with drainage channels on one face.
1. Board Size: 48 by 96 inches (1220 by 2440 mm).

D. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
   a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
      1) Class 2 - Faced with coated glass fiber mat facers on both major surfaces of the core foam.
      2) Compressive Strength: Classes 1-2-3, Grade 1, 16 psi (110 kPa), minimum.
      3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inches (38 mm) thick; Class 1, Grades 1-2-3, 8.4 (1.48), minimum, at 75 degrees F (24 degrees C).
2. Board Size: 48 by 96 inches (1220 by 2440 mm).
3. Board Thickness: As required to provideinidcated R-value.
4. Board Thickness: _____ inches (___ mm).
5. Board Edges: Square.

E. Mineral Wool Board Insulation: Rigid mineral wool fiber complying with ASTM C726; top surface coated with asphalt and Kraft paper.
1. Board Size: 48 by 48 inches (1220 by 1220 mm).
2. Board Thickness: 1 inch (25.4 mm).

F. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578, with natural skin surface and drainage channels on one face.
1. Board Size: 48 by 96 inches (1220 by 2440 mm).
2. Board Thickness: 1-1/2 inches (38 mm).
3. Tapered Board: Slope as indicated; minimum thickness 1/2 inch (12.7 mm); fabricate of fewest layers possible.

G. Composite Vacuum Insulated Panel Insulation: Comply with ASTM C1484.
1. Integral Protection Boards: Manufacturer's standard.

H. Cellular Glass Board Insulation: Comply with ASTM C552, Type IV.
1. Board Size: 24 by 48 inches (610 by 1220 mm), nominal.
2. Board Thickness: 2 inches (51 mm), nominal.

2.07 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

B. Sheathing Joint Tape: Paper type, ____ inches (____ mm) wide, self adhering.

C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

D. Membrane Adhesive: As recommended by membrane manufacturer.

E. Sealants: As recommended by membrane manufacturer.

F. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
   1. Composition: Roofing membrane manufacturer's standard.
   2. Surface Color: White or Yellow.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION - METAL DECK

A. Install deck sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Tape joints.

3.03 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.

B. Do not apply roofing membrane during cold or wet weather conditions.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.04 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Attachment of Insulation:
   1. Mechanically fasten subsequent layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.

C. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.

D. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. Do not install more insulation than can be covered with membrane in same day.

3.05 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive at manufacturer's recommended rate. Adhere membrane in accordance to membrane roofing system manufacturer's written instructions and warrantieed requirements.

D. Fully Adhered Application: Apply adhesive to substrate at rate of ___ gallons per square foot (___ L/sq m). Fully embed membrane in adhesive except in areas directly over or within 3 inches (76 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

E. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (76 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

F. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches (102 mm) onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.

G. Around roof penetrations, seal flanges and flashings with flexible flashing.

H. Coordinate installation of roof drains and sumps and related flashings.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing in accordance with requirements.

C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

3.07 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, sheet metal roofing, and exterior penetrations.

B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. Section 07 7123 - Manufactured Gutters and Downspouts.

1.03 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.

E. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2020.

F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

H. CDA A4050 - Copper in Architecture - Handbook; current edition.

I. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Anodized Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 20 gauge, 0.032 inch (0.81 mm) thick; clear anodized finish.

B. Pre-Finished Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 18 gauge, 0.040 inch (1.02 mm) thick; plain finish shop pre-coated with silicone modified polyester coating.
   1. Fluoropolymer Coating: High performance organic powder coating, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As indicated on drawings.

C. Lead Sheet: ASTM B749, 0.047-inch (1.19 mm) minimum thickness; UNS Number L51121.

D. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch (0.40 mm) thick; smooth No. 4 - Brushed finish.

E. Copper: ASTM B370, cold rolled 16 oz/sq ft, 24 gauge, 0.0216 inch (0.55 mm) thick; natural finish.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing _____. Return and brake edges.

2.03 GUTTERS AND DOWNSPOUTS

A. Seal metal joints.

2.04 EXTERIOR PENETRATION FLASHING PANELS

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.05 ACCESSORIES

A. Concealed Sealants: Non-curing butyl sealant.

B. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

C. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

C. Secure gutters and downspouts in place with concealed fasteners.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.05 SCHEDULE

A. Through-Wall Flashing in Masonry:
B. Gutters and Downspouts:
C. Scuppers:
D. Coping, Cap, Parapet, Sill and Ledge Flashings:
E. Counterflashings at Roofing Terminations (over roofing base flashings):
F. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports:

END OF SECTION

SECTION 07 7123
MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 07 6100 - Sheet Metal Roofing.

B. Section 07 6200 - Sheet Metal Flashing and Trim.

1.02 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Comply with applicable code for size and method of rain water discharge.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

1.05 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.01 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209/B209M, ___ alloy, ___ temper; 0.032 inch (0.8 mm) thick.
   1. Finish: Plain, shop pre-coated with modified silicone coating.
   2. Color: As selected from manufacturer's standard colors.

2.02 COMPONENTS

A. Gutters: SMACNA rectangular style profile.

B. Anchors and Supports: Profiled to suit gutters and downspouts.
   1. Anchoring Devices: In accordance with CDA requirements.
   2. Gutter Supports: as required in coordination with metal roof..

C. Fasteners: Same material and finish as gutters and downspouts, with soft neoprene washers.

2.03 FABRICATION

A. Form gutters and downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.04 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.05 ACCESSORIES

A. Splash Pads: Precast concrete type, profiles size(s) as indicated; minimum 3,000 psi (21 MPa) compressive strength at 28 days, with minimum 5 percent air entrainment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

3.02 PREPARATION

A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

3.03 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

B. Slope gutters ____ inch per foot (____ mm/m), ___ percent minimum.

END OF SECTION

SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof hatches, manual and automatic operation, including smoke vents.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 FALL PROTECTION ROOF ANCHOR

A. Basis-Of-Design: Frontline R012 Multifunction 12" Commercial Roof Anchor.
   1. Finish: Galvanized.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOF HATCHES AND VENTS

A. Roof Hatch Manufacturers:
   1. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
   2. Bilco Company; Type TB (various types and special size): www.bilco.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. Mounting Substrate: Provide frames and curbs suitable for mounting on standing seam metal roof panel system.

C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch (2.3 mm) thick.
   2. Insulation: Manufacturer's standard; 1 inch (25 mm) rigid glass fiber, located on outside face of curb.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf (1.92 kPa) live load.
   2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch (2.3 mm) thick, liner 0.04 inch (1.0 mm) thick.
   3. Insulation: Manufacturer's standard 1 inch (25 mm) rigid glass fiber.
   4. Gasket: Neoprene, continuous around cover perimeter.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.

B. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.

D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.

E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).

F. ITS (DIR) - Directory of Listed Products; Current Edition.

G. FM (AG) - FM Approval Guide; Current Edition.

H. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

I. UL (DIR) - Online Certifications Directory; Current Edition.

J. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:

1. Licensed by local authorities having jurisdiction (AHJ).

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
1. 3M Fire Protection Products; _____: www.3m.com/firestop/#sle.
2. A/D Fire Protection Systems Inc; _____: www.adfire.com/#sle.
3. Hilti, Inc; _____: www.hilti.com/#sle.
4. Specified Technologies Inc; _____: www.stifirestop.com/#sle.
5. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.

2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
1. Movement: Provide systems that have been tested to show movement capability as indicated.

B. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING FOR FLOOR-TO-FLOOR, FLOOR-TO-WALL, HEAD-OF-WALL, AND WALL-TO-WALL JOINTS

A. Gypsum Board Walls:
1. Wall-to-Wall Joints That Have Not Been Tested For Movement Capabilities (Static-S):
a. 1 Hour Construction: UL System WW-S-0063; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
2. Head-of-Wall Joints at Underside of Steel Beam and Concrete Over Metal Deck Floor with Sprayed On Fireproofing:
a. 1 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
3. Head-of-Wall Joints at Concrete Over Metal Deck:
a. 1 Hour Construction: UL System HW-D-0365; Specified Technologies Inc. SpeedFlex Joint Profile System.
b. 1 Hour Construction: UL System HW-D-0548; Specified Technologies Inc. SpeedFlex Joint Profile System.
c. 1 Hour Construction: UL System HW-D-0749; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.

d. 1 Hour Construction: UL System HW-D-0256; Tremco, TREMstop Acrylic Firestop Sealant.

4. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
   a. 1 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
5. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
   a. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
6. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
   a. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.

2.05 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

A. Penetrations Through Floors By:
   1. Multiple Penetrations in Large Openings:
      a. 2 Hour Construction: UL System F-A-8012; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
   2. Uninsulated Metallic Pipe, Conduit, and Tubing:
   3. Electrical Cables Not In Conduit:
      a. 2 Hour Construction: UL System F-A-3032; Specified Technologies Inc. Ready Split Sleeve.
      b. 2 Hour Construction: UL System F-A-3058; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.
   4. Electrical Busways:
      a. 3 Hour Construction: UL System C-AJ-6017; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
   5. Insulated Pipes:
      a. 2 Hour Construction: UL System F-A-5015; Hilti CP 680-P/M Cast-In Device.

B. Penetrations Through Walls By:
   1. Uninsulated Metallic Pipe, Conduit, and Tubing:
   2. Insulated Pipes:
      a. 2 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   3. HVAC Ducts, Uninsulated:
      a. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant, or CP 606 Flexible Firestop Sealant.
   4. HVAC Ducts, Insulated:
      a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.06 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

A. Blank Openings:
   1. 1 Hour Construction: UL System W-L-0020; Specified Technologies Inc. Composite Sheet.
   2. 1 Hour Construction: UL System W-L-0032; Specified Technologies Inc. FP Intumescent Firestop Plug.
   3. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.

B. Penetrations By:
   1. Uninsulated Metallic Pipe, Conduit, and Tubing:
      a. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 1 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
      c. 1 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.

d. 1 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.

2. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
   a. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
   b. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   c. 1 Hour Construction: UL System W-L-2243; Specified Technologies Inc. SSW Wrap Strips.
   d. 1 Hour Construction: UL System W-L-2493; Specified Technologies Inc. RTC Range-Taking Collar.
3. Electrical Cables Not In Conduit:
   a. 1 Hour Construction: UL System W-L-3374; Specified Technologies Inc. FP Intumescent Firestop Plug.
   b. 1 Hour Construction: UL System W-L-3378; Specified Technologies Inc. EZ Firestop Grommet.
   c. 1 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for Existing Cables.
4. Cable Trays with Electrical Cables:
   a. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
   b. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
5. Insulated Pipes:
   a. 1 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
   b. 1 Hour Construction: UL System W-L-5273; Specified Technologies Inc. LC Endothermic Firestop Sealant.
6. HVAC Ducts, Insulated:
   a. 1 Hour Construction: UL System W-L-7238; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
   b. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.07 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

3.04 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

END OF SECTION

SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

H. ASTM C1382 - Standard Test Method for Determining Tensile Adhesion Properties of Sealants when Used in Exterior Insulation and Finishing Systems (EIFS) Joints; 2016 (Reapproved 2023).

I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

J. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

L. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

M. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

E. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

F. Field Quality Control Log: Submit filled-out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

G. Executed warranty.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

D. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Field testing agency's qualifications.
   3. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to:
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Other joints indicated below.
   3. Do not seal the following types of joints:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover, or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.
      e. Joints between suspended panel ceilings/grid and walls.

B. Type ___ - Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.

C. Type ___ - Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.

2.02 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

B. Colors: To match adjacent surfaces.

2.03 NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Color: To match adjacent surfaces. Consult architect where adjacent to material color change..
   5. Service Temperature Range: Minus 20 to 180 degrees F (Minus 29 to 82 degrees C).
   6. Products:
      a. Dow; DOWSIL 756 SMS Building Sealant: www.dow.com/#sle.
      b. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
      c. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
      d. Dow; DOWSIL 795 Silicone Building Sealant: www.dow.com/#sle.
      e. Sika Corporation; Sikasil WS-290: www.usa.sika.com/#sle.
      f. Sika Corporation; Sikasil WS-295: www.usa.sika.com/#sle.
      g. Sika Corporation; Sikasil 728NS: www.usa.sika.com/#sle.

B. Type ___ - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
   1. Color: To match adjacent surfaces. Consult architect where adjacent to material color change..
   2. Products:
      a. Everkem Diversified Products, Inc; TruSil 100: www.everkemproducts.com/#sle.
      b. Pecora Corporation; Pecora 898 NST (Non-Staining Technology): www.pecora.com/#sle.
      c. Sika Corporation; Sikasil GP: www.usa.sika.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

C. Type ___ - Low Modulus, Silyl-Terminated Polyether (STPE) Joint Sealant: ASTM C920, Type S, Grade NS, Uses NT, A, M, Class 100/50. Tested in accordance with ASTM C1382.
   1. Movement Capability: Plus and minus ___ percent, minimum.
   2. Color: Match adjacent surfaces. Consult architect where material colors vary..
   3. Service Temperature Range: 40 to 100 degrees F (4 to 38 degrees C).
   4. Products:
      a. Sto Corp; StoSeal STPE Sealant: www.stocorp.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Type ___ - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Color: To be selected by Architect from manufacturer's standard range.
   3. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
   4. Products:
      a. Pecora Corporation; DynaTrol II: www.pecora.com/#sle.
      b. Pecora Corporation; DynaFlex: www.pecora.com/#sle.
      c. Sherwin-Williams Company; Stampede-1/-TX Polyurethane Sealant: www.sherwin-williams.com/#sle.
      d. Sika Corporation; Sikaflex-1a: www.usa.sika.com/#sle.

e. Sika Corporation; Sikaflex-15 LM: www.usa.sika.com/#sle.
f. Sika Corporation; Sikaflex-2c NS: www.usa.sika.com/#sle.
g. Substitutions: See Section 01 6000 - Product Requirements.

E. Type ___ - Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
1. Movement Capability: Plus and minus 35 percent, minimum.
2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.

F. Type ___ - Nonsag Traffic-Grade Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 20 to 30, Shore A, when tested in accordance with ASTM C661.
3. Color: Match adjacent finished surfaces.

G. Type ___ - Acrylic-Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; paintable; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
2. Hardness Range: 15 to 40, Shore A, when tested in accordance with ASTM C661.
3. Color: Match adjacent surfaces. Consult architect where material colors vary..
4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
5. Products:
a. DAP Products Inc; DYNAFLEX 920 Sealant: www.dapspecline.com/#sle.
b. Franklin International, Inc; Titebond UA 920 Sealant: www.titebond.com/#sle.
c. Sherwin-Williams Company; Shermax Urethanized Elastomeric Sealant: www.sherwin-williams.com/#sle.

H. Type ___ - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
3. Products:
a. Franklin International, Inc; Titebond Painter's Plus Caulk: www.titebond.com/#sle.
b. Sherwin-Williams Company; White Lightning 3006 Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
c. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
d. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound: www.tremcosealants.com/#sle.
e. Substitutions: See Section 01 6000 - Product Requirements.

I. Type ___ - Acrylic Latex Sealant: ASTM C834; for use as acoustical sealant and in firestopping systems for expansion joints and through penetrations.
1. Color: Standard colors matching finished surfaces.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Fire Rated System: Complies with UL 263 and ASTM E119 with UL fire resistance classifications.

2.04 SELF-LEVELING JOINT SEALANTS

A. Type ____ - Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

B. Preformed Extruded Silicone Joint Seal: Pre-cured low-modulus silicone extrusion, in sizes to fit applications indicated on drawings, combined with a neutral-curing liquid silicone sealant for bonding joint seal to substrates.
   1. Size: 1 inch (25.4 mm) wide, in rolls 100 feet (30.5 m) long.
   2. Thickness: 0.78 inch (19.8 mm), with ridges along outside bottom edges for bonding area.
   3. Color: As selected by Architect..
   4. Durometer Hardness, Type A: 26 to 32, minimum, when tested in accordance with ASTM D2240.
   5. Tensile Strength: 218 psi (1.5 MPa), in accordance with ASTM D412.
   6. Elongation at Break: 554 percent, in accordance with ASTM D412.
   7. Products:
      a. Tremco Commercial Sealants & Waterproofing; Spectrem Simple Seal: www.tremcosealants.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

G. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 08 0671

DOOR HARDWARE SCHEDULE

PART 2 PRODUCTS

1.01 FINISHES

A. Finishes: Complying with BHMA A156.18.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Thermally insulated hollow metal doors with frames.
E. Sound-rated hollow metal doors and frames.
F. Commercial security hollow metal doors and frames.
G. Detention security hollow metal doors and frames.
H. Blast-resistant hollow metal doors and frames.
I. Hurricane-resistant hollow metal doors and frames.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.
B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
C. Section 09 9113 - Exterior Painting: Field painting.
D. Section 09 9123 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.
C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
I. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
J. FBC TAS 201 - Impact Test Procedures; Testing Application Standard; 1994.
K. FBC TAS 202 - Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure; Testing Application Standard; 1994.
L. FBC TAS 203 - Criteria for Testing Products Subject To Cyclic Wind Pressure Loading; Testing Application Standard; 1994.
M. FLA (PAD) - Florida Building Code Online - Product Approval Directory; Current Edition.
N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
O. ITS (DIR) - Directory of Listed Products; Current Edition.

P. Miami (APD) - Approved Products Directory; Miami-Dade County; Current Edition.

Q. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

R. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

U. UFC 4-010-01 - DoD Minimum Antiterrorism Standards for Buildings; 2018, with Editorial Revision (2022).

V. UL (DIR) - Online Certifications Directory; Current Edition.

W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Design Submittals: Manufacturer to submit anchor design analysis calculations for blast-resistant doors signed and sealed by specialty design engineer experienced in this type of work and licensed in the State in which the Project is located.

1.05 QUALITY ASSURANCE

A. Wind Load Requirements: 130 mph exposure C, ASCE 7

B. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: https://steeldoor.org/sdi-certified/#sle.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

D. Maintain at project site copies of reference standards relating to installation of products specified.

E.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   3. Republic Doors, an Allegion brand; ____: www.republicdoor.com/#sle.
   4. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile: Manufacturers standard for application indicated.
   5. Typical Door Face Sheets: Flush.

6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
4. Door Finish: Factory primed and field finished.

C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
    a. Attach fire rating label to each fire rated unit.
4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
5. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

E. Type ___, Sound-Rated Interior Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 1 - Standard-duty.

b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.

2. Door Thickness: As required to meet acoustic requirements indicated.

F. Blast-Resistant Exterior Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 2 - Heavy-duty.
b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
c. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Blast Resistance: Complies with U.S. Department of Defense (DoD) UFC 4-010-01 standards with "High" levels of protection.
3. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements..
4. Door Thickness: 1-3/4 inch (44.5 mm).
5. Hinge Rail and Reinforcement: Non-beveled edge, reinforced with continuous steel channel, 12 gauge, 0.093 inch (2.3 mm) minimum metal thickness, welded at 5 inch (127 mm) on center maximum, and compatible with 4-1/2 inch (114 mm) full mortise template and continuous geared hinges.

G. Hurricane-Resistant Doors:
1. Comply with Florida Building Code (FBC) test protocols for High Velocity Hurricane Zone (HVHZ) FBC TAS 201, FBC TAS 202 and FBC TAS 203.
2. Design and size door and frame components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M.
a. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
b. Wind-Borne Debris Resistance: Door and frame components shall have FLA (PAD) approval or Miami (APD) approval for Large and Small Missile impact and pressure cycling at design wind loads.
3. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 3 - Extra Heavy-duty.
b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
4. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
5. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Coordinate door frame prepatation with hardware and access control wiring and requirements.

C. Frame Finish: Factory primed and field finished.

D. Exterior Door Frames: Knock-down type.
1. Weatherstripping: Separate, see Section 08 7100.

E. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.

F. Door Frames, Fire-Rated: Knock-down type.
1. Fire Rating: Same as door, labeled.

G. Sound-Rated Door Frames: Knock-down type.

H. Commercial and/or Detention Security-Resistant Door Frames: With same security resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.

I. Blast-Resistant Door Frames: With same blast resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.

J. Hurricane-Resistant Door Frames: With same hurricane resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.

K. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch (0.4 mm) dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
   1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.06 ACCESSORIES

A. Astragals for Double Doors:
   1. Exterior Doors: Steel, Z-shaped.
   2. Fire-Rated Doors: Steel, shape as required for fire rating.

B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 7100.

3.04 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

3.06 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, special function, and _____.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

B. Section 08 7100 - Door Hardware.

C. Section 08 8000 - Glazing.

D. Section 09 9123 - Interior Painting: Field finishing of doors.

E. Section 09 9300 - Staining and Transparent Finishing: Field finishing of doors.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

C. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Masonite Architectural; Aspiro Select Wood Veneer Doors: www.architectural.masonite.com/#sle.
   2. VT Industries, Inc; ____: www.vtindustries.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

3. Wood veneer facing for field transparent finish as indicated on drawings.
4. Wood veneer facing for field opaque finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Any option allowed by quality standard for grade.
   2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet (3 m) of each other when doors are closed.

B. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.

C. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
   1. Exception: Doors to be field finished.

E. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 5, Varnish, Conversion.
      b. Stain: As selected by Architect.
      c. Sheen: Semigloss.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

A. Glazing: See Section 08 8000.

B. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

C. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

D. Door Hardware: See Section 08 7100.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

3.02 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.03 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.04 SCHEDULE

A. See Door and Frame Schedule appended to this section.

END OF SECTION

SECTION 08 3100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall-mounted access units.

B. Wall- and ceiling-mounted access units.

1.02 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products; Current Edition.

B. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

D. Project Record Documents: Record actual locations of each access unit.

1.04 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units with Return Air Grille:
   1. Size: 12 by 12 inches (305 by 305 mm).
   2. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   3. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
   4. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.

B. Wall-Mounted Units in Wet Areas:
   1. Size: 12 by 12 inches (305 by 305 mm).
   2. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   3. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
   4. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
   5. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.

C. Fire-Rated Wall-Mounted Units:
   1. Wall Fire-Rating: As indicated on drawings.
   2. Size: 12 by 12 inches (305 by 305 mm).
   3. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.

D. Fire-Rated Ceiling-Mounted Units:
   1. Ceiling Fire-Rating: As indicated on drawings.
   2. Size: 12 by 12 inches (305 by 305 mm).

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Steel.
   2. Door Style: Single thickness with rolled or turned in edges.

3. Frames: 16-gauge, 0.0598-inch (1.52 mm) minimum thickness.
4. Heavy-Duty Frames: 14-gauge, 0.0747-inch (1.89 mm) minimum thickness.
5. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch (15.9 mm) back from wall face.
6. Insulation: Non-combustible mineral wool or glass fiber.
7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
   a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
8. Steel Finish: Primed.
9. Primed and Factory Finish: Polyester powder coat; _____ .
10. Hardware:
    a. Hardware for Fire-Rated Units: As required for listing.
    b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
    c. Latch/Lock: Tamperproof tool-operated cam latch.

2.03 WALL-MOUNTED ACCESS UNITS WITH RETURN AIR GRILLES

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 PREPARATION

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 3326
OVERHEAD COILING GRILLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead coiling metal grilles and operating hardware; electrically or manually operated.

B. Wiring from electric circuit disconnect to operator and to control station.

1.02 RELATED REQUIREMENTS

A. Section 26 0583 - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products; Current Edition.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

D. NEMA MG 1 - Motors and Generators; 2021.

E. UL (DIR) - Online Certifications Directory; Current Edition.

F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide, _____, general construction component connections and details, and electrical equipment.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Overhead Coiling Grilles:
   1. Cornell Iron Works, Inc; _____: www.cornelliron.com/#sle.
   2. The Cookson Company; ____: www.cooksondoor.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GRILLES AND COMPONENTS

A. Grille: Aluminum; horizontal bar curtain, coiling on overhead counterbalanced shaft.
   1. Finish: Anodized, color as selected by Architect.
   2. Mounting: As indicated on drawings.

B. Curtain: Round horizontal bars connected with vertical links.
   1. Horizontal bars: 5/16 inch (8 mm) diameter.
   2. Bar spacing: 1-1/2 inch (38 mm) on center.
   3. Tube spacers: 1/2 inch (13 mm) diameter.
   4. Spacer spacing: 3-1/4 inch (83 mm) on center.
   5. Link spacing: 9 inch (229 mm) on center.
   6. Bar Ends: Provide with nylon runners for quiet operation.
   7. Bottom Bar: Back-to-back angles with tubular resilient cushion.

C. Guides: Extruded aluminum angles, of profile to retain grille in place with snap-on trim, mounting brackets of same metal.

D. Hood Enclosure and Trim: Sheet metal; completely covering operating mechanisms; internally reinforced to maintain rigidity and shape.
   1. Material: Same metal as grille.

E. Lock Hardware:

F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb (10 kg) nominal force to operate.

2.03 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M).

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.

B. Electric Operators:
   1. Mounting: Side mounted, outboard of jamb. See drawings.
   2. Motor Enclosure:
      a. Interior Coiling Grilles: NEMA MG 1, Type 1; open drip proof.
   3. Motor Rating: 1/3 hp (250 W); continuous duty.
   4. Motor Voltage: 120 volts, single phase, 60 Hz.
   5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
   6. Controller Enclosure: NEMA 250 Type 1.
   7. Opening Speed: 6 inches per second (150 mm/sec).
   8. Brake: Adjustable friction clutch type, activated by motor controller.
   9. Manual override in case of power failure.
   10. Refer to Section 26 0583 for electrical connections.

C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
   1. 24 volt circuit.
   2. Surface mounted, at exterior location as indicated on drawings.
   3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
      a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

D. Safety Edge: Located at bottom of coiling grill, full width, electro-mechanical sensitized type, wired to stop and reverse grill direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that adjacent construction is suitable for door installation.

B. Verify that electrical services have been installed and are accessible.

C. Verify that door opening is plumb, header is level, and dimensions are correct.

D. Notify Architect of any unacceptable conditions or varying dimensions.

E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.02 INSTALLATION

A. Install grille unit assembly in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 26 0583.

F. Complete wiring from disconnect to unit components.

G. Install enclosure and perimeter trim.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch (1.5 mm).

C. Maximum Variation From Level: 1/16 inch (1.5 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft (3 mm per 3 m) straight edge.

3.04 ADJUSTING

A. Adjust grille, hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean grille and components.

B. Remove labels and visible markings.

END OF SECTION

SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum doors and frames for installation in glazed aluminum curtain walls.

B. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 4229 - Automatic Entrances.

C. Section 08 4413 - Glazed Aluminum Curtain Walls.

D. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.

E. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

H. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

J. FLA (PAD) - Florida Building Code Online - Product Approval Directory; Current Edition.

K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

A. Center-Set Style, Wind-Borne-Debris Resistance Tested:

B. Front-Set Style:
   1. Basis of Design: YKK, YES 50D.

C. Other Manufacturers: Not permitted; provide the product identified as "Basis of Design".

2.02 BASIS OF DESIGN -- SWINGING DOORS

A. Entrance Doors, Various Stile Widths:
   1. Basis of Design: YKK 50H wide stile.
   2. Blast Mitigation Tested:
      a. See Design Criteria on Structural drawings.

B. Wind-Borne-Debris Resistance Tested:
   1. Basis of Design: Large & Small Missile Impact – To 90 PSF.

C. Interior Wide Stile, Monolithic Glazing:
   1. Basis of Design: YKK 50 D wide stile.

2.03 ALUMINUM-FRAMED STOREFRONT

A. Provide door framing as required for installation in for installation in glazed aluminum curtain walls. See section 08 4413 - Glazed Aluminum Curtain Walls.

B. See Design Criteria on Structural drawings for blast and wind resistance requirements.

C. Performance Requiements: Door and door frames to be coordinated with performance requirements of glazed aluminum curtain wall system.
   1. See Design Criteria on Structural drawings for blast and wind resistance requirements.
   2. See section 08 4413 - Glazed Aluminum Curtain Walls.
   3. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

D. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

1. Finish: Class I color anodized.
   a. Factory finish all surfaces that will be exposed in completed assemblies.
2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

E. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.

2.04 COMPONENTS

A. Aluminum Door Frames Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. See Design Criteria on Structural drawings for blast and wind resistance requirements.
2. Framing members for interior applications need not be thermally broken.
3. Framing members for interior applications need not meet blast or wind Design Criteria.
4. Glazing Stops: Flush.
5. Cross-Section: As indicated on drawings.
6. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: See Section 08 8000.

C. Swing Doors: As idnidcated by Basis-Of-Design..

2.05 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

D. Fasteners: Stainless steel.

E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

F. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.06 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
1. Coordinate finish with adjacent curtain wall assembly.

2.07 HARDWARE

A. Other Door Hardware: See Section 08 7100.

B. Other Door Hardware: Storefront manufacturer's standard type to suit application.

1. Finish on Hand-Contacted Items: Polished chrome.
2. For each door, include butt hinges and pivots.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

F. Automatic Door Operators and Actuators: See Section 08 4229.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Aluminum corner covers.

B. Section 08 8000 - Glazing.

1.02 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.

D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

F. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

J. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

K. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

N. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2020.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, _____, and infill.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.

E. Structural Sealant Glazing (SSG): Submit product data and calculations showing compliance with performance requirements.

F. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

H. Designer's Qualification Statement.

I. Manufacturer's Qualification Statement.

J. Installer's Qualification Statement.

K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties: size, shape, dimensions, material, durability, storage conditions, and color.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.06 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with installer.

C. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glazed Aluminum Curtain Walls Manufacturers:
   1. Basis-Of-Design: YKK AP America, Inc; YHC 300 OG: www.ykkap.com/commercial/#sle.
      a. Mullion depth varies by location, as indicated on drawings.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BASIS OF DESIGN - CURTAIN WALL SYSTEMS

A. Basis-Of-Design: YKK AP America, Inc; YHC 300 OG:
   1. Mullion depth varies by location, as indicated on drawings.

B. Strucutral requirements for wind, blast and seismic as indicated on Structural drawings.

2.03 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
   2. Mullion Dimenions: Dimenions vary. See locations, as indicated on drawings:
      a. Vertical Mullion Dimensions: 3 inches wide by 10-1/2 inches deep.
      b. Vertical Mullion Dimensions: 3 inches wide by 7-3/4 inches deep.

3. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
1. See Design Criteria on structural drawings.
2. Blast Loads:
   a. Comply with the requirements of US Department Of Defense, Unified Facilites Criteria (UFC).
   b. Measure performance by testing in accordancde with ASTM F2248-19.
3. Design Wind Loads: Comply with the requirements of ASCE 7.
   a. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
   b. Member Deflection: For spans less than 13 feet 6 inches (4115 mm), limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (19 mm), whichever is less and with full recovery of glazing materials.
   c. Member Deflection: For spans over 13 feet 6 inches (4115 mm) and less than 40 feet (12.2 m), limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch (1/240 of span plus 6.4 mm), with full recovery of glazing materials.
4. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
5. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
6. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection tested by independent agency in accordance with ASTM E1996 for Wind Zone 3 - Enhanced Protection for Large and Small Missile impact and pressure cycling at design wind pressure.
7. Movement: Accommodate the following movement without damage to components or deterioration of seals:
   a. Expansion and contraction caused by 180 degrees F (82 degrees C) surface temperature.
   b. Expansion and contraction caused by cycling temperature range of 170 degrees F (77 degrees C) over a 12 hour period.
   c. Movement of curtain wall relative to perimeter framing.
   d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
1. Test Pressure Differential: 20 psf (960 Pa).
2. Test Method: ASTM E331.

D. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf (300 Pa) pressure difference across assembly.

E. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
   2. Thermal Resistance of Framing:.45 (deg F hr sq ft)/Btu (_____ (K sq m)/W), minimum.

2.04 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

B. Glazing: See Section 08 8000.
   1. For Exterior Framing: Type Insulated Glass Unit as indicated on drawings..
   2. For Interior Framing: Type Monolithic Glass as inidcated on drawings..
   3. Glass Spandrel Panels: Type Insulated Glass Unit as indicated on drawings..

2.05 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

D. Exposed Flashings: Aluminum sheet, 20-gauge, 0.032-inch (0.81 mm) minimum thickness; finish to match framing members.

E. Concealed Flashings: Sheet aluminum, 26-gauge, 0.017-inch (0.43 mm) minimum thickness.

F. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.

G. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.

H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

I. Glazing Accessories: See Section 08 8000.

2.06 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm/m) noncumulative or 0.5 inches per 100 feet (12 mm/30 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6 mm).

3.04 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

B. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.

C. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

D. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Schedule”.
2. Division 08 Section “Hollow Metal Doors and Frames”.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
5. Division 08 Section “Automatic Door Operators”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.

8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must

precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.
    c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Please note that ASSA ABLOY is transitioning the Yale Commercial brand to Arrow. This affects only the brand name; the products and product numbers will remain unchanged. The brand transition is expected to be complete in or about May of 2024, and products shipping after that time will be branded Arrow.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

    a. Two Hinges: For doors with heights up to 60 inches.
    b. Three Hinges: For doors with heights 61 to 90 inches.
    c. Four Hinges: For doors with heights 91 to 120 inches.
    d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

    a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
    b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

    a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

    a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

    a. Hager Companies (HA) - BB Series, 5 knuckle.
    b. McKinney (MK) - TA/T4A Series, 5 knuckle.
    c. dormakaba Best (ST) - F/FBB Series, 5 knuckle.

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

    a. Hager Companies (HA).
    b. Pemko (PE).
    c. Dormakaba Best (ST).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. McKinney (MK) - QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Securitron (SU) - EL-CEPT Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.

1. Manufacturers:

    a. Door Controls International (DC).
    b. Rockwood (RO).
    c. Trimco (TC).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

6. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

a. Corbin Russwin Hardware (RU).

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

F. Construction Keying: Provide construction master keyed cylinders.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Heavy duty mortise locks shall have a ten-year warranty.

2. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180-degree viewing angle with protective covering to prevent tampering.

3. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ML2000 Series.
    b. Schlage (SC) – L900 Series
    c. Sargent Manufacturing (SA) – 8200 Series

2.7 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

3. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ML20900 Series.
    b. Sargent Manufacturing (SA) - 8200 Series.
    c. Schlage (SC) - L9000 EL/EU/RX Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.

2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) – 80 Series
c. Dormakaba Best (PR) – Apex 2000 Series

2.10 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.

1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.

3. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED5000 Series.
b. dormakaba Precision (PR) - Apex 2000 Series.
c. Sargent Manufacturing (SA) - 80 Series.

2.11 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Large body cast iron surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

a. Norton Rixson (NO) - 9500 Series.
b. LCN Closers (LC) - 4040XP Series.
c. Norton Rixson (NO) - 9500 Series.

C. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted closers with door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.

1. Manufacturers:

a. Norton Rixson (NO)
b. LCN Closers (LC)
c. Norton Rixson (NO)

2.12 ELECTROHYDRAULIC DOOR OPERATORS

A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Conforming to ANSI/BHMA A156.19.

C. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Norton Rixson (NO) - 6000 Series.

2.13 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

2.14 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. Norton Rixson (RF).
    b. Sargent Manufacturing (SA).

2.15 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko (PE).
3. Reese Enterprises, Inc. (RE).

2.16 ELECTRONIC ACCESSORIES

A. Key Switches: Key switches furnished standard with stainless steel single gang face plate with a 12/24VDC bi-color LED indicator. Integral backing bracket permits integration with any 1 1/4" or 1 1/2" mortise type cylinder. Key switches available as momentary or maintained action and in narrow face plate options.

1. Manufacturers:

a. Securitron (SU) - MK Series.

B. Touchless Switches: FCC certified microwave sensing switch used for REX or activation of various access control devices in place of a traditional wired switch. Unit to have an adjustable sensing zone from 4” to 24”. At exterior locations furnish foam gaskets and weather covers. Provide single gang or double gang unit as specified in the hardware sets.

1. Manufacturers:

a. Norton Rixson (NO) - 700 Series.

C. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Securitron (SU) - DPS Series.

D. Linear Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw plus 50% for the specified electrified hardware and access control equipment.

1. Manufacturers:

a. Securitron (SU) - BPS Series.
b. Corbin Russwin (RU) 784.

E. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.

1. Manufacturers:

a. Securitron (SU) - AQL Series.

2.17 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. RU - Corbin Russwin
5. OT - Other
6. RF - Rixson
7. NO - Norton
8. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 101A

1 Continuous Hinge	CFM__SLF-HD1 PT - DOOR HEIGHT		PE
1 Rim Exit Device, Nightlatch	ED4200 K157ET M92 MELR M52 CT6R	630	RU
2 Interchangeable Core	CR8000	626	RU
1 Mortise Cylinder Housing	CR1070 (CAM/LENGTH TO SUIT)	630	RU
1 Pull	RM201 Mtg-Type 1XHD	US32D	RO
1 Automatic Opener	6011/6021 (TO SUIT)	689	NO
1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
1 Sweep (w/ drip edge)	3452CNB		PE
1 Frame Harness	QC-C1500P		MK
1 Door Harness	QC-CXXX- LENGTH TO SUIT		MK
1 Card Reader	Provided By Security Supplier		OT
1 Position Switch	DPS-M/W-BK (TO SUIT)		SU
2 Wall Wave Switch	700		NO
1 Power Supply	AQLxx-R8E1 (TO SUIT)		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		
1 Electric Power Transfer	EL-CEPT	630	SU

Notes:
• Perimeter and meeting stile gasket by door / frame manufacturer.
• Keyswitch powers operator switches. Switch to be turned off when door is locked.
• Doors to be dogged during the day.
• Electronic Operation: Outside, Card reader signals power supply to retract exit device latch allowing entry by door pull or automatic operator by wall switch. Key override. Inside, Free egress at all times by exit device with request to exit in panic bar or automatic operator by wall switch with request to exit switch in operator switch. In case of power loss, door remains locked and latched.

Set: 2.0

Doors: 102A, 102B

1 Continuous Hinge	CFM__SLF-HD1 - DOOR HEIGHT		PE

1 Rim Exit Device, Exit Only	ED4200 EO M61 CT6R	630	RU
1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	UNI9500	689	NO
1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
1 Sweep (w/ drip edge)	3452CNB		PE
1 Position Switch	DPS-M/W-BK (TO SUIT)		SU

Notes:

• Perimeter and meeting stile gasket by door / frame manufacturer.
• Open from exterior with key only, no pulls.
•Pushing on panic bar sounds alarm. Key arms/disarms alarm function. Free egress at all times.

Set: 3.0

Doors: 104

2 Continuous Hinge	CFM__SLF-HD1 PT - DOOR HEIGHT		PE
1 Concealed Vert Rod Exit, Exit Only	ED5800 EO M92 MELR M52 CT6R	630	RU
1 Concealed Vert Rod Exit, Nightlatch	ED5800 K157ET M92 MELR M52 CT6R	630	RU
3 Interchangeable Core	CR8000	626	RU
2 Mortise Cylinder Housing	CR1070 (CAM/LENGTH TO SUIT)	630	RU
2 Pull	RM201 Mtg-Type 1XHD	US32D	RO
1 Surface Closer	UNI9500	689	NO
1 Automatic Opener	6011/6021 (TO SUIT)	689	NO
1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
2 Sweep (w/ drip edge)	3452CNB		PE
2 Frame Harness	QC-C1500P		MK
2 Door Harness	QC-CXXX- LENGTH TO SUIT		MK
2 Door Position Switch	DPS-M/W-BK (TO SUIT)		SU
2 Wall Wave Switch	700		NO
1 Keyswitch	MKAN		SU
1 Power Supply	AQLxx-R8E1		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		OT

2 Electric Power Transfer	EL-CEPT	630	SU

Notes:
• Perimeter and meeting stile gasket by door / frame manufacturer.
• Keyswitch powers operator switches. Switch to be turned off when door is locked.
• Doors to be dogged prior to automatic operation.
• Electronic operation: Outside, Free ingress at all times by door pull/push plate or automatic operator by wall switch. Inside, Free egress at all times by push plate/door pull or automatic operator by wall switch.

Set: 4.0

Doors: 101B, 129A

1 Continuous Hinge	CFM__SLF-HD1 - DOOR HEIGHT		PE
1 Rim Exit Device, Nightlatch	ED4200 K157ET M92 M52 CT6R	630	RU
2 Interchangeable Core	CR8000	626	RU
1 Mortise Cylinder Housing	CR1070 (CAM/LENGTH TO SUIT)	630	RU
1 Pull	RM201 Mtg-Type 1XHD	US32D	RO
1 Surface Closer	UNI9500	689	NO
1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
1 Sweep (w/ drip edge)	3452CNB		PE
1 Position Switch	DPS-M/W-BK (TO SUIT)		SU

Notes:

• Perimeter and meeting stile gasket by door / frame manufacturer.
• Door to remain unlocked during the day.

Set: 5.0

Doors: 129B

1 Continuous Hinge	CFM__SLF-HD1 - DOOR HEIGHT		PE
1 Rim Exit Device, Nightlatch	ED4200 K157ET M52 CT6R	630	RU
2 Interchangeable Core	CR8000	626	RU
1 Mortise Cylinder Housing	CR1070 (CAM/LENGTH TO SUIT)	630	RU
1 Automatic Opener	6011/6021 (TO SUIT)	689	NO

2 Wall Wave Switch	700		NO
1 Keyswitch	MKAN		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		

Notes:
• Perimeter and meeting stile gasket by door / frame manufacturer.
• Keyswitch powers operator switches. Switch to be turned off when door is locked.
• Doors to be dogged prior to automatic operation.
• Electronic operation: Outside, Free ingress at all times by door pull/push plate or automatic operator by wall switch. Inside, Free egress at all times by push plate/door pull or automatic operator by wall switch.

Set: 6.0

Doors: 100B, 119B, 124B

1 Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE
1 Rim Exit Device, Nightlatch	ED5200 K157ET CT6R	630	RU
1 Interchangeable Core	CR8000	626	RU
1 Pull	RM201 Mtg-Type 1XHD	US32D	RO
1 Surface Closer	UNI9500	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
1 Gasketing (Head/Jambs)	S773BL		PE
1 Sweep (w/ drip edge)	3452CNB		PE
1 Position Switch	DPS-M/W-BK (TO SUIT)		SU

Set: 7.0

Doors: 123B

1 Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE
1 Continuous Hinge	CFM__HD1 PT - DOOR HEIGHT		PE
1 Flush Bolt (Automatic, set)	2842/2962 (TO SUIT)	US26D	RO
1 Fail Secure Lock	ML20906-SEC 102T M92 CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
1 Coordinator	2600 Series x Wear Plates	Black	RO
2 Mounting Bracket	2601AB / C (type as req)	Black	RO
2 Surface Closer	UNI9500	689	NO
2 Kick Plate	K1050 10" CSK	US32D	RO

1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
1 Gasketing (Head/Jambs)	S773BL		PE
2 Sweep (w/ drip edge)	3452CNB		PE
1 Astragal (Overlapping)	357SP		PE
1 Astragal (Meeting Edge)	S771C		PE
1 Frame Harness	QC-C1500P		MK
1 Door Harness	QC-CXXX- LENGTH TO SUIT		MK
1 Card Reader	Provided By Security Supplier		OT
2 Position Switch	DPS-M/W-BK (TO SUIT)		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		OT

Notes:
• Electronic Operation: Valid card unlocks outside lever or key retracts latchbolt. Request to exit shows authorized egress. Free egress at all times. In case of power loss, door remains locked and latched.

Set: 8.0

Doors: 126, 127

2 Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE
2 Flush Bolt (Manual)	555/557 (TO SUIT)	US26D	RO
1 Storeroom Lock	ML2057 102T CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
1 Surf Overhead Stop	9-X36	630	RF
2 Surface Closer	UNI9500	689	NO
2 Kick Plate	K1050 10" CSK	US32D	RO
1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
1 Gasketing (Head/Jambs)	S773BL		PE
2 Sweep (w/ drip edge)	3452CNB		PE
1 Astragal (Overlapping)	357SP		PE
1 Astragal (Meeting Edge)	S771C		PE
2 Position Switch	DPS-M/W-BK (TO SUIT)		SU

Set: 9.0

Doors: 128B

1 Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE

1 Storeroom Lock	ML2057 102T CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	PR9500H	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Threshold	252x3AFG MSES25SS		PE
1 Rain Guard	346C		PE
1 Gasketing (Head/Jambs)	S773BL		PE
1 Sweep (w/ drip edge)	3452CNB		PE
1 Position Switch	DPS-M/W-BK (TO SUIT)		SU

Notes:
•Template closer to swing and hold open

Set: 10.0

Doors: 101D, 103, 129D

4 Hinge (heavy weight)	T4A3786	US26D	MK
1 Rim Exit Device, Nightlatch	ED4200 K157ET M52 CT6R	630	RU
2 Interchangeable Core	CR8000	626	RU
1 Mortise Cylinder Housing	CR1070 (CAM/LENGTH TO SUIT)	630	RU
1 Pull	RM201 Mtg-Type 1XHD	US32D	RO
1 Surface Closer	UNI9500	689	NO

Notes:
• Perimeter/meeting stile seals by frame/door supplier.
• Door to remain dogged down during occupancy.

Set: 11.0

Doors: 101C, 129C

1 Continuous Hinge	CFM__SLF-HD1 - DOOR HEIGHT		PE
1 Rim Exit Device, Nightlatch	ED4200 K157ET M52 CT6R	630	RU
2 Interchangeable Core	CR8000	626	RU
1 Mortise Cylinder Housing	CR1070 (CAM/LENGTH TO SUIT)	630	RU
1 Pull	RM201 Mtg-Type 1XHD	US32D	RO
1 Automatic Opener	6011/6021 (TO SUIT)	689	NO

2 Wall Wave Switch	700	NO
1 Keyswitch	MKAN	SU
1 Wiring Diagram	Elevation and Point to Point as Specified	

Notes:
• Perimeter and meeting stile gasket by door / frame manufacturer.
• Keyswitch powers operator switches. Switch to be turned off when door is locked.
• Doors to be dogged prior to automatic operation.
• Electronic operation: Outside, Free ingress at all times by door pull/push plate or automatic operator by wall switch. Inside, Free egress at all times by push plate/door pull or automatic operator by wall switch.

Set: 12.0

Doors: 119A

2 Hinge (heavy weight)	T4A3786	US26D	MK
1 Electric Hinge (heavy weight)	T4A3786-QC12	US26D	MK
1 Rim Exit Device, Passage	ED5200 102910ET M61 M91 M93	630	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
3 Silencer	608/609 (TO SUIT)		RO
1 Frame Harness	QC-C1500P		MK
1 Door Harness	QC-CXXX- LENGTH TO SUIT		MK
1 Card Reader	Provided By Security Supplier		OT
1 Position Switch	DPS-M/W-BK (TO SUIT)		SU
1 Harness	709F989		RU
1 Power Supply	784		OT
1 Power Supply	AQLxx-R8E1 (TO SUIT)		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		

Notes:
• Electronic Operation: Valid card shunts alarm function; Depressing touchbar with no valid card permits free egress with alarm sounding. Free egress and ingress at all times. Key on panic device arms/disarms alarm function.

Set: 13.0

Doors: 124A

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Rim Exit Device, Nightlatch	ED5200 102957ET CT6R	630	RU
1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
3 Silencer	608/609 (TO SUIT)		RO

Set: 14.0

Doors: 201

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Fire Rated Rim Exit, Nightlatch	ED5200A 102957ET CT6R	630	RU
1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
1 Gasketing (Head/Jambs)	S88BL		PE

Set: 15.0

Doors: 100A

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Fire Rated Rim Exit, Passage	ED5200A 102910ET	630	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
1 Gasketing (Head/Jambs)	S88BL		PE

Set: 16.0

Doors: 113

5 Hinge (heavy weight)	T4A3786	US26D	MK
1 Electric Hinge (heavy weight)	T4A3786-QC12	US26D	MK
1 Dust Proof Strike	570	US26D	RO
1 Flush Bolt (Automatic, set)	2842/2962 (TO SUIT)	US26D	RO
1 Fail Secure Lock	ML20906-SEC 102T M92 CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU

1 Coordinator	2600 Series x Wear Plates	Black	RO
2 Mounting Bracket	2601AB / C (type as req)	Black	RO
2 Surface Closer	R/PR9500 (TO SUIT)	689	NO
2 Kick Plate	K1050 10" CSK	US32D	RO
2 Silencer	608/609 (TO SUIT)		RO
1 Frame Harness	QC-C1500P		MK
1 Door Harness	QC-CXXX- LENGTH TO SUIT		MK
1 Card Reader	Provided By Security Supplier		OT
2 Position Switch	DPS-M/W-BK (TO SUIT)		SU
1 Power Supply	AQLxx-R8E1 (TO SUIT)		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		

Notes:
• Electronic Operation: Valid card unlocks outside lever or key retracts latchbolt. Request to exit shows authorized egress. Free egress at all times. In case of power loss or fire alarm, door remains locked and latched.

Set: 17.0

Doors: 123A

5 Hinge (heavy weight)	T4A3786	US26D	MK
1 Electric Hinge (heavy weight)	T4A3786-QC12	US26D	MK
1 Dust Proof Strike	570	US26D	RO
1 Flush Bolt (Automatic, set)	2842/2962 (TO SUIT)	US26D	RO
1 Fail Secure Lock	ML20906-SEC 102T M92 CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
1 Coordinator	2600 Series x Wear Plates	Black	RO
2 Conc Overhead Stop	1-x36	630	RF
2 Surface Closer	R/PR9500 (TO SUIT)	689	NO
2 Kick Plate	K1050 10" CSK	US32D	RO
2 Silencer	608/609 (TO SUIT)		RO
1 Frame Harness	QC-C1500P		MK
1 Door Harness	QC-CXXX- LENGTH TO SUIT		MK
1 Card Reader	Provided By Security Supplier		OT
2 Position Switch	DPS-M/W-BK (TO SUIT)		SU
1 Power Supply	AQLxx-R8E1 (TO SUIT)		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		

Notes:
• Electronic Operation: Valid card unlocks outside lever or key retracts latchbolt. Request to exit shows authorized egress. Free egress at all times. In case of power loss or fire alarm, door remains locked and latched.

Set: 18.0

Doors: 112

2 Hinge (heavy weight)	T4A3786	US26D	MK
1 Electric Hinge (heavy weight)	T4A3786-QC12	US26D	MK
1 Fail Secure Lock	ML20906-SEC 102T M92 CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
3 Silencer	608/609 (TO SUIT)		RO
1 Frame Harness	QC-C1500P		MK
1 Door Harness	QC-CXXX- LENGTH TO SUIT		MK
1 Card Reader	Provided By Security Supplier		OT
1 Position Switch	DPS-M/W-BK (TO SUIT)		SU
1 Power Supply	AQLxx-R8E1 (TO SUIT)		SU
1 Wiring Diagram	Elevation and Point to Point as Specified		

Notes:
• Electronic Operation: Valid card unlocks outside lever or key retracts latchbolt. Request to exit shows authorized egress. Free egress at all times. In case of power loss or fire alarm, door remains locked and latched.

Set: 19.0

Doors: 122A, 122B

2 Hinge (heavy weight)	T4A3786	US26D	MK
1 Electric Hinge (heavy weight)	T4A3786-QC12	US26D	MK
1 Fail Secure Lock	ML20906-SEC 102T M92 CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
1 Gasketing (Head/Jambs)	S88BL		PE

1 Frame Harness	QC-C1500P	MK
1 Door Harness	QC-CXXX- LENGTH TO SUIT	MK
1 Card Reader	Provided By Security Supplier	OT
1 Position Switch	DPS-M/W-BK (TO SUIT)	SU
1 Power Supply	AQLxx-R8E1 (TO SUIT)	SU
1 Wiring Diagram	Elevation and Point to Point as Specified	

Notes:
• Electronic Operation: Valid card unlocks outside lever or key retracts latchbolt. Request to exit shows authorized egress. Free egress at all times. In case of power loss or fire alarm, door remains locked and latched.

Set: 20.0

Doors: 116

6 Hinge, Full Mortise	TA2714	US26D	MK
1 Dust Proof Strike	570	US26D	RO
2 Flush Bolt (Manual)	555/557 (TO SUIT)	US26D	RO
1 Storeroom Lock	ML2057 102T CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
2 Surf Overhead Stop	10-X36	630	RF
2 Silencer	608/609 (TO SUIT)		RO

Set: 21.0

Doors: 106, 111, 125

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom Lock	ML2057 102T CT6R	626	RU
1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
3 Silencer	608/609 (TO SUIT)		RO

Set: 22.0

Doors: 128A

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	ML2055 102T CT6R	626	RU

1 Interchangeable Core	CR8000	626	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
3 Silencer	608/609 (TO SUIT)		RO

Set: 23.0

Doors: 109

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Privacy Lock	ML2060 102T V21	626	RU
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Mop Plate	K1050 4" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
3 Silencer	608/609 (TO SUIT)		RO
1 Coat Hook	RM802	US32D	RO

Set: 24.0

Doors: 107, 108

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Door Pull	RM3300-13 Mtg-Type 1	US32D	RO
1 Push Plate	70C	US32D	RO
1 Surface Closer	R/PR9500 (TO SUIT)	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Mop Plate	K1050 4" CSK	US32D	RO
1 Door Stop	403/441CU (TO SUIT)	US26D	RO
3 Silencer	608/609 (TO SUIT)		RO

Set: 25.0

Doors: 103C

0 All Hardware	BY DOOR SUPPLIER

Set: 26.0

Doors: 115, 117

1 Cylinder/Core	Provided by Door Supplier	OT
1 All Hardware	BY DOOR SUPPLIER	

END OF SECTION 087100

SECTION 08 8000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Plastic sheet glazing units.

D. Laminated glass interlayers.

E. Decorative Glass.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

B. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

C. Section 08 3223 - Sliding and Folding Glazed Walls and Doors: Glazing provided by door manufacturer.

D. Section 08 4313 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

E. Section 08 4413 - Glazed Aluminum Curtain Walls: Glazing provided as part of wall assembly.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

D. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

E. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

F. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

G. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

H. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2020.

I. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2020.

J. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data on Insulating Glass Unit, Glazing Unit, Plastic Sheet Glazing Unit, Plastic Film, and _____ Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Insulating Glass Units: One of each glass size and each glass type.

1.06 QUALITY ASSURANCE

1.07 FIELD CONDITIONS

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
   1. Cardinal Glass Industries; _____: www.cardinalcorp.com/#sle.
   2. Vitro Architectural Glass (formerly PPG Glass); _____: www.vitroglazings.com/#sle.

B. Laminated Glass Manufacturers:
   1. Cardinal Glass Industries; _____: www.cardinalcorp.com/#sle.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   3. Glass thicknesses listed are minimum.

B. Blast Resistance: Provide completed assemblies that meet blast resistant requirements as outlined in UFC-4-010-01, Section B-3.1, untilizing "Conventional Construction Standoff Distances".

C. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:

D. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 INSULATING GLASS UNITS

A. Manufacturers:
   1. Cardinal Glass Industries; _____: www.cardinalcorp.com/#sle.
   2. Pilkington North America Inc; _____: www.pilkington.com/na/#sle.
   3. Vitro Architectural Glass (formerly PPG Glass); _____: www.vitroglazings.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

C. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Spacer Color: Black.
4. Edge Seal:
   a. Color: Black.
5. Purge interpane space with dry air, hermetically sealed.

D. Type GL-01 - Insulating Glass Units: Vision glass, double glazed. Low-E, HS and Laminated
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Clear.
   b. Coating: Low-E (passive type), on #2 surface.
4. Inboard Lite: Laminated float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Clear.
5. Total Thickness: 1 1/4 inch (____ mm). Verify and coordinate with curtain wall manufactuer.
6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.26, maximum.
7. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.28, maximum.
8. Visible Light Transmittance (VLT): _____ percent, nominal.
9. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.

E. Type GL-02 - Insulating Glass Units: Vision glass, double glazed. Low-E, Tempered and Laminated
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Clear.
4. Inboard Lite: Laminated float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Clear.
5. Total Thickness: [1 1/4] inch ([____] mm). Verify and coordinate with curtain wall manufactuer.
6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.26, maximum.
7. Thermal Transmittance (U-Value), Winter - Center of Glass: [0.28], maximum.
8. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.

F. Type GL-03 - Insulating Glass Units: Spandrel, double glazed. Low-E, HS and Laminated
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Clear.
4. Inboard Lite: Laminated float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Surface 3: clear
   b. Tint: Surface 4: Opacified with a.acid-etched appearnce.
5. Total Thickness: [1 1/4] inch ([____] mm). Verify and coordinate with curtain wall manufactuer.
6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.26, maximum.
7. Thermal Transmittance (U-Value), Winter - Center of Glass: [0.28], maximum.
8. Solar Heat Gain Coefficient (SHGC): [0.25], maximum.

G. Type GL-08 - Interior double glazed unit: HS Fully Tempered, Laminated: Glazing provided by partition manufacturer; see section 102239.13 - Folding Glass-Panel Partitions.

2.05 GLAZING UNITS

A. Type GL-04 - Monolithic Exterior Vision Glazing:
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Glass Type: Laminated, Fully tempered, Heat-strengthed glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

B. Type GL-05 - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Acid-etched..
   4. Thickness: 1/4 inch (6.4 mm), nominal.

C. Type [GL-06] - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

D. Type [GL-7] - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Heat-strengthed glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

E. Type DG-01 - Back-Painted Safety Glass: Back-painted on one surface and highly opaque.
   1. Applications: Locations as indicated on drawings.
   2. Glazing Type: tempered; laminated safety glass; clarity as required by color, finish and treatment..
   3. Thickness: As required for application.
   4. Size: As indicated on drawings
   5. Special Treatments: As indicated on Finish Legend and drawings..
   6. Colors: As indicated on Finish Legend.
   7. Finish: Style as indicated on Finish Legend..

2.06 PLASTIC SHEET GLAZING UNITS

A. Type P-6 - Acrylic Sheet:
   1. Application: Locations as indicated on drawings.
   2. Class A or B Flame Spread rating required, per location inidicated on drawings.
   3. Type: Monolithic (single layer solid) sheet.
   4. Ultraviolet stabilized.
   5. Tint: Custome colors vary. To be selected by Architect..
   6. Thickness: 1/2 inch (12 mm).

2.07 LAMINATED GLASS INTERLAYERS

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

3.04 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.05 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

3.07 SCHEDULES

A. Glazing Types listed in Part 2 of this specificaiton section. See Glazing Type locations as indicated on drawings. Consult architect where further clarification is required.

B. Aluminum-Framed Storefront Glazing: Glass Type _____, install glass using dry method, and with glass thickness as required to comply with performance requirements indicated in Section 08 4313.

C. Glazed Aluminum Curtain Wall Glazing: Glass Type _____, install glass using dry method, and with glass thickness required to comply with performance requirements indicated in Section 08 4413.

D. Aluminum Entrance Window Glazing: Glass Type _____, install glass using wet/dry method with Type GC-___ glazing compound.

END OF SECTION

SECTION 08 8300
MIRRORS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 09 3000 - Tiling: Tile substrate at mirrors.

B. Section 10 2800 - Toilet, Bath, and Laundry Accessories: Metal mirror frames.

1.02 REFERENCE STANDARDS

A. ASTM C1036 - Standard Specification for Flat Glass; 2021.

B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

1.04 QUALITY ASSURANCE

1.05 FIELD CONDITIONS

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass; Type ____: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
   1. Thickness: 1/4 inch (6 mm).
   2. Size: As indicated on drawings.

2.02 ACCESSORIES

A. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.

B. Mirror Attachment Accessories: Stainless steel clips.

C. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep (12.7 mm by 12.7 mm by 9.5 mm deep) with 90 degree mitered corners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

3.03 INSTALLATION

A. Installation and installation materials to be coordinated and compatible with tile substrates.

B. Install mirrors in accordance with manufacturer's recommendations.

C. Set mirrors plumb and level, and free of optical distortion.

D. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

E. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.04 CLEANING

A. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 08 9100
LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.

D. Test Reports: Independent agency reports showing compliance with specified performance criteria.

PART 2 PRODUCTS

2.01 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
   1. Wind Load Resistance: Design to resist positive and negative wind load as required by code without damage or permanent deformation.
   2. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   3. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.

2.02 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), ____ alloy, ____ temper.

2.03 FINISHES

A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch (0.030 mm).

2.04 ACCESSORIES

A. Blank-Off Panels: Same material as louver, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.

B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.

C. Insect Screen: 18 x 16 size aluminum mesh.

D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

D. Secure louver frames in openings with concealed fasteners.

3.02 ADJUSTING

A. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

3.03 CLEANING

A. Clean surfaces and components.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Resilient sound isolation clips.
E. Gypsum sheathing.
F. Cementitious backing board.
G. Gypsum wallboard.
H. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Structural steel stud framing.
B. Section 07 2100 - Thermal Insulation: Acoustic insulation.
C. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
D. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
E. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).
B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.
C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
D. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
E. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
F. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
G. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
I. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
J. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
K. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
L. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
M. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

N. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
O. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
P. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
Q. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
R. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
S. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
T. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
U. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018.
V. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022.
W. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
X. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
Y. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
Z. ASTM E413 - Classification for Rating Sound Insulation; 2022.
AA. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
AB. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
AC. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.
AD. GA-600 - Fire Resistance and Sound Control Design Manual; 2021.
AE. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
AF. UL (FRD) - Fire Resistance Directory; Current Edition.
AG. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
AH. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
AI. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
C. Steel Framing Industry Association (SFIA) Certification:

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design Category D, E, or F and complying with the following:

D. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
   1. Rate asse
   2. ICC-ES Evaluation Report No. _____.

E. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. Fire-Resistance-Rated Partitions: as indicated on drawings..
   2. Head of Fire-Resistance-Rated Partitions: as indicated on drawings.; as specifed in section 07 8400-Firestopping.
   3. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
   4. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
   5. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.

C. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich; ____: www.clarkdietrich.com/#sle.
   2. MarinoWARE; ____: www.marinoware.com/#sle.
   3. Steel Construction Systems; _____: www.steelconsystems.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
   5. Furring Members: U-shaped sections, minimum depth of 3/4 inch (19 mm).
   6. Furring Members: Zee-shaped sections, minimum depth of 1 inch (25 mm).

7. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (13 mm) channel depth.
    a. Products:
        1) Same manufacturer as other framing materials.
8. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.
9. Sill Plate Isolation Pads: Acoustical separation between sole plate and subfloor.

E. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

F. Area Separation Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with specified performance requirements.

G. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

H. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.

I. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

J. Preformed Top Track Firestop Seal:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

K. Non-structural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.

L. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company; ____: www.americangypsum.com/#sle.
2. CertainTeed Corporation; ____: www.certainteed.com/#sle.
3. Georgia-Pacific Gypsum; ____: www.gpgypsum.com/#sle.
4. Gold Bond Building Products, LLC provided by National Gypsum Company; ____: www.goldbondbuilding.com/#sle.
5. USG Corporation; ____: www.usg.com/#sle.
6. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    a. Mold resistant board is required at all locations.
3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness:
    a. Vertical Surfaces: 5/8 inch (16 mm) and 1/2 inch (13 mm).
    b. Ceilings: 5/8 inch (16 mm) and 1/2 inch (13 mm).

5. Mold-Resistant, Paper-Faced Products:
    a. American Gypsum Company; M-Bloc: www.americangypsum.com/#sle.
    b. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
    c. American Gypsum Company; M-Bloc Type C: www.americangypsum.com/#sle.
    d. Georgia-Pacific Gypsum; ToughRock Mold-Guard: www.gpgypsum.com/#sle.
    e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
    f. USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.

C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including plumbing walls in kitchen, cafe, and toilets..
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    a. Thickness: 1/2 inch (13 mm).
4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
    a. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch (16 mm).

D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 1/2 inch (13 mm).
3. Edges: Tapered.

E. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
3. Edges: Square.
4. Glass Mat Faced Products:
    a. American Gypsum Company; M-Glass Exterior Sheathing Type X: www.americangypsum.com/#sle.
    b. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing: www.certainteed.com/#sle.
    c. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing: www.gpgypsum.com/#sle.
    d. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.

F. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
3. Types: Regular and Type X, in locations indicated.
4. Type X Thickness: 5/8 inch (16 mm).
5. Type C Thickness: 5/8 inch (16 mm).
6. Regular Type Thickness: 1/2 inch (13 mm).
7. Edges: Tapered.
8. Products:
    a. American Gypsum Company; Exterior Soffit Gypsum Wallboard Type X: www.americangypsum.com/#sle.
    b. CertainTeed Corporation; 5/8" Soffitboard Type C: www.certainteed.com/#sle.
    c. CertainTeed Corporation; 5/8" Soffitboard Type X: www.certainteed.com/#sle.

d. Georgia-Pacific Gypsum; ToughRock Fireguard C Soffit Board: www.gpgypsum.com/#sle.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: See Section 07 2100.

B. Water-Resistive Barrier: See Section 07 2500.

C. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.

D. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. Wall Mounted Deflection Beads: Flexible gasket and bead with 1-1/8 inch (29 mm) flange.
      a. Fire-Resistance Rated: 1 hour when joint system tested in accordance with ASTM E1966 or UL 2079.
   3. Expansion Joints:
      a. Fire-Resistance Rated: 1 hour when joint system tested in accordance with UL 2079.
      b. Type: V-shaped metal with factory-installed protective tape.
      c. Type: Off-angle inside corner expansion.

E. Ceiling Pockets with Prewired Raceway: UL 325 listed, extruded aluminum shade pocket with removable closure panel and ceiling tile support, for recess mounting in acoustical tile or drywall ceilings; size and configuration as indicated on drawings.
   1. Designed to accommodate installation of motor control and wiring accessories within pocket.

F. Moisture Guard Trim: ASTM C1047, rigid plastic, 48 inch (1219.2 mm) length, applied to bottom edge of gypsum board.

G. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

H. Finishing Compound: Surface coat and primer, takes the place of skim coating.

I. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

J. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

K. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

L. Adhesive for Attachment to Wood, ASTM C557 and Metal:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

C. Studs: Space studs at 16 inches on center (at 406 mm on center).

1. Extend partition framing to structure where indicated and to ceiling in other locations.
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.
   2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

D. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.

E. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

G. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Moisture Guard Trim: Install on bottom edge of gypsum board according to manufacturer's instructions and in locations indicated on drawings.

3.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.09 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean _____.

END OF SECTION

SECTION 09 2300
GYPSUM PLASTERING

END OF SECTION

SECTION 09 3000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Cementitious backer board as tile substrate.

D. Coated glass mat backer board as tile substrate.

E. Ceramic trim.

F. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).

B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 2017.

C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2021).

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2019.

F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 2021.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 1999 (Reaffirmed 2019).

H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).

I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2019).

J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).

K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.

L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2019).

M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

O. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.

P. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.

Q. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.

R. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).

S. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.

T. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

1.06 QUALITY ASSURANCE

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for general requirements for mock-up.

B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
   1. Minimum size of mock-up is indicated on drawings.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products by the same manufacturer.
   1. Florida Tile.
      a. As indicated on Finish Legend and drawings.
   2. Mosaic Tile Comany.
      a. As indicated on Finish Legend and drawings.
   3. Substitutions: Not permitted.

B. Porcelain Tile, Type Floor and Wall.: ANSI 326.3.
   1. Edges: Pressed..
   2. Surface Finish: Matte..
   3. Color(s): as indicated on Finish Legend and drawings..
   4. Pattern: Pressed.
   5. Trim Units: Matching bullnose, cove base, and cove shapes in sizes coordinated with field tile.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: As indicated on Finish Legend., style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:
      a. Transition between floor finishes of different heights.
      b. Tile to carpet.
   2. Manufacturers:
      a. Schluter-Systems: www.schluter.com/#sle.

2.03 SETTING MATERIALS

2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Standard Grout: ANSI A118.6 standard cement grout.
   1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
   2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.

2.05 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
   1. Applications: Between tile and plumbing fixtures.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
   1. Composition: Water-based colorless silicone.

2.06 ACCESSORY MATERIALS

A. Tile Transitions Strips.
   1. Maufacturer: Schluter Sytesms.
      a. As indicated on Finish Legend and drawings.

B. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
   1. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum.

C. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch (11 mm) thick; 2 inch (51 mm) wide coated glass fiber tape for joints and corners.

D. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.

E. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
   1. Use uncoupling membrane under all tile unless other underlayment is indicated.

B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

C. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

3.08 SCHEDULE

A. Schedule as indicated on Finish Legend. See drawings for locations and patterns.

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Product Data: Provide data on suspension system components and acoustical units.

D. Samples: Submit two full size samples illustrating material and finish of acoustical units.

E. Samples: Submit two samples each, 12 inches (____ mm) long, of suspension system main runner, cross runner, and perimeter molding.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc; ____: www.armstrongceilings.com/#sle.

B. Suspension Systems:
   1. Same as for acoustical units.
   2. Armstrong World Industries, Inc; ____: www.armstrongceilings.com/#sle.

2.02 ACOUSTICAL UNITS

A. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Application(s): As indicated on Finish Legend and drawings..
   2. Classification: ASTM E1264 Type III.
   3. Size: 24 by 24 inches (610 by 610 mm).
   4. Thickness: 3/4 inch (19 mm).
   5. Panel Edge: Varies. See Finish Legend..
   6. Tile Edge: Varies. See Finish Legend..
      a. Joint: Kerfed and rabbeted.
   7. Color: See Finish Legend.
   8. Suspension System: Exposed grid.

9. Suspension System: Varies. See Finish Legend..
10. Products:
    a. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; Refer to Basis-Of-Design products.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.

D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
    1. Use longest practical lengths.

C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

F. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

G. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
    1. Make field cut edges of same profile as factory edges.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. Replace damaged or abraded components.

END OF SECTION

SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).

D. Protect roll materials from damage by storing on end.

PART 2 PRODUCTS

2.01 SHEET FLOORING

2.02 RESILIENT BASE

A. Resilient Base - Type ____: ASTM F1861, Type TS, rubber, vulcanized thermoset; style as scheduled.
   1. Basis-of-Design: TightLock Carpet andResilient Wall Base by Johsonite: www.johnsonite.com/#sle.
   2. Other Manufacturers:
      a. Mannington Commercial: www.manningtoncommercial.com#sle.
      b. Roppe Corporation: www.roppe.com/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.
   3. Height: 4 inches (100 mm).
   4. Thickness: 0.080 inch (2.0 mm).
   5. Finish: As selected from manfacturer's full line..
   6. Color: To be selected by Architect from manufacturer's full range.
   7. Accessories: Premolded external corners and internal corners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.02 PREPARATION

A. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

3.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

3.08 SCHEDULE

A. As indicated on drawings.

END OF SECTION

SECTION 09 6623
RESINOUS MATRIX TERRAZZO FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Epoxy matrix terrazzo with ground and polished finish.

B. Divider strips.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete subfloor with steel trowel finish.

1.03 REFERENCE STANDARDS

A. NTMA (GRAD) - Aggregate Gradation Standards; Current Edition.

B. NTMA (EPOXY) - Epoxy Terrazzo Specifications; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with NTMA recommendations as posted at their web site at www.ntma.com.

1.06 MOCK-UP

A. Construct mock-up of terrazzo illustrating appearance of finished work in each configuration required. Size mock-up to be not less than 3 by 3 feet (1 by 1 m).

B. Locate where directed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store terrazzo materials in a dry, secure area.

B. Maintain minimum temperature of 60 degrees F (16 degrees C).

C. Keep products away from fire or open flame.

1.08 FIELD CONDITIONS

A. Do not install terrazzo when temperature is below 50 degrees F (10 degrees C) or above 90 degrees F (32 degrees C).

B. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of flooring.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Resinous Matrix Terrazzo Flooring: Terrazzo & Marble Supply Companies; Terroxy Resin Systems: www.tmsupply.com/#sle.

2.02 EPOXY MATRIX TERRAZZO APPLICATIONS

A. Floors:
   1. Thickness: 3/8 inch (9 mm), nominal.
   2. Color(s): To be selected by Architect.
   3. Aggregate Type: Marble chips.
   4. Aggregate Size: No. 2.

B. Wall Base:
   1. Thickness: Same as floors.
   2. Style: Coved.
   3. Aggregate Type and Size: Same as floors.

2.03 MATERIALS

A. Epoxy Matrix Terrazzo: Aggregate and matrix mix applied to substrate, troweled flat, and ground smooth.

B. Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.
   1. Products:
      a. Terrazzo & Marble Supply Companies; Terroxy Epoxy Matrix: www.tmsupply.com/#sle.

C. Aggregate: Type as indicated; sized in accordance with NTMA aggregate gradation standards; color(s) as indicated, uniform in color.

D. Finishing Grout: Epoxy, color to match terrazzo matrix.

2.04 ACCESSORIES

A. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.

B. Base Cap, Base Divider Strip, and Separator Strip: Match divider strips.

C. Primer: _____.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive terrazzo.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive terrazzo.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for terrazzo flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by terrazzo flooring manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Clean substrate of foreign matter.

B. Prepare concrete subfloor by mechanically abrading surface in accordance with manufacturer's instructions.

C. Apply primer in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Saw cut substrate to install divider and control joint strips.

B. Install control joint strips straight and flat to locations indicated.

C. Install divider strips according to pattern approved on shop drawings.

D. Install base and border divider and control joint strips to match floor pattern.

E. Install terminating cap strip at top of base; attach securely to wall substrate.

F. Place terrazzo mix over substrate to thickness indicated.

3.04 FINISHING

A. Finish terrazzo to NTMA requirements.

B. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive, using a wet method or using a dry grinder with vacuum to control dust.

C. Apply grout to fill voids exposed from grinding.

D. Remove grout coat by grinding, using a fine grit abrasive.

3.05 TOLERANCES

3.06 CLEANING

A. Immediately after terrazzo has dried, apply sealer in accordance with manufacturer's instructions.

B. Polish surfaces in accordance with manufacturer's instructions.

3.07 PROTECTION

A. Protect finished terrazzo from damage due to subsequent construction until Date of Substantial Completion.

END OF SECTION

SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints.

D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 MATERIALS

A. Tile Carpeting, Type CPT-01: as indicated on Finish Legend/, manufactured in one color dye lot.

2.03 ACCESSORIES

A. Edge Strips: As indicated on Finish Legend and selected by Architect, color as selected by Architect.

B. Adhesives:
   1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

B. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).

1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 7200
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall covering and borders.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on wall covering and adhesive.

C. Shop Drawings: Indicate wall elevations with seaming layout.

D. Samples: Submit two samples of wall covering, ____by____ inch (____by____ mm) in size illustrating color, finish, and texture.

E. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.

F. Manufacturer's Installation Instructions: Indicate special procedures.

G. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

H. Manufacturer's Qualification Statement.

I. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

B. Wall Covering: Graphic Mural, complying with the following:
   1. Basis-of-Design: "DigiBrick" by Fetch Graphics.

2. Vinyl Film: UV-resistant vinyl film with pressure sensative permanent adhesive on back; high resolution imagees and indicated on Drawings and suitable fo exterior application.
3. Digital file of artwork content to be provided by OWner.
4. Substrate Sealer: Clear sealer as recommended by manufacturer.

C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate with a VOC content of 70 g/l or less for adhesives used inside the weatherproofing system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

3.02 PREPARATION

A. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

C. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

END OF SECTION

SECTION 09 8300
ACOUSTIC FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field application of acoustic plaster.

B. Surface preparation.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets for products specified.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in installing work of the type specified in this section, and with at least three years of documented experience.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide acoustical ceiling tile with applied acoustic coating indicating color and finish.

C. Locate where directed.

D. Mock-ups may remain as part of the work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Coatings:
   1. Basis-OF-Design: Pyrok StarSilent; "Superfine" finish..
   2. Other Manufacturers:
      a. Fellert Even Better System; "Silk" finish..
      b. Armstrong, Acoustibuilt; "Fine" texture"

2.02 ACOUSTIC COATINGS

A. General:
   1. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Plaster System: Suspended 1-inch thick seamless acoustic plaster system, with no hard backing. Provide manufactuer's complete system materials.
   1. Substrate: Fiberglass Board:
   2. Primer as recommended by plaster manufacturer.
   3. Plaster as indicated.
      a. Color: White.

C. Performance Requirements.
   1. Noise Reduction Coefficient (NRC): 0.80.

D. Accessory Materials: Provide primers, sealers, cleaning agents, and clean up materials as required for completion of acoustic finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of acoustic finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

3.02 APPLICATION

A. Acoustic Coatings: Apply in accordance with manufacturer's written instructions.
   1. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
   2. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes from subsequent construction operations.

END OF SECTION

SECTION 09 8414

ACOUSTIC STRETCHED-FABRIC WALL AND CEILING SYSTEMS - NOVAWALL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustic stretched-fabric wall system.

B. Acoustic stretched-fabric ceiling system.

C. Accessories as required for complete installation.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

D. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2023.

E. ASTM E2573 - Standard Practice for Specimen Preparation and Mounting of Site-Fabricated Stretch Systems to Assess Surface Burning Characteristics; 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Specimen warranty.

C. Shop Drawings: Details indicating typical transitions to other finish surfaces.

D. Verification Samples:
   1. For each fabric specified, minimum size 12 inch (305 mm) square, representing actual product in color, texture, and pattern.

E. Maintenance Contract.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect fabric, acoustical backing, and track from excessive moisture in shipment, storage, and handling.

B. Do not deliver materials to project until wet work such as concrete and plaster has been completed.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 MOCK-UP

A. See Section 01 4000 - Quality Requirements for additional mock-up requirements.

B. Construct mock-up of acoustic stretched-fabric wall system at location indicated by Architect.

1. Minimum mock-up dimensions; 96 by 96 inches (2440 by 2440 mm).
2. Approved mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

A. Do not begin installation until interior conditions have reached temperature and humidity that will be maintained during occupancy.

B. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Stretched-Fabric Wall and Ceiling System:
1. Novawall Systems, Inc; 1-inch Classic Panel with square edge: www.novawall.com/#sle.

2.02 ACOUSTIC STRETCHED-FABRIC SYSTEM

A. Acoustic Stretched-Fabric System: Field installed, fabric is stretched and set into framework and laid over acoustic material anchored to substrate. Framework consists of continuous perimeter and intermediate mounting frames anchored to substrate, and designed to permit removal and replacement of fabric within framed areas without affecting adjacent areas.
1. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 450, maximum; when whole system is tested in accordance with ASTM E84 using mounting specified in ASTM E2573 for stretched systems.
2. Noise Reduction Coefficient (NRC): 0.80, minimum, when tested in accordance with ASTM C423, Type A mounting per ASTM E795.

2.03 MATERIALS

A. Frame: Extruded polymer framing system with serrated jaws of sufficient strength to hold fabric in place after repeated applications.

B. Acoustic Material:
1. 1-inch Fiberglass Core (6-pound density, unbacked.
2. Ensure that thickness of acoustic material fills depth of frame as necessary for application without use of support blocking.

C. Rigid Blocking: Fire-retardant treated medium density fiberboard complying with ANSI A208.2, in thickness to meet project requirements.

D. Fabric: Heavy-duty fire-retardant commercial fabric, as provided by manufacturer of acoustic stretched-fabric system; color, pattern, and texture as indicated on Finish Legend.

E. Fasteners: As recommended by manufacturer of acoustic stretched-fabric system in accordance with project requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Begin installation only after substrates have been properly prepared.

B. Verify that casework, markerboards, door and window jambs, finished ceiling, and other finished items adjacent or abutting the acoustic stretched-fabric system have been properly installed.

C. When preparation of substrate is the responsibility of another installer, notify Architect of unsatisfactory preparation prior to proceeding with this work.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation of this work.

B. Prepare substrate surfaces using methods as recommended by the manufacturer for achieving acceptable result as required for this work.

C. Remove wall plates and other obstacles, and properly prepare substrates to receive frames and acoustic material in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install acoustic stretched-fabric system at locations indicated in accordance with approved shop drawings and manufacturer's instructions.

3.04 CLEANING

A. Clean exposed surfaces of acoustic stretched-fabric system in compliance with manufacturers instructions for cleaning and repair of minor damage to exposed surfaces.

3.05 PROTECTION

A. Protect installed materials upon completion of this work, using methods that will ensure that the finished work is without damage or deterioration upon Date of Substantial Completion.

3.06 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 09 8430
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sound-absorbing panels.

1.02 RELATED REQUIREMENTS

A. Section 09 5100 - Acoustical Ceilings: Ceiling suspension system.

1.03 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Shop Drawings: Fabrication and installation details, panel layout, fabric orientation, and wood grain orientation.

D. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch (305 by 305 mm), showing construction, edge details, and fabric covering.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

B. Store units flat, in dry, well-ventilated space; do not stand on end.

C. Protect edges from damage.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional mock-up requirements.

B. Construct mock-up of acoustical units at location as indicated by Architect.
   1. Minimum mock-up dimensions; 96 by 96 inches (2440 by 2440 mm).
   2. Mock-up may remain as part of work.

PART 2 PRODUCTS

2.01 ACOUSTICAL INSULATION PANEL

A. Manufacturers:
   1. EchoTouch by TechNature: www.technature.ca/; 416-594-6558..
   2. Echo Eliminator Bonded Acoustical Cotton (BAC) Pad by Acoustical Surfaces, Inc: www.acousticalsurfaces.com/; 952-448-5300..

B. Acoustical Cotton Board for Ceilings:
   1. Sound Absorption: Noise Reduction Coefficient (NRC) of 1.0 for 2-inch thick material when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
   2. Density: 3 lb/cu ft (___ kg/cu m).
   3. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 50, maximum; when tested in accordance with ASTM E84 and UL 723.
   4. Color: White where indicated on drawings.
   5. Color: Black where indicated on drawings.

6. Adhesive: Type recommended by ceiling covering manufacturer to suit application.

2.02 ACCESSORIES

A. Mechanical Fasteners:
   1. Hilti X-IE6 insulation faster.
   2. Gemco Type 0912 insulation hander with perforated base and S-250 self-locking washer (black) and black dome cap from Goodloe E. More, Danville, IL, 800-331-1164.
   3. Substitutions not permitted.

B. Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Install mounting accessories and supports in accordance with shop drawings.

C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

D. Attach ceiling panels at locations and heights as indicated.

3.03 CLEANING

A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Precast Concrete Wall Panels.
   8. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting.

B. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Painted identification.

C. Section 22 0553 - Identification for Plumbing Piping and Equipment: Painted identification.

D. Section 23 0553 - Identification for HVAC Piping and Equipment: Painted identification.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

F. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

B. Paints:
1. Behr Process Corporation; _____: www.behr.com/#sle.
2. PPG Paints; _____: www.ppgpaints.com/#sle.
3. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
4. Benjamin Moore.

C. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
5. Supply each paint material in quantity required to complete entire project's work from a single production run.
6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: As indicated in Color Schedule.
1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-TR-C - Transparent Finish on Concrete Floors:
1. 1 coat stain.
2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
3. Sealer Sheen:
a. Eggshell: MPI gloss level 3; use this sheen at all locations.

B. Paint CE-OP-3L - Masonry/Concrete, Opaque, Latex, 3 Coat:
1. One coat of block filler.
2. Semi-gloss: Two coats of latex enamel; ____.
3. Flat: Two coats of latex enamel; ____.

C. Paint GE-OP-3L - Exterior Gypsum Board and Exterior Plaster, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer.
2. Flat: Two coats of latex; ____.

D. Paint ME-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of latex primer.
2. Gloss: Two coats of latex enamel; ____.

E. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.

F. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat galvanize primer.
2. Gloss: Two coats of latex enamel; ____.

G. Paint MaE-OP-3A - Aluminum and Copper, Unprimed, Alkyd, 3 Coat:
1. One coat etching primer.
2. Gloss: Two coats of alkyd enamel; ____.
3. Semi-gloss: Two coats of alkyd enamel; ____.

H. Paint E-Pav - Pavement Marking Paint:
1. White: One coat, with reflective particles; _____.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Alkali Resistant Water Based Primer; MPI #3.
2. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
3. Water Based Primer for Galvanized Metal; MPI #134.
4. Rust-Inhibitive Water Based Primer; MPI #107.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Plaster and Stucco: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.

H. Exterior Gypsum Board: Fill minor defects with exterior filler compound. Spot prime defects after repair.

I. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

J. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

K. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Floors, unless specifically indicated. See drawings.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 05 5100 - Metal Stairs: Shop-primed items.

C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Painted identification.

D. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Color coding scheme for items to be painted under this section.

E. Section 22 0553 - Identification for Plumbing Piping and Equipment: Painted identification.

F. Section 23 0553 - Identification for HVAC Piping and Equipment: Painted identification.

G. Section 26 0553 - Identification for Electrical Systems: Painted identification.

H. Section 32 1723 - Pavement Markings: Painted pavement markings.

I. Section 33 1600 - Water Utility Storage Tanks: Painting inside and outside of tanks.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

E. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

G. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

H. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

I. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system products to be used in project; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gal (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum _____ years experience and approved by manufacturer.

1.07 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 8 feet (8 m) long by ____ feet (____ m) wide, illustrating paint color, texture, and finish.

C. Provide door and frame assembly illustrating paint color, texture, and finish.

D. Locate where directed by Architect.

E. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
   2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.

B. Paints:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
   2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   5. Supply each paint material in quantity required to complete entire project's work from a single production run.
   6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: As indicated on drawings.
   1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:

1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
2. Two top coats and one coat primer.
3. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.

C. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including gypsum board, plaster, concrete, concrete masonry units, uncoated steel, shop primed steel, galvanized steel, and aluminum.
1. Two top coats and one coat primer.

D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, galvanized piping, and _____.
1. One top coat over pre-primed or galvanized metal..
2. Top Coat: Latex Dry Fall for pre-primed metal; MPI #118, 155, or 226.
3. Top Coat: Water Based Dry Fall for Galvanized Steel; MPI #131, 133, or 158.
4. Primer: Where required: As recommended by top coat manufacturer for specific substrate.

E. Paint I-TR-C - Transparent Finish on Concrete Floors.
1. 2 coats sealer.
2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.

F. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer.

G. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of latex primer.

H. Paint MgI-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat galvanize primer.

I. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
1. One coat of alkyd primer sealer.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Plaster and Stucco: 12 percent.
3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Concrete:
   1. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

F. Masonry:
   1. Prepare surface as recommended by top coat manufacturer.

G. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

J. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

K. Galvanized Surfaces:

L. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

M. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

N. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

O. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

E. Sand wood and metal surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

B. Owner will provide field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9600
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings.

B. Surface preparation.

1.02 REFERENCE STANDARDS

A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.

C. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors available for selection.

D. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Maintenance Data: Include cleaning procedures and repair and patching techniques.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
   2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.04 QUALITY ASSURANCE

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for general requirements for mock-ups.

B. Provide mock-up of _____, ____ feet (____ m) long by ____ feet (____ m) wide, illustrating coating, for each specified coating.

C. Locate where directed.

D. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.

C. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).

D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

E. Restrict traffic from area where coating is being applied or is curing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. High-Performance Coatings:
   1. Dur-A-Flex.
   2. Substitutions: Not permitted.

2.02 HIGH-PERFORMANCE COATINGS

A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in MPI Approved Products List.

B. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
   2. NFPA 101, Class A rated.

2.03 TOP COAT MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

B. Urethane Coating for Floors:
   1. Number of Coats: as prescribed by manufactuers instructions for the specified system..
   2. System as indicated on Finish Legend..
      a. Products:
         1) Dur-A-Flex: Poly-Crete MDB..
         2) Substitutions: Not permitted.

C. Shellac: Pure, white type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.02 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

C. Remove finish hardware, fixture covers, and accessories and store.

3.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

END OF SECTION

SECTION 10 1423
PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panel signage.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.02 PANEL SIGNAGE

A. Panel Signage Type _____:
   1. Application: Room and door signs.
   2. Description: Flat signs with engraved panel media, tactile characters.
   3. Sign Size: 4 inches by 6 inches (100 mm by 152 mm).
   4. Total Thickness: 1/8 inch (3 mm).
   5. Sign Edges: Radiused.
   6. Corners: Radiused.
   7. Color and Font, unless otherwise indicated:
      a. Character Font: Helvetica, Arial, or other sans serif font.
      b. Character Case: Upper and lower case (title case).
      c. Background Color: To be selected by Architect..
      d. Character Color: Contrasting color.
   8. Material: Laminated colored plastic engraved through face to expose core as background color.
   9. Profile: Flat panel in aluminum frame.
      a. Frame Finish: Black anodized.
   10. Tactile Letters: Raised 1/32 inch minimum.
   11. Braille: Grade II, ADA-compliant.

2.03 SIGNAGE APPLICATIONS

A. Room and Door Signs:
   1. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section for replaceable occupant name.

2. Conference and Meeting Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section with sliding "In Use/Vacant" indicator.
3. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
4. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

B. Emergency Evacuation Map Panel Signs:
1. Allow for one map per elevator lobby.
2. Map content to be provided by Owner.

2.04 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.

B. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid plastic toilet compartments.

B. Urinal and vestibule screens.

1.02 RELATED REQUIREMENTS

A. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, _____by_____ inch (_____by_____ mm) in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solid Plastic Toilet Compartments:
   1. Scranton Products; Hiny Hiders Partitions: www.scrantonproducts.com/#sle.
   2. Substitutions: Section 01 6000 - Product Requirements.

2.02 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted unbraced.
   1. Doors:
      a. Thickness: 1 inch (25 mm).
      b. Width: 24 inch (610 mm).
      c. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
      d. Height: 55 inch (1397 mm).
   2. Panels:
      a. Thickness: 1 inch (25 mm).
      b. Height: 55 inch (1397 mm).
   3. Pilasters:
      a. Thickness: 1 inch (25 mm).
      b. Width: As required to fit space; minimum 3 inch (76 mm).
   4. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.03 ACCESSORIES

A. Pilaster Shoes: Stainless steel, satin finish, 3 inches (76 mm) high; concealing floor fastenings.

B. Head Rails: Extruded aluminum, anti-grip profile.
   1. Size: Manufacturer's standard size.

C. Wall and Pilaster Brackets: Stainless steel; continuous type.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.

E. Hinges: Stainless steel, manufacturer's standard finish.
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.

F. Door Hardware: Stainless steel, manufacturer's standard finish.
   1. Door Latch: Slide type with exterior emergency access feature.
   2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.

G. Coat Hook: One per compartment, mounted on door.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch (6 mm).

B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2239
FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Top-supported folding panel partitions, horizontal opening.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing.

1.03 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

D. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2020).

E. ASTM E596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.

C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Folding Panel Partitions - Horizontal Opening:
   1. Modernfold, a DORMA Group Company: www.modernfold.com/#sle.
   2. Substitutions: Not permitted.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Folding Panel Partitions: Center opening; paired panels; center stacking; manually operated.

B. Panel Construction:
   1. Frame: 21 gauge, ___ inch (____ mm) thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.

C. Panel Finishes:
   1. Facing: Maharam Tek-Wall Strake 300076-007 Raku.
   2. Exposed Metal Trim: Natural Choice.

D. Panel Seals:
   1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
   2. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, retractable floor and ceiling seals, and above track to structure acoustic seal.

E. Suspension System:
   1. Track: Formed steel; 1-1/4 by 1-1/4 inch (32 by 32 mm) size; thickness and profile designed to support loads, steel sub-channel and track connectors, and track switches.
   2. Carriers: Nylon wheels on trolley carrier at top of every second panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

F. Performance:
   1. Acoustic Performance:
      a. Noise Reduction Coefficient (NRC): ASTM E596, NRC of 0.65 minimum.
   2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   3. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

G. Accessories:
   1. Ceiling Closure: White enameled ceiling closure; aluminum jamb and head molding, fittings and attachments, and intermediate meeting posts.
   2. Pass Door: Double door, 36 inch (____ mm) wide by 84 inch (____ mm) high opening; same design and construction as panel; fit door with perimeter acoustic gaskets, concealed closer, keyed lock, view window of _____ glass, and tool operated floor seal.

2.03 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Install acoustic sealant to achieve required acoustic performance.

C. Coordinate electrical connections.

3.02 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.03 CLEANING

A. Clean finish surfaces and partition accessories.

END OF SECTION

SECTION 10 2239.13
FOLDING GLASS-PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior aluminum-framed folding glass-panel partitions, horizontal opening.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Concealed steel support members.

B. Section 08 7100 - Door Hardware: Cylinders and keying.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. AAMA 1801 - Voluntary Specification for the Acoustical Rating of Exterior Windows, Doors, Skylights and Glazed Wall Sections; 2021.

C. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

H. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

K. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2020).

L. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems; 2014 (Reapproved 2023).

M. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer.
   2. Notify Architect four calendar days in advance of scheduled meeting date.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, and colors and finishes available.

C. Design Data: Design calculations bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

D. Shop Drawings: Indicate layout, dimensions, identification of components, and interface with adjacent construction.
   1. Include field measurements of openings.
   2. Include elevations showing:
      a. Locations and identification of manufacturer-supplied door hardware and fittings.
      b. Locations and sizes of cut-outs and drilled holes for other door hardware.
   3. Include details of:
      a. Requirements for support and bracing of overhead track.
      b. Installation details.
      c. Appearance of manufacturer-supplied door hardware and fittings.

E. Selection Samples: Two sets, representing manufacturer's full range of available metal, glass, and wood materials and finishes.

F. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.

G. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Operation and Maintenance Data: For manufacturer-supplied operating hardware.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 INTERIOR FOLDING GLASS-PANEL PARTITIONS - HORIZONTAL OPENING

A. Basis-Of-Design: Sunflex SF 55 H-S-W

B. Folding Glass-Panel Partitions: Top hung, factory-fabricated assemblies consisting of full-width aluminum-framed glass panels; complete with support and anchorage devices.

C. Performance Criteria:
   1. Acoustical Performance: Provide folding glass-panel partition assemblies tested by qualified testing agency in accordance with ASTM E90, ASTM E1425, or AAMA 1801.
   2. Structural Performance: No glazing material breakage or permanent damage to fasteners, anchors, hardware, or actuating mechanisms, when tested in accordance with ASTM E330/E330M.
      a. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
   3. Seismic Performance: Operable partition shall withstand effects of earthquake motions determined according to ASCE 7.

D. Configuration: As indicated on drawings.

E. Glazed Aluminum-Framed Panel Construction:
   1. Aluminum Frames: Factory finished; manufacturer's standard corner construction; nonthermally broken.
   2. Glazing: Type GL-07, double glazed glass unit, provided by door manufactuer.
   3. Glass: Clear.
   4. Panel hardware finish to match frame.

5. Panel hardware finish: As selected from manufacturer's standard line.

2.02 MATERIALS

A. Glazing: Type GL-07.
   1. Insulating Glass Units (IGU): Hermetically sealed double pane units, 1/4 inch (6 mm) thick lights, laminated float glass panes, unit thickness as indicated; certified by independent testing agency to comply with ASTM E2190.
      a. Glass: Laminated Glass: Fully tempered float glass laminated in accordance with ASTM C1172, with eased and polished edges.
   2. Setting Blocks: Manufacturer's standard type; complying with ASTM C864.

B. Aluminum Components: Complying with ASTM B221 (ASTM B221M), alloy 6063, temper as indicated, with anodized finish complying with AAMA 611, and powder coating complying with AAMA 2603 or AAMA 2604 for select colors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify track supports are laterally braced and will permit track to be level within 1/4 inch (6 mm) of required position and parallel to the floor surface.

C. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

D. Do not begin installation until supports and adjacent substrates have been properly prepared.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean substrates thoroughly prior to installation.

B. Prepare substrates using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Use anchorage devices to securely fasten assembly to adjacent construction without distortion or imposed stresses.

D. Fit and align partition assembly egress doors level and plumb.

3.04 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation from Plumb: 1/16 inch (1.5 mm).

C. Maximum Variation from Level: 1/16 inch (1.5 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 feet (3.05 m) straight edge.

3.05 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

3.06 CLEANING

A. Thoroughly clean surfaces and materials installed as part of this work.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for closeout submittals.

B. Demonstrate operation of partition and identify potential operational problems.

3.08 PROTECTION

A. Protect installed products and materials until Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

SECTION 10 2600
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Crash rails.

B. Protective corridor handrails.

C. Corner guards.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing. Placement of supports in stud wall construction.

B. Section 09 2116 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

C. Section 09 2216 - Non-Structural Metal Framing: Placement of supports in stud wall construction.

1.03 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.

B. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
   1. Basis-Of-Design Product: ProTek Systems, Inc. CG-50..

B. Metal Crash Rails:
   1. Basis-Of-Design Product: ProTek Systems, Inc. CRS-55SSV..
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

2.03 PRODUCT TYPES

A. Metal Crash Rails: Factory- or shop-fabricated, with preformed end wall returns, and internal and external corners:
   1. Material: Metal; Stainless Steel, type 304.
   2. Mounting: Surface.

3. Rail Type: Continuous metal bar.
4. Finishes.
    a. Stainless steel, No.4.

B. Protective Corridor Handrails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
1. Mounting: Surface.

C. Corner Guards - Surface Mounted:
1. Material: Type 304 stainless steel, No. 4 finish, _____ gauge, _____ inch (_____ mm) thick.
2. Width of Wings: 3-1/2 inches (____ mm).
3. Corner: 9-degree radius.
4. Color: As selected from manufacturer's standard colors.
5. Length: One piece.

2.04 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.05 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Position top of corridor hand rail 36 inches (914 mm) from finished floor.

B. Position corner guard 4 inches (102 mm) above finished floor to ____ inches high (____ mm high).

C. Terminate rails 1 inch (25.4 mm) short of door openings and intersecting walls.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch (6 mm).

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.04 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Under-lavatory pipe supply covers.

C. Electric hand/hair dryers.

D. Diaper changing stations.

E. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 8300 - Mirrors: Other mirrors.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

F. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. Bobrick Companies: https://www.bobrick.com/#sle..

B. Electric Hand/Hair Dryers:

C. Diaper Changing Stations:
   1. Koala Kare Products; _____: www.koalabear.com/#sle.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

C. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

A. TA.04: Toilet Paper Dispenser: Single Jumbo roll, surface mounted.

B. TA.10: Combination Towel Dispenser/Waste Receptacle: Semi-recessed., stainless steel; seamless wall flanges, continuous piano hinges, ____.

C. TA.09: Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.

D. TA.11: Mirrors: Accent Mirror.
   1. Arteriors: Wilder Mirror.
      a. Size: 47 inch (h) x 31 inch (w) x 2.5 inch (d)
      b. Color: Bronze-iron.

E. TA.05: Seat Cover Dispenser: Stainless steel, recessed, reloading by concealed opening at base, tumbler lock.

F. TA.01, TA.02, TA.03: Grab Bars: Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
      b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.
      e. Products:
         1) TA.01: Bobrick: B-5806x36
         2) TA.02: Bobrick: B-5806x42
         3) TA.03: Bobrick: B-5806x18.

G. TA.06: Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

H. TA.07: Coat Hook.
   1. Products:
   2. Bobrick: B-6727.

2.05 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
   3. Construction: 1/8 inch (3.2 mm) flexible PVC.
      a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
      b. Comply with ICC A117.1.
      c. Microbial and Fungal Resistance: Comply with ASTM G21.
   4. Color: White.
   5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

2.06 TA.08 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
   1. Material: Stainless steel.
   2. Mounting: Recessed.

2.07 TA.13 UTILITY ROOM ACCESSORIES

A. Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, hat-shaped channel. See Plumbing Schedules.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

B. FM (AG) - FM Approval Guide; Current Edition.

C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

D. UL (DIR) - Online Certifications Directory; Current Edition.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

1.03 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
   2. Potter-Roemer; _____: www.potterroemer.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Kidde, a unit of United Technologies Corp; _____: www.kidde.com/#sle.
   2. Larsen's Manufacturing Co; _____: www.larsensmfg.com/#sle.
   3. Nystrom, Inc; _____: www.nystrom.com/#sle.
   4. Potter-Roemer; _____: www.potterroemer.com/#sle.
   5. _____.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to ___ degrees F (___ degrees C).

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Fire Rated Cabinet Construction: One-hour fire rated.

C. Cabinet Configuration: Recessed and Semi-recessed as indicated on plan type.
   1. Size to accommodate accessories.
   2. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

D. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

E. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.

F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

G. Fabrication: Weld, fill, and grind components smooth.

H. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

I. Finish of Cabinet Interior: White colored enamel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, ____ inches (____ mm) from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

END OF SECTION

SECTION 10 7500
FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete base and foundation construction.

B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016 (Reapproved 2020).

B. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.

C. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

A. Product Data: Provide data on pole, accessories, and configurations.

B. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

C. Designer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:
   1. Concord American Flagpole; Internal - Independence: www.concordamericanflagpole.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001.
   1. Material: Aluminum.
   2. Design: Cone tapered.
   3. Mounting: Ground mounted type.
   4. Nominal Height: 30 ft (____ m); measured from nominal ground elevation.
   5. Halyard: Internal type, manual winch operation.
      a. Provide control stop device and removable handle.
      b. Provide flush access door secured with cylinder lock.

B. Performance Requirements:
   1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 140 miles/hr (____ km/hr) wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.03 POLE MATERIALS

A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Aluminum. Size to match flagpole butt-diameter, unless indicated otherwise.

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
   1. Concealed revovling truck assembly.
   2. Finish truck assembly to match flagpole.

C. Halyard: 5/16 inch (8 mm) diameter stainless steel aircraft cable.

D. Counterbalance: Plastic coated counterweight and sling..

2.05 OPERATORS

A. Hand Crank: Removable _____ type.

2.06 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gauge, 0.0598 inch (1.52 mm) steel, galvanized, depth of ____ inches (____ mm) as indicated.

B. Pole Base Attachment: Flush; aluminum base with base cover.

2.07 FINISHING

A. Aluminum: Mill finish.

B. Finial: Gold anodized finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1 inch (25 mm).

3.05 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 11 1313
LOADING DOCK BUMPERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Loading dock bumpers of molded rubber with attachment frame.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Placement of loading dock bumper frame anchors into concrete.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on unit dimensions, method of anchorage, and details of construction.

C. Manufacturer's Installation Instructions: Submit installation requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Loading Dock Bumpers:

2.02 COMPONENTS

A. Loading Dock Bumpers: Molded rubber, ozone resistant, nylon reinforced, Shore A Durometer of 70, minimum, and tensile strength of 950 to 1050 psi (6550 to 7240 kPa), minimum.
   1. Projection From Wall: 3 inches (76 mm), minimum.
   2. Vertical Height: 10 inches (254 mm), minimum.
   3. Width: 5 inches (127 mm), minimum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that anchor placement is acceptable.

3.02 INSTALLATION

A. Install dock bumpers in accordance with manufacturer's instructions.

B. Set plumb and level.

END OF SECTION

SECTION 11 1319
STATIONARY LOADING DOCK EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Recessed loading dock levelers.

B. Maintenance.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

A. ANSI MH30.1 - Design, Testing, and Utilization of Dock Leveling Devices; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.05 QUALITY ASSURANCE

1.06 FIELD CONDITIONS

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Recessed Loading Dock Levelers:
   1. Blue Giant Equipment Corporation; _____: www.bluegiant.com/#sle.
   2. Rite-Hite Corp; _____: www.ritehite.com/#sle.
   3. Basis-Of-Desgin: RHH-4000 Series..

2.02 RECESSED LOADING DOCK LEVELERS

A. Recessed Loading Dock Levelers: Provide manufacturer92s standard loading dock levelers, in compliance with ANSI MH30.1 requirements, and of capacity, size, and construction as indicated, consisting of a nonslip steel platform, complete with controls, safety devices, and required accessories.
   1. Recessed Concrete Pit: Provide preformed concrete pit sized to fit dimensions of specified loading dock levelers.
      a. Ensure concrete slab is reinforced as required to support dock leveler.
      b. See Section 03 3000 for additional cast concrete requirements.
   2. Rated Capacity: Capable of supporting 30,000 lbs (13,608 kg) without permanent deflection or distortion.
   3. Platform Width: As indicated on drawings.
   4. Platform Length: As indicated on drawings.
   5. Toe Guards: Provide open sides of dock leveler with metal toe guards, equipped for entire upper operating-range.
   6. Range of Operating: Dock levelers to compensate for height differences between truck bed and loading platform, as follows; 12 inches (305 mm) above dock level, and 12 inches (305 mm) below dock level.
   7. Automatic Vertical Compensation: Floating travel of dock leveler ramp edge extended to automatically compensate for upward and downward movement of truck bed during loading and unloading operations.
   8. Automatic Lateral Compensation: Tilting of dock leveler ramp edge extended and resting on truck bed to automatically compensate for canted truck bed up to 4 inches (102 mm) over width of ramp.
   9. Ramp Edge Operation: Manufacturer's standard mechanism that automatically extends and supports hinged ramp edge and rests on truck bed over dock leveler's working range,

allows ramp edge to yield under incoming truck impact and automatically retracts ramp edge when truck departs.

B. Construction: Fabricate loading dock leveler frame, edge and platform supports from structural and formed steel shapes, with platform and hinged edge welded to supports, chamfer edge to minimize obstructing material-handling vehicles, and ensure entire assembly is fabricated to withstand deformation during operation and storage phases of service.
   1. Ramp Traffic Support: Provide support for ramp at platform level in stored position with ramp edge retracted, and means to release supports allowing ramp to descend below platform level.
   2. Ramp Maintenance Support: Provide mechanism in framework to support ramp in up position during dock leveler maintenance.

C. Finish: Manufacturer92s standard paint applied to factory-assembled and tested loading dock levelers prior to shipment.
   1. Color of Surfaces: Manufacturer's standard color.
   2. Color of Toe Guards: Paint with yellow and black stripes.

2.03 MATERIALS

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine loading dock equipment area for compliance with requirements for installation tolerances and other conditions related to this work.

B. Examine rough-in for electrical systems of loading dock equipment to verify openings and locations are acceptable prior to installation of equipment.

3.02 PREPARATION

3.03 INSTALLATION

A. Install loading dock leveler unit in prepared opening in accordance with manufacturer's written instructions.
   1. Set square and level.
   2. Anchor unit securely, flush with dock, and weld back of leveling dock to pit frame; touch-up welds with primer.
   3. Install electrical connections as required for fully operational system.

3.04 ADJUSTING

A. Adjust installed loading dock equipment and safety devices for smooth and balanced operation, and lubricate as recommended by manufacturer.

3.05 CLEANING

A. Clean recessed pits of debris.

3.06 CLOSEOUT ACTIVITIES

3.07 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide service and maintenance of operating equipment for a period of five from Date of Substantial Completion.
   1. Includes monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation of loading dock equipment at rated speed and capacity.
   2. Provide manufacturer's authorized replacement parts and supplies.

END OF SECTION

SECTION 11 3013
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Kitchen appliances.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping: Plumbing connections for appliances.

B. Section 26 0583 - Wiring Connections: Electrical connections for appliances.

1.03 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.

C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

D. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.

B. Refrigerator, Type ____: Free-standing, side-by-side, and frost-free.
   1. Capacity: Total minimum storage of 24 cubic ft (0.67 cu m); minimum 25 percent freezer capacity.
   2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
   3. Features: Include glass shelves, automatic icemaker, light in freezer compartment, in-door water and ice dispenser, and ____.
   4. Exterior Finish: Stainless steel.
   5. Manufacturers:
      a. KitchenAid: Model: KRFC704FPS.

C. Microwave, Type ____: Countertop.
   1. Capacity: 1.5 cubic ft (0.042 cu m).
   2. Power: 1200 watts.
   3. Features: Include turntable, cooktop light, night light, and 2-speed exhaust fan.
   4. Exterior Finish: Stainless steel.
   5. Manufacturers:
      a. Basis-Of-Design: KitchenAid: Model: KMCC5015GSS.

D. Dishwasher, Type ____: Undercounter.
   1. Controls: Solid state electronic.

2. Wash Levels: Two (2).
3. Cycles: Six (6), including normal, rinse and hold, short, china/crystal, pot and pan, and ____.
4. Features: Include rinse aid dispenser, optional no-heat dry, optional water temperature boost, adjustable upper rack, adjustable lower rack, and ____.
5. Finish: Stainless steel.
6. Manufacturers:
   a. KitchenAid: Model: KDFE104KPS.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.04 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION

SECTION 11 4000
FOODSERVICE EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foodservice equipment.

B. Connections to utilities.

PART 2 PRODUCTS

Specifications

07/28/2023

Project
Museum of the Marine

From

ITEM 01 - MOBILE HEATED CABINET (2 REQ'D)

Metro Model C539-HDC-4 Dimensions: 71(h) x 27.63(w) x 31.5(d)

C5™ 3 Series Heated Holding Cabinet, with Red Insulation Armour™, mobile, full height, insulated, Dutch clear polycarbonate doors, removable bottom mount control module, thermostat to 200°F, fixed wire slides on 3" centers (17) 18" x 26" or (32) 12" x 20" x 2 1/2" pan capacity, 5" casters (2 with brakes), aluminum, 120v/60/1 ph, 2000 watts, 16.7 amps, NEMA 5 20P, cULus, NSF

2 ea 1 year warranty against manufacturing defects

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1	Cord & Plug		5-20P	16.7	2.0			

ITEM 02 - COMBI OVEN, ELECTRIC (1 REQ'D)

Alto-Shaam Model 7-20E PRO Dimensions: 37.81(h) x 43.75(w) x 46.19(d)

Prodigi™ Pro Combi Oven/Steamer, electric, boiler-free, countertop, capacity (7) 18" x 26" full size sheet or (16) 12" x 20" full size hotel pan (GN 1/1), Wi-Fi enabled control with steam/convection/combi cooking modes, removable "T" style temperature probe, (2) power levels, programmable cool-down, SafeVent™ steam venting, (5) cleaning levels, triple-pane door, high efficiency LED lighting, (2) side racks with (8) non-tilt support rails, door hinged right, stainless steel construction, adjustable stainless steel legs, EcoSmart®, cULus, UL EPH Classified, CE, IPX5, ENERGY STAR®, EAC, city-wide COA for New York City

1 ea NOTE: Subject to Manufacturer's Terms & Conditions. See Documents Section

1 ea One year parts and labor warranty, standard

1 ea It is the sole responsibility of the owner/operator/purchaser of this equipment to verify that the incoming water supply is comprehensively tested and, if required, provide a means of water treatment that would meet the compliance requirements with the manufacturers water quality standards published on the product spec sheet. Non-compliance with these minimum standards will potentially damage this equipment and/or components and VOID the original equipment manufacturers warranty

1 ea ECO

1 ea 208-240v/50/60/3-ph, 45.7-52.7 amps, 16.5-21.9kW, 4-3 AWG, NO cord or plug

1 ea Model 7-20EVH Ventech Type 1 Hood with Condensation, for 7-20E, self-contained, two-speed high-powered fans, 1242-1410 CFM, includes (2) easy clean grease filters, (2) odor filters, stainless steel construction, 1.92 amps, 0.40 kW, cULus, UL EPA, ANSI/NSF 4, CE, EAC (not available with smoking feature, or units with recessed door) (All utilities are run through the oven, no additional hookups required)

1 ea Factory install ((NET) NO FURTHER DISCOUNTS APPLY)

1 ea For Field install, Combitherm Factory Authorized Installation Program (above) MUST be selected for field install option to become available for selection

1 ea Wifi, standard

1 ea Removable "T" style temperature probe, standard

1 ea Model 5016084 Combi Oven Stand, stationary, 25-7/16" x 39-13/16" x 36-5/16" (645mm x 1010mm x 922mm), with pan slides and shelf, spacing 2-11/16" (68mm), stainless steel, for 7-20 or 10-20

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208-240	50/60	3	Direct			45.7-52.7	16.5-21.9			
2							1.92	0.40			

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1				3/4"		3/4"			

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1-1/2"	

ITEM 03 - WORK TABLE, WITH PREP SINK(S) (3 REQ'D)

John Boos Model EPT6R5-3072SSK-L Dimensions: 40.75(h) x 72(w) x 30(d)

Work Table With Prep Sink, 72"W x 30"D x 40-3/4"H overall size, (1) 16"W x 20" front-to-back x 12" deep sink bowl on left, 5"H backsplash, includes 10" swing spout faucet 4" O.C., 16/300 stainless steel top, stainless steel legs & adjustable undershelf, 1" stainless steel adjustable bullet feet, NSF, CSA-Sanitation, KD

- 3 ea Model PB-LWS-1 Straight Handle Lever Waste, for 3-1/2" industry standard sink opening, standard valve, basket strainer (includes adapter for either 2" or 1-1/2' drain outlet)
- 3 ea Model PB-LWB Lever waste support arm bracket. Not for use with PB-LWS-1 or PB-LWS-1OV straight handle lever waste.
- 3 ea Note: Provisions made at factory for installation.
- 3 ea Model DR2020SC-S30 Drawer, for 30"D work tables, 20"W x 20" front-to-back x 5" deep, stainless steel front & drawer pan, self closing, roller bearing slides, NSF, for stainless steel table tops only

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1	1/2"			1/2"					

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		

PLUMBING 1 REMARKS

(1) set of 1" faucet holes, 8" centers, 3-1/2" drain opening

ITEM 04 - WORK TABLE, 60", STAINLESS STEEL TOP (3 REQ'D)

John Boos Model ST6-3060SSK Dimensions: 35.75(h) x 60(w) x 30(d)

Work Table, 60"W x 30"D, 16/300 stainless steel flat top, with Stallion Safety Edge front & back, 90° turndown on sides, stainless steel legs & adjustable undershelf, adjustable bullet feet, NSF, CSA-Sanitation, KD

- 3 st Model CAS01-R Casters, 5", heavy duty, locking, for 1-5/8" diameter legs (set of 4)

ITEM 05 - ROLL-IN REFRIGERATOR (1 REQ'D)

Hoshizaki Model RN2A-FS Dimensions: 87.5(h) x 68(w) x 38.9(d)

Steelheart Series Refrigerator, roll-in, two-section, 78.35 cu. ft., top mounted self-contained refrigeration system, (2) full-height solid hinged doors with locks, digital temperature display/controls, LED interior lighting, stainless steel ramp & floor accommodate roll in racks up to 72"H, stainless steel interior, stainless steel exterior front, sides & top, R290 Hydrocarbon refrigerant, 1 HP, NEMA 5-15P, cETLus, ETL-Sanitation

- 1 ea Warranty: 3-Year parts & labor on entire machine
- 1 ea Warranty: 5-Year parts on compressor
- 1 ea 115v/60/1-ph, 8.2 amps, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1				Cord & Plug		5-15P			1		
2	115	60	1				8.2				

ITEM 06 - SPARE NO.

ITEM 07 - REACH-IN REFRIGERATOR (1 REQ'D)

Hoshizaki Model ER2A-FS Dimensions: 81.63(h) x 54.37(w) x 29.63(d)

Economy Series Refrigerator, reach-in, two-section, 38.61 cu. ft., bottom mounted self-contained refrigeration, (6) adjustable epoxy coated shelves, (2) full-height solid hinged doors with locks, digital temperature display/controls, temperature alarms, LED interior lighting, stainless steel interior floor, aluminum interior sides, rear, & top, stainless steel front, gray painted steel exterior sides, top & rear, (6) 4" casters (2 with brakes), R290 Hydrocarbon refrigerant, 1/3 HP, NEMA 5-15P, UL EPH Classified, cULus, ENERGY STAR®

1 ea Warranty: 2-Year parts & labor on entire machine

1 ea Warranty: 5-Year parts on compressor

1 ea 115v/60/1-ph, 4.3 amps, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1				Cord & Plug		5-15P			1/3		
2	115	60	1				4.3				

ITEM 08 - REACH-IN FREEZER (1 REQ'D)

Hoshizaki Model EF1A-FS Dimensions: 81.63(h) x 27(w) x 29.63(d)

Economy Series Freezer, reach-in, one-section, 17.74 cu. ft., bottom mounted self-contained refrigeration, (3) adjustable epoxy coated shelves, (1) full-height solid right hinged door with lock, digital temperature display/controls, temperature alarms, LED interior lighting, stainless steel interior floor, aluminum interior sides, rear, & top, stainless steel front, gray painted steel exterior sides, top & rear, (4) 4" casters (2 with brakes), R290 Hydrocarbon refrigerant, 1/3 HP, NEMA 5-15P, UL EPH Classified, cULus

1 ea Warranty: 2-Year parts & labor on entire machine

1 ea Warranty: 5-Year parts on compressor

1 ea 115v/60/1-ph, 3.2 amps, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1				Cord & Plug		5-15P			1/3		
2	115	60	1				3.2				

ITEM 09 - ICE MAKER, CUBE-STYLE (1 REQ'D)

Manitowoc Model IYT0620A Dimensions: 21.5(h) x 22(w) x 24.5(d)

Indigo NXT™ Series Ice Maker, cube-style, air-cooled, self-contained condenser, 22"W x 24-1/2"D x 21-1/2"H, production capacity up to 575 lb/24 hours at 70°/50° (465 lb AHRI certified at 90°/70°), easyTouch display with 13 different language options, date/time stamp display, automatic reminder/alert icon, one touch asset information, automatic detection of accessories, continuous operating status, programmable production options (time, weight, day or night), one touch cleaning with displayed instructions, Alpha-San anti-microbial protection, acoustical ice sensing probe, self-diagnostic technology, DuraTech™ exterior, half-dice size cubes, R410 refrigerant, NSF, cULus, CE, ENERGY STAR®

- 1 ea Model WARRANTY-ICE-SC 3 year parts & labor (Machine), 5 year parts & labor (Evaporator), 5 year parts & 3 years labor (Compressor), standard
- 1 ea (-161) 115v/60/1-ph, 12.2 amps
- 1 ea Model AR-10000-P Arctic Pure® Plus Primary Water Filter Assembly, includes head, shroud, hardware, mounting assembly, & (1) filter cartridge, 15,000 gallon capacity, 0-600 lbs./ice per day
- 1 ea Model WARRANTY-ARCPURE 3 year parts & labor warranty on cap, housing, hardware, & mounting assembly (does not refer to filter cartridge), standard
- 1 ea Model D420 Ice Bin, 22"W, 34"D x 50"H, with side-hinged front-opening door, side grips, 383 lbs. application capacity, AHRI certified 12.9 cu. ft., for top-mounted ice maker, Duratech exterior, NSF
- 1 ea Model WARRANTY-BIN/DISP 3 year parts & labor warranty, standard
- 1 ea Legs, 6" adjustable stainless steel, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1				12.2				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1				3/8"					
2									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1/2"	
2	3/4"	

PLUMBING 1 REMARKS

Drain for ice maker

ITEM 10 - SPARE NO.

ITEM 11 - DISHTABLE, WITH POTSINKS (1 REQ'D)

John Boos Model DT3B18244-2D24R Dimensions: 44.06(h) x 103.63(w) x 30.38(d)

Dishtable/Pot Sinks, clean, straight design, 103-5/8"W x 30-3/8"D x 44-1/16"H overall size, (3) 18"W x 24" front-to-back x 14" deep compartments, (2) 24" drainboards, dish machine attachment on left side, 10"H boxed backsplash, (1) set of splash mount faucet holes with 8" centers, (3) rack slides with storage bracket, 16/300 stainless steel construction, stainless steel legs, bracing, & adjustable bullet feet, NSF, CSA-Sanitation (limited options available for this model)

- 1 ea SPECIFY DISH MACHINE BRAND AND MODEL. Certain dish machines require modification at additional cost not shown here.
- 1 ea Model PB-PRW-1LF Prerinse Unit, splash mount, flex stainless steel hose, 8" centers, 1/4 turn cramic cartridges, color coded hot/cold indicators, integral check valve, 1/2" NPT, includes 12" wall bracket, NSF, cCSAus, ADA Compliant (LEAD FREE FAUCET)

1 ea Model PB-AD-12LF Add-On-Faucet, 12" swing spout, fits on PB-PRW-1LF or PB-PRD-2LF pre-rinse units (LEAD FREE FAUCET)

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									
2									
3									
4	1/2"			1/2"					

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		
2		
3		
4		

PLUMBING 1 REMARKS
1" faucet holes, 8" centers, 3-1/2" drain opening
PLUMBING 2 REMARKS
3-1/2" drain opening
PLUMBING 3 REMARKS
3-1/2" drain opening
PLUMBING 4 REMARKS
8" centers

ITEM 12 - DISHWASHER, DOOR TYPE, VENTLESS (1 REQ'D)

Champion Model DH-6000T-VHR Dimensions: 79(h) x 33.94(w) x 31.63(d)

Genesis Dishwasher, door type, extended hood (27" opening for trays), ventless heat recovery, high temperature sanitizing with built-in stainless steel electric booster for (40°-70° rise), (40) racks/hour capacity, auto start, single point electrical connection, door interlock switch, on-board service diagnostics, Rinse Sentry feature, auto-fill, detergent & chemical connections, interchangeable upper & lower spray arms, automatic drain valve, vent fan control, bottom mounted HMI controls, mounted water PRV, stainless steel construction, electric tank heat, peg rack, flat rack, 2 HP self draining pump, NSF, cULus, ENERGY STAR®

1 ea Fuel Surcharge (NET/NET)
1 ea 1 year parts & labor warranty, standard
1 ea Complimentary factory authorized performance test included, upon equipment start-up. Consult local Champion sales representative for coordination of the start-up. If customer is beyond 60 miles from Champion authorized service agent, consult factory.
1 ea Single-point electrical connection, standard
1 ea 208-240v/60/3-ph
1 ea Straight-through design application
1 ea Drain water tempering kit, factory mounted & inter-wired

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									2		
2	208-240	60	3								

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1				3/4"					

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1"	

ITEM 13 - CLEAN DISHTABLE (1 REQ'D)

John Boos Model CDT6-S60SBK-L Dimensions: 44.06(h) x 60(w) x 30.38(d)

Pro-Bowl Clean Dishtable, straight design, 60"W x 30"D x 44"H overall size, right-to-left operation, 10"H boxed backsplash with 45° & 2" return, 2-1/4"H rolled edge, 16/300 stainless steel top, stainless steel legs, bracing, & adjustable bullet feet, NSF

1 ea SPECIFY DISH MACHINE BRAND AND MODEL. John Boos standard opening is 20-7/8". Certain dish machines require modification at additional cost not shown here.

ITEM 14 - DISHTABLE SORTING SHELF (2 REQ'D)

John Boos Model BHS1842-TS Dimensions: 12.25(h) x 42(w) x 18(d)

Dishrack Sorting Shelf, 42"W x 18"D x 12-1/4"H, wall mounted, slanted, tubular, includes brackets, 16/300 stainless steel, NSF

ITEM 15 - HAND SINK (2 REQ'D)

John Boos Model PBHS-W-1410-EE Dimensions: 13.25(h) x 17(w) x 15.5(d)

Pro-Bowl Hand Sink, wall mount, 14"W x 10" front-to-back x 5" deep bowl, splash mount electronic eye faucet with 3-1/2" gooseneck spout, stainless steel construction (Splash Mount Electronic Eye Faucet Included)

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1	1/2"								

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		

PLUMBING 1 REMARKS

2" drain opening

ITEM 16 - WIRE SHELVING UNIT (6 kt REQ'D)

Quantum Model WR74-2148P Dimensions: 74(h) x 48(w) x 21(d)

Wire Shelving Starter Kit, 48"W x 21"D x 74"H, 600 - 800 lb. capacity, includes (4) wire shelves & (4) posts, green epoxy antimicrobial finish, NSF, shipped KD

6 kt 15 year limited warranty (limited against rust and corrosion)

6 ea Model DB Donut Bumper, 3" dia., NSF

6 st Model WR-00H Casters, set of (4) 5" swivel (2 with brakes), thermoplastic resin

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ITEM 17 - MOP SINK CABINET (1 REQ'D)

John Boos Model PBJC-224884-L Dimensions: 84(h) x 48(w) x 22.5(d)

Janitor Cabinet, 48"W x 22-1/2"D x 84"H overall size, enclosed cabinet with open back for plumbing, (2) lockable louvered swing doors, left side includes: 20" x 16" x 12" deep mop sink with 3-1/2" drain, (1) over head shelf, (2) side mounted mop/broom holder with locking cam and panel-less back, right side includes: (3) shelves and bottom storage area, includes (1) service faucet with vacuum breaker and 120" hose, 18/300 stainless steel, NSF

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		

PLUMBING 1 REMARKS

3-1/2" drain opening

ITEM 18 - BUSSING UTILITY TRANSPORT CART, METAL (2 REQ'D)

Channel Manufacturing Model US2135-3 Dimensions: 37.25(h) x 39.5(w) x 22(d)

Banquet / Utility Cart, Utility / Bussing Cart, 39.5"W x 22"D x 37.25"H, Stainless Construction, (3) shelves, 5" Swivel Plate Casters, 68lbs. (ITEM WEIGHT ONLY), 500 lb. distributed weight capacity, push handle, weight does not include 50 lbs. for pallet weight

2 ea Lifetime warranty against rust and corrosion

ITEM 19 - UNIVERSAL PAN RACK (3 REQ'D)

Channel Manufacturing Model UTR-18 Dimensions: 64(h) x 20.5(w) x 26(d)

Steam Table Pan Rack, Bun Pan / Steam Table Pan Rack, Standard Series, 20.5"W x 26"D x 64"H, Aluminum Construction, End Load, 3" Angle Spacing, (18) 18" x 26" or (36) 13" x 18" (2 per shelf) or 12" x 20" steam table pans (pan height determines capacity), 5" Swivel Stem Casters model # CSS45O, Made in USA, NSF, 50lbs. (ITEM WEIGHT ONLY), weight does not include 50 lbs. for pallet weight

3 ea Lifetime warranty against rust and corrosion

ITEM 20 - SPARE NO.

ITEM 21 - REACH-IN HEATED CABINET (1 REQ'D)

True Mfg. - General Foodservice Model TH-23G~FGD01 Dimensions: 78.38(h) x 27(w) x 29.75(d)

Heated Cabinet, reach-in, one-section, framed glass door version 01, (1) glass hinged door with lock, (3) heavy-duty chrome-plated adjustable shelves, interior lighting, stainless steel front, aluminum sides, stainless steel interior, 4" castors, 850 watts, 115/60/1-ph, 7.8 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA

1 ea Door hinged right standard

1 ea 4" stem castors, standard (adds 5" to OA height)

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1	Cord & Plug		5-15P	7.8	.85			

ITEM 22 - REACH-IN REFRIGERATOR (2 REQ'D)

True Mfg. - General Foodservice Model T-35G-HC~FGD01 Dimensions: 78.25(h) x 39.63(w) x 29.88(d)

Refrigerator, reach-in, two-section, framed glass door version 01, (2) glass doors, (6) PVC coated adjustable wire shelves, LED interior lighting, stainless steel front, aluminum sides, clear coated aluminum interior with stainless steel floor, 4" castors, R290 Hydrocarbon refrigerant, 1/3 HP, 115v/60/1-ph, 5.6 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA

2 ea Self-contained refrigeration standard

2 ea 7 year compressor warranty, 6 years parts warranty, 5 year labor warranty standard. Please visit www.truemfg.com for specifics standard

2 ea Left door hinged left, right door hinged right standard

2 ea 4" stem castors, standard (adds 5" to OA height)

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115		1	Cord & Plug		5-15P	5.6		1/3		15.0

ITEM 23 - DISPLAY CASE, REFRIGERATED/NON-REFRIG (1 REQ'D)

True Mfg. – Specialty Retail Display Model TGM-DZ-59-SC/SC-B-W Dimensions: 49.13(h) x 59.25(w) x 39(d)

Glass Merchandiser, dual zone (dry/refrigerated), 59-1/4"W, self-contained refrigeration, with fixed curved glass front, solid colored sides, (2) rear sliding glass doors, (3) tiered levels of adjustable white PVC coated wire shelves (6 shelves total), LED interior lighting, black powder coated exterior, white powder coated interior, R290 Hydrocarbon refrigerant, 1/4 HP, 115v/60/1-ph, 10.0 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA

1 ea Warranty - 5 year parts and labor, please visit www.Truemfg.com for specifics

1 ea Self-contained refrigeration standard

1 ea Warranty - 7 year compressor (self-contained only), please visit www.Truemfg.com for specifics

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1			5-15P	10		1/4		

ITEM 24 - ESPRESSO CAPPUCCINO MACHINE (1 REQ'D)

Eversys Inc. Model ENIGMA E'4M X-WIDE Dimensions: 30(h) x 34(w) x 26(d)

Enigma E'4M Automated Espresso Coffee Machine, 2 group, super automatic, up to 350 espresso per hour production capacity, (2) 10" touch screen controls, electronic e'Foam Micro Air Dosing (MAD) system, electronic milk texturing system, includes: (2) Everfoam steam arms, (2) ceramic burr grinders, (2) 3.3 lb coffee bean hoppers, (1) 1.5 lb grounds drawer, (1) hot water spout, (1) 5.4 liter steam boiler, (2) 1.5 liter coffee boilers, brown & black exterior, 4.6kW, 208v/60/2-ph, NEMA L6-30

1 ea 1 year labor & service, 2 year parts, standard

1 ea Pricing also includes installation, unless specifically noted otherwise.

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	60	2	Cord & Plug		L6-30		4.6			

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1				3/8"					

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	56mm	

ITEM 25 - MEGA TOP SANDWICH / SALAD PREPARATION REFRIGERATOR (1 REQ'D)

True Mfg. - General Foodservice Model TSSU-36-12M-B-HC Dimensions: 40.38(h) x 36.38(w) x 34.13(d)

Mega Top Sandwich/Salad Unit, (12) 1/6 size (4"D) poly pans, stainless steel insulated cover, 8-7/8"D cutting board, aluminum back, (2) full doors, (4) PVC coated adjustable wire shelves, stainless steel top/front/sides, GalFan coated steel back, aluminum interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/4 HP, 115v/60/1-ph, 4.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA

1 ea Self-contained refrigeration standard

1 ea 7 year compressor warranty, 6 years parts warranty, 5 year labor warranty standard. Please visit www.truemfg.com for specifics standard

1 ea Castors, 5" (36" work surface height) standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1	Cord & Plug		5-15P	4.5		1/4		15.0

ITEM 26 - RAPID COOK OVEN (2 REQ'D)

Pratica Products Inc. Model ROCKET EXPRESS Dimensions: 25.06(h) x 21(w) x 31.75(d)

Rocket Express Rapid Cook Oven, electric, countertop, combination impinged air, convection, bottom infrared heat & microwave cooking, ventless with removable catalytic converter, 0.74 cu. ft. capacity, touch pad controls, variable speed impingement airflow, independently controlled top and bottom heaters, manual mode, 86° to 530°F temperature range, stores up to (1024) recipes, USB port, includes: (1) baking stone, (1) cooking basket, (1) aluminum paddle & (1) USB drive, cool touch AISI430 stainless steel exterior, cETLus, ETL-Sanitation, CE

2 ea 1 year parts and labor warranty, standard

2 ea 208v/60/1-ph, 6.2 kW, 30 amps, cord, NEMA 6-30P, standard

2 ea Model EXPRESS PACKAGE 1 Rocket Express Package (Standard Accessories):

•(200603) Aluminum paddle

•(200601) Panini plate

•(200201) Solid basket

•(200902) Oven cleaner

•(200901) Oven protector

•(200905) Non-scratch scrub pad

•(200904) (2) cleaning towels

•(200903) Standard trigger sprayer

•(200906) Foaming trigger sprayer

•(200401) USB drive

(Included with oven purchase)

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	60	1	Cord & Plug		6-30P	30.0	6.2			

ITEM 27 - UNDERCOUNTER REFRIGERATOR (1 REQ'D)

True Mfg. - General Foodservice Model TUC-24-HC Dimensions: 31.63(h) x 24(w) x 24.75(d)

Undercounter Refrigerator, 33 - 38°F, (1) stainless steel door, (2) PVC coated adjustable wire shelves, stainless steel top, front & sides, clear coated aluminum interior with stainless steel floor, front breathing, R290 Hydrocarbon refrigerant, 1/6 HP, 115v/60/1-ph, 2.0 amps, NEMA 5-15P, cULus, UL EPH Classified, CE, Made in USA, ENERGY STAR®

1 ea Self-contained refrigeration standard

1 ea Right Hand, Standard: Unit comes with field reversible hinges & is built with hinging on right side of unit.

1 ea Bolt locks, factory installed, standard

1 ea NOTE: Four (4) stationary castors. 31-5/8" (804 mm) work surface height. Two (2) front leg

levelers included with unit for alternate use. No other castor/leg options are available for this model.

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1	Cord & Plug		5-15P	2		1/6		

ITEM 28 - DRAFT BEER COOLER (1 REQ'D)

True Mfg. - General Foodservice Model TDD-1-S-HC Dimensions: 39.75(h) x 23.5(w) x 31.25(d)

Draft Beer Cooler, 23-1/2"W, (1) 1/2 keg capacity, stainless steel counter top, (1) door with lock, (1) column type beer faucet, stainless steel exterior, galvanized interior with stainless steel floor, castors, R290 Hydrocarbon refrigerant, 1/10 HP 115v/60/1-ph, 1.4 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA, ENERGY STAR®

1 ea Self-contained refrigeration standard

1 ea 7 year compressor warranty, 6 years parts warranty, 5 year labor warranty standard. Please visit www.truemfg.com for specifics standard

1 ea Two-Way Manifold, for direct draw draft

1 ea Draft Column, double faucet, 3" dia., angled top

1 ea May require an additional manifold

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1	Cord & Plug		5-15P	1.4		1/10		15.0

ITEM 29 - ICE BIN / ICE CADDY , MOBILE (1 REQ'D)

BK Resources Model BK-MIB-2411 Dimensions: 29(h) x 11(w) x 24(d)

Mobile Ice Bin, with sliding lid, 11"W x 24"D x 29"H, stainless steel, 53lb. capacity, removable bottom tray, drain valve in rear of unit, 3" casters with brake

ITEM 30 - SPARE NO.

ITEM 31 - REACH-IN UNDERCOUNTER FREEZER (1 REQ'D)

Silver King Model SKF27A-EDUS1 Dimensions: 32.16(h) x 27(w) x 29.32(d)

Undercounter Freezer, one-section, 27"W, (2) drawers, adjustable temperature control, automatic defrost, aluminum interior, stainless steel & galvanized exterior, 3" casters (2 with locks), rear-mounted self-contained refrigeration, front breathing, R290, 115v/60/1-ph, 2.0 amps, NEMA 5-15P, cETLus, ETL-Sanitation

1 ea 1 year parts & labor warranty, 5 year compressor (part only) warranty, 90 days replacement parts, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1	Cord & Plug		5-15P	2				

ITEM 32 - DROP-IN SINK (1 REQ'D)

John Boos Model PB-DISINK091106-STD Dimensions: 17.25(h) x 16.5(w) x 17.5(d)

Pro-Bowl Drop-In Sink, 1-compartment, 16-1/2"W x 17-1/2"D x 17-1/4"H overall size, (1) 11-1/2"W x 9-1/4" front-to-back x 6" deep bowl, deck mount faucet holes with 4" centers, 2" drain opening with basket drain, with left & right side splashes, integrated towel dispenser, includes soap dispenser (PB-SD-DM), stainless steel construction

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		

PLUMBING 1 REMARKS

(1) set of 1" faucet holes, 4" centers, 2" drain opening

ITEM 33 - DROP-IN SINK (1 REQ'D)

Advance Tabco Model SS-1-1919-12 Dimensions: 12(h) x 19(w) x 19(d)

Smart Series™ Drop-In Sink, 1-compartment, self-rim design, 16"W x 14" front-to-back x 12" deep bowl, 8" OC faucet holes (1-1/4" diameter hot & cold water, 1" diameter center hole), 18/304 stainless steel, includes: 3-1/2" basket drain & mounting clips

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1-1/2"	

PLUMBING 1 REMARKS

8" OC faucet holes (1-1/4" diameter hot & cold water, 1" diameter center hole)

ITEM 34 - UNDERCOUNTER REFRIGERATOR (1 REQ'D)

True Mfg. - General Foodservice Model TUC-36-HC Dimensions: 29.75(h) x 36.38(w) x 30.13(d)

Undercounter Refrigerator, 33 - 38°F, (2) stainless steel doors, (4) PVC coated adjustable wire shelves, stainless steel top & sides, aluminum interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/6 HP, 115v/60/1-ph, 2.0 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA

- 1 ea Self-contained refrigeration standard
- 1 ea 7 year compressor warranty, 6 years parts warranty, 5 year labor warranty standard. Please visit www.truemfg.com for specifics standard
- 1 ea Bolt locks, factory installed, standard
- 1 ea Castors, 1-1/2" (31-7/8" work surface height = LP)

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1	Cord & Plug		5-15P	2		1/6		15.0

ITEM 35 - COFFEE BREWER (1 REQ'D)

BUNN Model 34600.0001 Dimensions: 35.7(h) x 21.8(w) x 20.2(d)

34600.0001 DUAL TF BrewWISE® DBC® ThermoFresh® Coffee Brewer, 18.9 gal/hr, coffee extraction controlled with pre-infusion & pulse brew, digital temperature control, large spray head, automatic programming, stores individual recipes, SplashGard® & optional funnel locks, wireless brewer-grinder interface, black finish, lower hot water faucet, wireless brewer-grinder interface, holds (2) 1-1/2 gallon ThermoFresh servers (servers sold separately), 120/240v/60/1-ph, 6600w, 27.5amps, UL, NSF

4 ea Model 44050.0200 44050.0200 TF ThermoFresh® Server with Mechanical Sight Gauge, with base & drip tray, 1-1/2 gallon, lever action dispensing, brew-through lid, portable, soft-grip bail handle, fast flow faucet, aluminum faucet guard, vacuum insulated, stainless steel liner, black finish, for use with twin or single Infusion Series brewers, NSF

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120/240	60	1				27.5	6.6			

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1				3/8"					

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		

ITEM 36 - POS STATION (1 REQ'D)

Foodesign Cutsheets Model BY OWNER

ITEM 37-40 - SPARE NO.

METRO®

We put space to work.®

Item # _____

Job _____

Metro C5® 3 Series Insulation Armour® Heated Holding and Proofing Cabinets

- **Insulation Armour™:** Patented insulation technology retains heat, saves energy, and provides a cool-to-touch exterior. Durable polymer construction is dent, impact, and stain resistant. Molded-in hand holds create vertical handles for mobile applications.
- **Colors:** Insulation Armour is available in Red, Blue, or Gray standard and in other colors on a promotional basis or upon request.
- **Control:** Three modules are available: Holding, Moisture, and Combination Proof and Hold. All feature an easy-to-read digital thermometer, recessed control dials, a master on/off switch, and power indicator lights. All are removable without tools for easy cleaning, and allow for future upgrades without replacing entire cabinet body.
- **Performance:** All modules provide fast heat-up and recovery through a thermostatically controlled, forced convection system.
- **Sizes:** C5 3 Series cabinets are available in Full Height (71", 1803mm), 3/4 Height (59", 1499mm), 1/2 Height (44", 1118mm), and Under Counter (32", 813mm) sizes.
- **Doors:** Solid insulated aluminum or clear polycarbonate doors are available. Full Height cabinets can be configured with full length or dutch-style doors. Clear doors provide visibility of the contents of the cabinet without the heat loss associated with opening the door.
- **Capacity:** Three slide styles provide maximum holding capacity. Choose from Universal Wire, Lip Load, or Fixed Wire.
- **Reliability:** Reliability and durability are designed into every C5. High-quality components provide a long life of worry free use.
- **Power Options:** Choose between standard high wattage or low wattage models based on the specific needs of the application.

Red Full Height Dutch Clear Doors

Red Under Counter Solid Door

Blue 1/2 Height Full Solid Door

Gray 3/4 Height Full Clear Door

Blue Full Height Full Clear Door

3 Series Removable Control Modules

- **Holding Module:** Hot holding at higher temperatures without moisture control.*
- **Moisture Module:** Hot holding and proofing. Moisture control at any temperature.
- **Combination Module:** Hot holding and proofing. Moisture control at lower temperatures (proofing).

* Note: Cabinets with holding module do not include the water pan.

All Metro Catalog Sheets are available on our website: **www.metro.com**

Metro Heated cabinets are for hot food holding applications only.

METRO®

InterMetro Industries Corporation
North Washington Street, Wilkes-Barre, PA 18705
Product Information. U.S. and Canada: 1.800.992.1776
Outside U.S. and Canada: www.metro.com/contactus

L03-270
Printed in U.S.A. Rev. 11/18

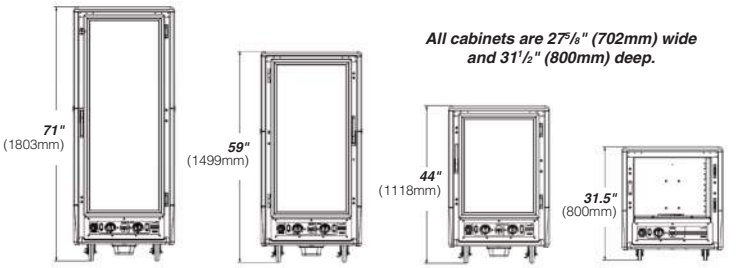
13.93

C5® 3 Series Insulation Armour® Heated Holding and Proofing Cabinets

Job _____

C5® 3 Series Insulation Armour® Heated Holding and Proofing Cabinets

METRO®
We put space to work.



- **Cabinet Material:** .063" (1.8mm) aluminum, natural interior with .125" (3.2mm) aluminum chassis.
- **Insulation Armour™:** High Density Polyethylene (HDPE).
- **Casters:** Four casters with 5" (127mm) donut neoprene wheel, double ball bearing swivel, ball bearing axel, nickel plated, two with brake. 3" rubber casters on Under Counter models.
- **Solid Doors:** Fully insulated with 1" (25.4mm) fiberglass, double panel .063" (1.8mm) aluminum, brushed exterior, natural interior.
- **Clear Doors:** Extruded aluminum powder coated frame with .090" (2.3mm) polycarbonate window.
- **Hinges:** Field reversible, double hinged, 180° swing, with long-life nylon bearings.
- **Gaskets:** High temperature, door mounted, Santoprene gaskets.
- **Latches:** Polymer high-strength magnetic pull latch with lever-action release.
- **Hand Holds:** Molded into the Insulation Armour™ on all four corners.
- **Universal Slides:** ¼" (6.4mm) dia. nickel-chrome electroplated wire, adjustable on 1½" (38mm) increments.
- **Lip Load Slides:** 1½"x1½"x.063" (38x38x1.8mm) extruded aluminum channel slides, 1½" (38mm) fixed spacing.
- **Fixed Wire Slides:** ¼" (6.4mm) dia. nickel-chrome electroplated wire, welded on 3" (76mm) spacing. Not offered in Under Counter models.
- **Drip Trough:** Smooth polymer drip trough with catch pan.
- **Holding Modules:** Removable without tools, digital thermometer, recessed control dials, master on/off switch, "Power On" light, water pan, ball bearing blower forced air system, 7½' cord, UL, CUL, and NSF Listed.

Electrical and Performance:

- **Holding Module:** 80°F (27°C) to 200°F (93°C) operating temperature range. Available:120V 2000W & 1440W, 220-240V 1681-2000W.
- **Moisture Module:** 80°F (27°C) to 200°F (93°C) operating temperature range. 35% RH at 160°F (71°C), 95% RH at 95°F (35°C). Available: 120V 2000W, 220-240V 1681-2000W.
- **Combination Module:** 80°F (27°C) to 200°F (93°C) operating temperature range. 95% RH at 95°F (35°C). Available:120V 2000W & 1440W, 220-240V 1681-2000W.
- **Clearance Requirements:** 18" (46cm) away from any cooking equipment. AVOID contact with surfaces that exceed 200°F (90°C). Minimum clearance from enclosures is 1½" (38mm) on sides and back, ½" (12.7mm) on top.

Cabinet Height
9 = Full Height
7 = 3/4 Height
5 = 1/2 Height
3 = Under Counter

Module Type
C = Combination
M = Moisture
H = Heated Holding

Slide Type
U = Universal Wire
4 = Fixed Wire
L = Lip Load Aluminum

C539-CDC-U

NEMA 5-20P
For Standard Wattage Cabinets (120V, 16A, 60Hz, 2000W)

Door Style
FS = Full Length Solid
FC = Full Length Clear
DS = Dutch Solid *
DC = Dutch Clear *

*Please note: Dutch doors only available on full-height models. Cabinets ordered without a color designation default to Red.

Low Watt Model Number Description

C539-CLDC-U

NEMA 5-15P
Add "L" for Lower Wattage Combination or Holding Module Cabinets (120V, 12A, 60Hz, 1440W)

Note: Under Counter holding and combination module cabinets are only available in low watt. Under Counter moisture module cabinets are available in 120V, 2000W.

Export Model Number Description

C539-CXDC-U

NEMA 6-15P
Add "X" for Export Cabinets (220-240V, 7.6-8.3A, 50/60Hz, 1681-2000W)

Blue or Gray Model Description

C539-CDC-U-BU

** Cabinets ordered without a color designation default to Red.

Please Note: Under Counter Cabinets are only offered in Red & Gray.

Color **
No Suffix = Red
BU = Blue
GY = Gray

Models with Accessories or Options

C539-CDC-UA
C539-CDC-U-BUA

An "A" suffix indicates that accessories need to be factory assembled to the cabinet. Order accessories separately.

Please Note: Under Counter Combination & Holding modules are not available in 120V, 2000W.

Options/Accessories*

- Small Item Shelf (C5-SHELF-S)
- Stainless Steel Legs (C5-SSLEGS)
- Universal Slide Pair, Chrome (C5-USLIDEPR-C)
- 6" Casters (C5-6CASTER)
- Rear Rigid Casters (C5-5RDGCSTR)
- Travel Latch (C5-TRVL)
- Flush Door Latch (C5-LATCHFLUSH-1)*
- Straight Plug, 20 Amp, 120V (C5-STRPLG-20)
- Straight Plug, 15 Amp, 120V (C5-STRPLG-15)
- Factory Left-Hand Hinging (DD3768)
- Stainless Steel Universal Slides (please call)

Please note: (2) handles required for dutch door models

Pan Capacity	Universal Wire Slide					Lip Load Slide	Fixed Wire Slide	
Cabinet Size	Slide Pairs	Sheet Pans	Steam Pans			Sheet Pans	Sheet Pans	Steam Pans
	Provided	18"x26"	12"x20"x2.5" GN 1/1 65mm	12"x20"x4" GN 1/1 100mm	12"x20"x6" GN 1/1 150mm	18"x26"	18"x26"	12"x20"x2.5" GN 1/1 65mm
Full Height	18	18	34	24	14	35	18	34
Full Height Dutch	18	17	32	22	12	34	17	32
3/4 Height	14	14	26	16	10	27	14	26
1/2 Height	9	8	16	10	6	17	8	16
Under Counter	5	5	10	6	4	10	N/A	N/A

Prodigi™ Pro 7-20 (E/G)

Electric or Gas

UL

Engineered for dependability, connectivity, and cost savings, Prodigi™ Pro combination ovens are an all-in-one solution for efficient and consistent food production. These ovens do the work of a convection oven, kettle, steamer, fryer, smoker and more. With advanced features and accessories and an intelligent, customizable control, Prodigi Pro combination ovens are designed to support—and connect—the most demanding kitchens.

Standard features

- Boilerless steam generation
- Absolute Humidity Control™ for selecting any humidity level from 0-100% to maximize food quality, texture, and yield
- Three cooking modes—steam, convection, and combination
- 10.1" programmable, touchscreen control with customizable home screen options, recipe categorization and filtering, lockout features and more
- Easy recipe upload/download via USB port
- ChefLinc™ remote oven management to push and pull recipes, software or oven settings from anywhere
- Four fully automated cleaning cycles
- Front-accessible and retractable rinse hose
- LED illuminated door handle to provide visual notification of the oven status
- SafeVent™ automatic steam venting at the end of the cooking cycle
- Zero clearance design

CAPACITY

7 Seven full-size sheet pans;
16* full-size hotel pans or GN 1/1 pans, two rows deep (*one less on models with smokers)
14 half-size sheet pans

Two side racks with eight non-tilt support rails; 19-7/8" (505mm) horizontal width between rails, 2-3/4" (70mm) vertical spacing between rails

168 lb (76 kg) product maximum

105 quarts (133 liters) volume maximum

Four (4) wire shelves included.

Copper Installation kits

Base kit selection on amp draw found in electrical table

Electric

- ☐ 20A (5026970)
- ☐ 30A (5026932)
- ☐ 40A (5026972)
- ☐ 50A (5026973)
- ☐ 80A (5026974)

Gas

- ☐ 20A (5026980)
- ☐ 30A (5026933)
- ☐ No cord (5026971)

CPVC Installation kits

Base kit selection on amp draw found in electrical table

Electric

- ☐ 20A (5021521)
- ☐ 30A (5021519)
- ☐ 40A (5021525)
- ☐ 50A (5021526)
- ☐ 80A (5021527)
- ☐ 125A (5021529)
- ☐ 150A (5021530)
- ☐ 200A (5021531)
- ☐ 250A (5021531)

Gas

- ☐ 20A (5021522)
- ☐ 30A (5021520)
- ☐ No cord (5021524)

Condensable Particulate Matter (CPM) emissions produced through the most aggressive testing methods available were measured at 0.77 mg/m³ for 11,660 beef patties which is below the maximum allowable level of 5.0 mg/m³ established by EPA test method 202. This product is UL listed under KNLZ in the U.S. and Canada.

ANSI/NSF 4

COA# 5760
Electric models only

7-20 Pro

Configuration for Electric Models (select one)

- ☐ Turbo
- ☐ ECO

Configuration for Gas Models (select one)

- ☐ Natural gas
- ☐ Propane

Electrical

- ☐ 120V 1ph (Gas only)
- ☐ 208–240V 1ph (Gas only)
- ☐ 208–240V 3ph
- ☐ 440–480V 3ph

Door swing

- ☐ Right hinged
- ☐ Recessed door, optional (not available with Ventech hood)

ChefLinc connection

- ☐ Wi-Fi (standard)
- ☐ Ethernet (optional)

Options (select all that apply)

- ☐ Ventech™ Hood*
- ☐ Ventech™ PLUS Hood*
- ☐ CombiSmoke® feature—smoke hot or cold with real wood chips (not available on units with hoods or units with security devices)
- ☐ Automatic grease collection system

*Electric models only

Cleaning

- ☐ Automatic tablet-based cleaning system (standard)
- ☐ Automatic liquid cleaning system (optional)

Probe choices

- ☐ Removable, quick-release, T-style probe (PR-37158) (standard)
- ☐ Removable, single-point, sous vide probe (PR-36576) (optional)
- ☐ Removable probe with stop for grease collection (5035704)

Security devices for correctional facility use

- ☐ Optional base package (not available with recessed door): includes tamper-proof screw package
- ☐ Anti-entrapment device (5017157) (optional)
- ☐ Control panel security cover (5017144) (optional)
- ☐ Hasp door lock (padlock not included) (5017145) (optional)

Water treatment

- ☐ RO System OPS175C R/5 (5031203)

Extended warranty

- ☐ One-year warranty extension

Installation options (select one)

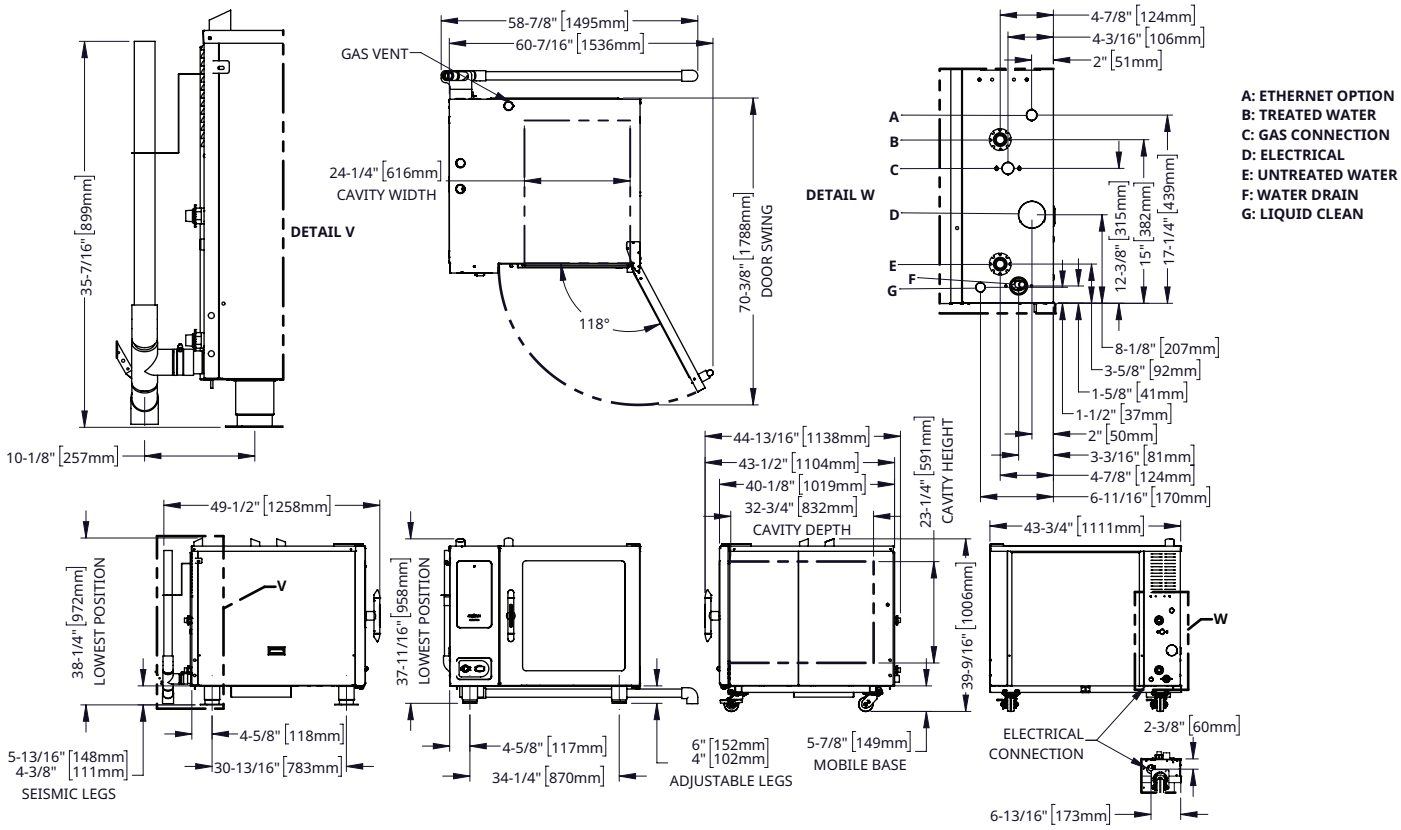
- ☐ Alto-Shaam Combination Factory Authorized Installation Program - available in the U.S. and Canada only
- ☐ Installation Start-Up Check — available through an Alto-Shaam authorized service agency

Accessories (reference accessory catalog)

Prodigi™ Pro 7-20 (E/G)

ALTO-SHAAM

DIMENSIONS — standard door



Model	Exterior (H x W x D)	Interior (H x W x D)	Net Weight
7-20	37-11/16" x 43-3/4" x 44-13/16" (958mm x 1111mm x 1138mm)	23-1/4" x 24-1/4" x 32-3/4" (591mm x 616mm x 832mm)	680 lb (308)

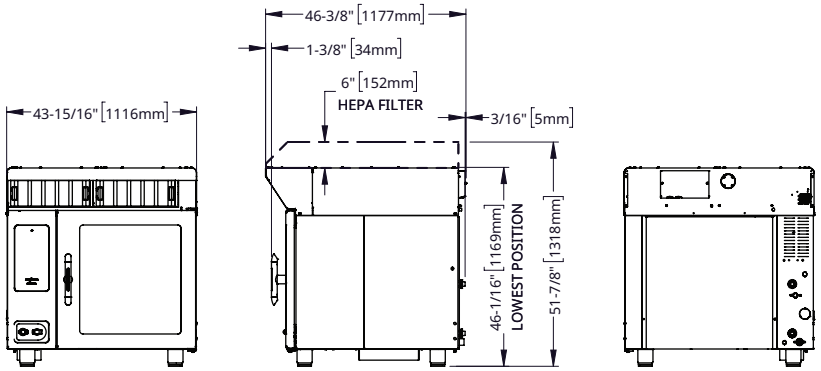
Ship Dimensions (L x W x H)*	Ship Weight
56" x 49" x 51" (1422mm x 1245mm x 1295mm)	727 lb (330 kg)

*Domestic ground shipping information. Contact factory for export weight and dimensions.

OVENS WITH VENTECH® HOOD

Electric only

Eliminate the need for a traditional kitchen hood. Ventech Type 1 hoods with condensation technology condense steam while capturing and removing grease-laden air, vapors, and lingering smoke. For more demanding locations, Ventech PLUS™ hoods include a HEPA filter. These hoods combine the fine particulate filtering of a HEPA filter with condensation technology of the standard Ventech hood.



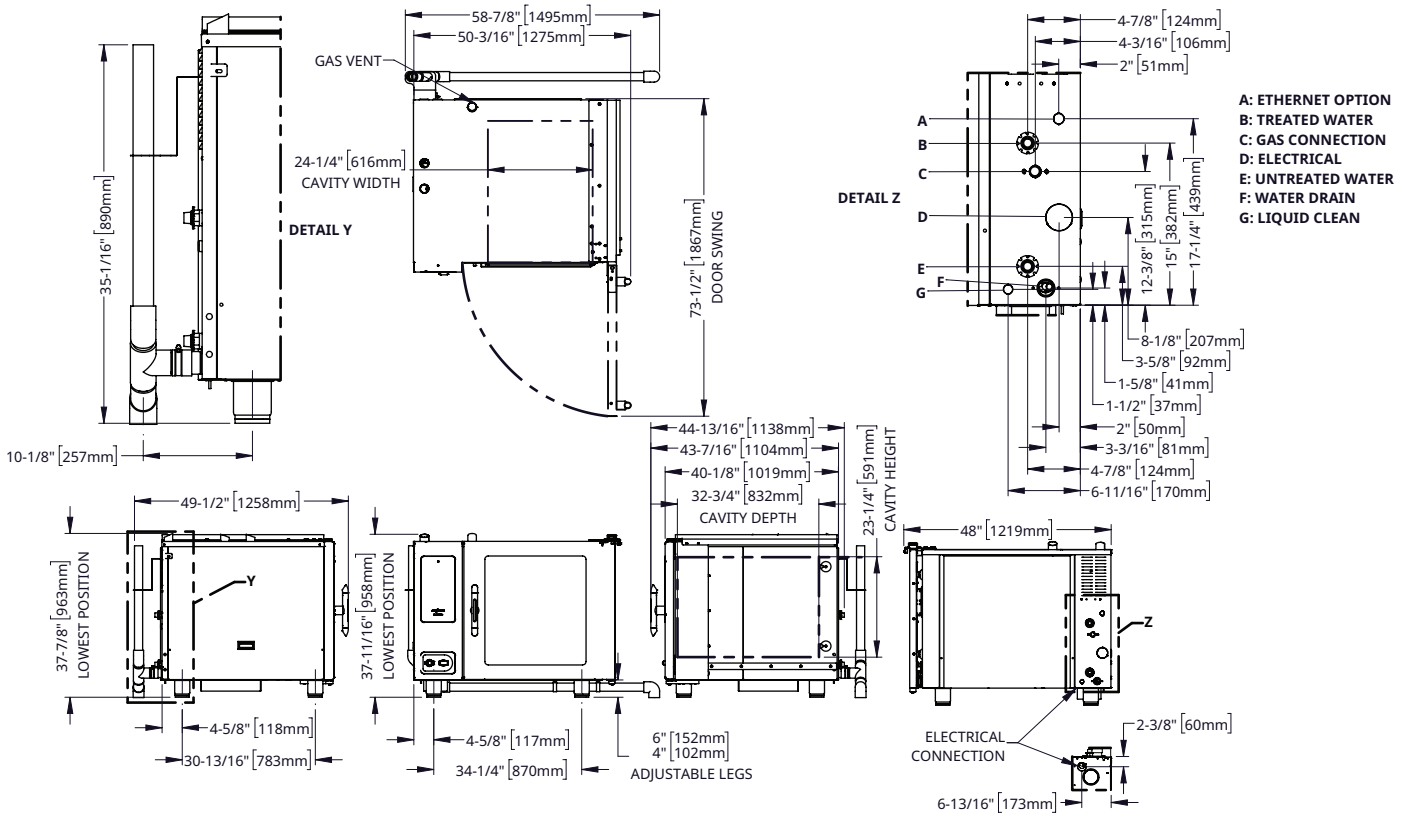
Model	Ventech Hood Exterior (H x W x D)	Net Weight	Ship Dimensions (L x W x H)*	Ship Weight*
VH-20	11-1/8" x 43-15/16" x 46-3/8" (282mm x 1116mm x 1177mm)	158 lb (72 kg)	56" x 49" x 20" (1422mm x 1245mm x 508mm)	276 lb (125 kg)
	Ventech Hood Plus Exterior (H x W x D)	**Net Weight**	**Ship Dimensions (L x W x H)***	**Ship Weight***
	17-1/8" x 43-15/16" x 46-3/8" (435mm x 1116mm x 1177mm)	211 lb (96 kg)	59" x 49" x 20" (1500mm x 1245mm x 508mm)	336 lb (152 kg)
	Oven with Ventech Hood (H x W x D)	**Net Weight**	**Ship Dimensions (L x W x H)***	**Ship Weight***
	43-1/4" x 43-15/16" x 41-11/16" (1099mm x 1116mm x 1059mm)	Call factory	56" x 45" x 65" (1422mm x 1143mm x 1651mm)	Call factory
	Oven with Ventech Hood Plus (H x W x D)	**Net Weight**	**Ship Dimensions (L x W x H)***	**Ship Weight***
	49-1/4" x 43-15/16" x 43-15/16" (1242mm x 1116mmx 1059mm)	Call factory	56" x 45" x 65" (1422mm x 1143mm x 1651mm)	Call factory

*Domestic ground shipping information. Contact factory for export weight and dimensions.

Prodigi™ Pro 7-20 (E/G)

ALTO-SHAAM

DIMENSIONS — recessed door



Model	Exterior (H x W x D)	Interior (H x W x D)	Net Weight
7-20	37-11/16" x 48" x 44-13/16" (958mm x 1219mm x 1138mm)	23-1/4" x 24-1/4" x 32-3/4" (591mm x 616mm x 832mm)	680 lb (308)

Ship Dimensions (L x W x H)*	Ship Weight
56" x 49" x 51" (1422mm x 1245mm x 1295mm)	727 lb (330 kg)

*Domestic ground shipping information. Contact factory for export weight and dimensions.

Prodigi™ Pro 7-20 (E/G)

ALTO-SHAAM

7-20E ELECTRIC

					ECO			Turbo Option*			
7-20E	V	Ph	Hz	AWG	A	Breaker	kW	A	Breaker	kW	Connection
208–240V	208	3	50/60	4	45.7	50	16.4	58.7	60	19.2	3Ø/PE
	240	3	50/60	3	52.7	60	21.9	67.7	70	25.5	3Ø/PE
440–480V	440	3	50/60	8	20.6	25	15.7	26.5	30	18.3	3Ø/PE
	480	3	50/60	8	22.4	25	18.7	28.8	35	21.8	3Ø/PE

*No-cost option on electric models.

- Electrical connections must meet all applicable federal, state, and local codes.
- For use on individual branch circuit only.
- Ovens are not supplied with an electrical cord or plug.
- For CE models use a Type B current protection device that accommodates a leakage current of 30mA.

With Smoker Option					ECO			Turbo Option*			
7-20E	V	Ph	Hz	AWG	A	Breaker	kW	A	Breaker	kW	Connection
208–240V	208	3	50/60	4	48.2	50	17.0	61.2	70	19.7	3Ø/PE
	240	3	50/60	3	55.6	60	22.6	70.6	70	26.2	3Ø/PE
440–480V	440	3	50/60	8	21.9	30	16.2	27.3	30	18.8	3Ø/PE
	480	3	50/60	8	23.8	30	19.2	30.0	35	22.3	3Ø/PE

*No-cost option on electric models.

- Electrical connections must meet all applicable federal, state, and local codes.
- For use on individual branch circuit only.
- Ovens are not supplied with an electrical cord or plug.
- For CE models use a Type B current protection device that accommodates a leakage current of 30mA.

7-20G ELECTRIC

						Without Smoker Option			With Smoker Option			
	7-20G	V	Ph	Hz	AWG	A	Breaker	kW	A	Breaker	kW	Connection
†	120V	120	1	60	12	6.8	20	0.84	12.0	20	1.5	1Ø/PE
†	208–240V	208	1	50/60	14	4.8	15	1.0	7.3	15	1.5	1Ø/PE
		240	1	50/60	14	4.2	15	1.0	7.1	15	1.7	1Ø/PE
†	208–240V	208	3	50/60	14	4.8	15	1.0	7.3	15	1.5	3Ø/PE
		240	3	50/60	14	4.2	15	1.0	7.1	15	1.7	3Ø/PE

† Per UL requirements, must be permanently connected to electrical supply source.

- Electrical connections must meet all applicable federal, state, and local codes.
- For use on individual branch circuit only.
- Ovens are not supplied with an electrical cord or plug.
- For CE models use a Type B current protection device that accommodates a leakage current of 30mA.

Prodigi™ Pro 7-20 (E/G)

ALTO-SHAAM

CLEARANCE

Top:	20" (508mm)
Left:	0" (0mm)
	18" (457mm) recommended service access
Right:	0" (0mm) non-combustible surfaces
	2" (51mm) combustible surfaces
Bottom:	5-1/8" (130mm)
Back:	4" (102mm) between plumbing and nearest object

CHECK FIRST

- Oven must be installed level.
- Oven must be installed on noncombustible surface.
- Use a water supply shut-off valve and back-flow preventer when required by local code.
- Exhaust hood installation is required on gas-heated models.
- Drain must not be located directly underneath the appliance unless a stand with solid top or shelf is used.

HEAT: ELECTRIC

Heat of rejection

7-20E	Heat Gain qs, BTU/hr	Heat Gain qs, kW
	1,305	0.38

NOISE: ELECTRIC

Noise emissions

Without hood system, a maximum 67 dBA was measured at 3.3 ft (1 m) from unit.

With hood system, a maximum 81 dBA was measured at 3.3 ft (1 m) from unit.

HEAT: GAS

Heat of rejection

7-20G	Heat Gain qs, BTU/hr	Heat Gain qs, kW
	549	0.16

NOISE: GAS

Noise emissions

Without hood system, a maximum 67 dBA was measured at 3.3 ft (1 m) from unit.

With hood system, a maximum 81 dBA was measured at 3.3 ft (1 m) from unit.

GAS

Gas Requirements
- Gas type must be specified on order
- Hook-up: 3/4" NPT

UL Marked Appliances	Maximum Input BTU/h	Minimum Input BTU/h	Maximum Inlet Pressure Inches WC (kPa)	Minimum Inlet Pressure Inches WC (kPa)	Maximum Fuel Consumption*	
					CFH	GPH
Natural Gas	98,000	80,000	14.0 (3.5)	5.5 (1.1)	93.3	N/A
Propane	98,000	68,000	14.0 (3.5)	9.2 (2.8)	39.2	1.1

*Assumes an average heating value for natural gs to be 1050 BTU/SCF and a specific gravity of 0.60. The assumed value for propane gas is 2,500 BTU/SCF, and a specific gravity of 1.53.

WATER

Water requirements (per oven)

Two cold water inlets — drinking quality

- One treated water inlet: 3/4" NPT male connection. Line pressure 30 psi minimum dynamic and 90 psi maximum static (200–1000 kPa) at a minimum flow rate of 0.26 gpm (1 L/min).
- One untreated water inlet: 3/4" NPT male connection. Line pressure 30 psi minimum dynamic and 90 psi maximum static (200–1000 kPa) at a minimum flow rate of 2.64 gpm (10 L/min). Water drain: 1-1/2" (40mm) connection with a vertical vent to extend above the exhaust vent. Materials must withstand temperatures up to 200°F (93°C).

CLEARANCE

Clearance requirements for water filtration system

Do not install a water filtration system behind unit.

Water Quality Standards

It is the sole responsibility of the owner/operator/purchaser of this equipment to verify that the incoming water supply is comprehensively tested and, if required, a means of "water treatment" provided that would meet compliance requirements with the published water quality standards shown below. Non-compliance with these minimum standards will potentially damage this equipment and/or components and void the original equipment manufacturer's warranty. Alto-Shaam recommends using the Alto-Shaam Reverse Osmosis System to properly treat your water.

Inlet Water Requirements		
Contaminant	Treated Water	Untreated Water
Free Chlorine	Less than 0.1 ppm (mg/L)	Less than 0.1 ppm (mg/L)
Hardness	30-70 ppm	30-70 ppm
Chloride	Less than 30 ppm (mg/L)	Less than 30 ppm (mg/L)
pH	7.0 to 8.5	7.0 to 8.5
Silica	Less than 12 ppm (mg/L)	Less than 12 ppm (mg/L)
Total Dissolved Solids (tds)	50-125 ppm	50-360 ppm

CONTACT US

W164 N9221 Water Street | Menomonee Falls, Wisconsin 53051 | U.S.A.
Phone: 262.251.3800 | 800.558.8744 U.S.A./Canada | Fax: 262.251.7067 | alto-shaam.com

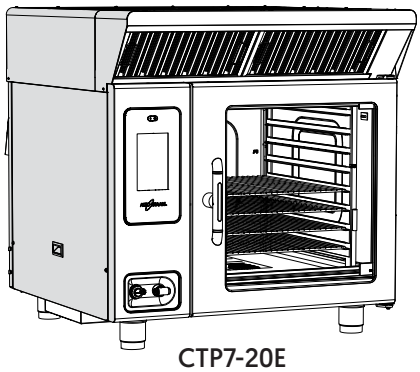
PRO-SPC-0043 5/23 Printed in U.S.A.

Combitherm® CTP7-20E

Ventech™ Type 1 Hood with Condensation

Combining multiple cooking functions into a single appliance, Combitherm® ovens provide endless versatility, reliability and unmatched performance. An all-in-one solution for efficient and consistent food production. Combitherm ovens do the work of a convection oven, kettle, steamer, fryer, and more. Execute every dish, no matter how simple or complex, faster than ever with flawless precision and consistency.

Eliminate the need for a traditional kitchen hood. Ventech Type 1 hoods with condensation technology condense steam while capturing and removing grease-laden air, vapors, and lingering smoke. For more demanding locations, Ventech PLUS™ hoods include a HEPA filter. These hoods combine the fine particulate filtering of a HEPA filter with condensation technology of the standard Ventech hood.



CTP7-20E

Also available for CTC ovens. Contact factory for details.

Standard features

- Four cooking modes—steam, convection, combination, and retherm
- Programmable, touchscreen control
- Easy recipe upload/download via USB port
- Five fully automated cleaning cycles
- Front-accessible and retractable rinse hose
- LED illuminated door handle is designed for the needs of the busy kitchen, and provides visual notification of the oven status
- Absolute Humidity Control™ allows for selection any humidity level from 0-100% to maximize food quality, texture, and yield
- CoolTouch3™ triple panel glass door keeps the heat inside, while keeping the glass cool to the touch and providing 15% greater thermal retention to improve performance and efficiency
- SafeVent™ provides automatic steam venting at the end of the cooking cycle

CAPACITY

8 Eight, full-size sheet pans or eight GN 2/1 pans; sixteen full-size or GN 1/1 pans, two rows deep

2 Two side racks with eight non-tilt support rails; 19-7/8" (505mm) horizontal width between rails, 2-3/4" (70mm) vertical spacing between rails

168 lb (76 kg) product maximum

105 quarts (133 liters) volume maximum

Four (4) wire shelves included. Additional wire shelves required for maximum capacity.

Condensable Particulate Matter (CPM) emissions produced through the most aggressive testing methods available were measured at 0.77 mg/m³ for 11,660 beef patties which is below the maximum allowable level of 5.0 mg/m³ established by EPA test method 202. This product is UL listed under KNLZ in the U.S. and Canada.

Cooking appliance with integral systems for limiting the emission of grease laden air 1P35.

Configurations (select one)

- ☐ Boiler-free, standard
- ☐ Boiler-free, PROpower™
- ☐ Boiler version
- ☐ Boiler version, PROpower™

Door swing

- ☐ Right hinged

Electrical

- ☐ 208-240V, 1ph
- ☐ 208-240V, 3ph
- ☐ 380-415V, 3ph
- ☐ 440-480V, 3ph

Accessories (select all that apply)

- ☐ CombiLatch™
- ☐ Ventech Plus™ HEPA filter
- ☐ Door steam condenser, optional
- ☐ Seismic feet package, optional
- ☐ Mobile base, optional (U.S. only)
- ☐ Extended one-year warranty
- ☐ Automatic grease collection system, includes four 6-piece, self-trussing poultry racks #5014438, interior drip collection pan, and grease collection container with shut-off valve

Cleaning

- ☐ Automatic tablet-based cleaning system, standard
- ☐ Automatic liquid cleaning system, optional

Probe choices

- ☐ Removable, single-point, quick-connect core temperature probe, standard
- ☐ Removable, single-point, quick-connect sous vide temperature probe, optional
- ☐ Hard-wired, multi-point core temperature probe, optional (factory only installed)

Security devices for correctional facility use

- ☐ Optional base package (not available with recessed door): includes tamper-proof screw package, excludes temperature probe
- ☐ Anti-entrapment device, optional
- ☐ Control panel security cover, optional
- ☐ Hasp door lock (padlock not included), optional
- ☐ Removable, single-point, quick-connect core temperature probe, optional

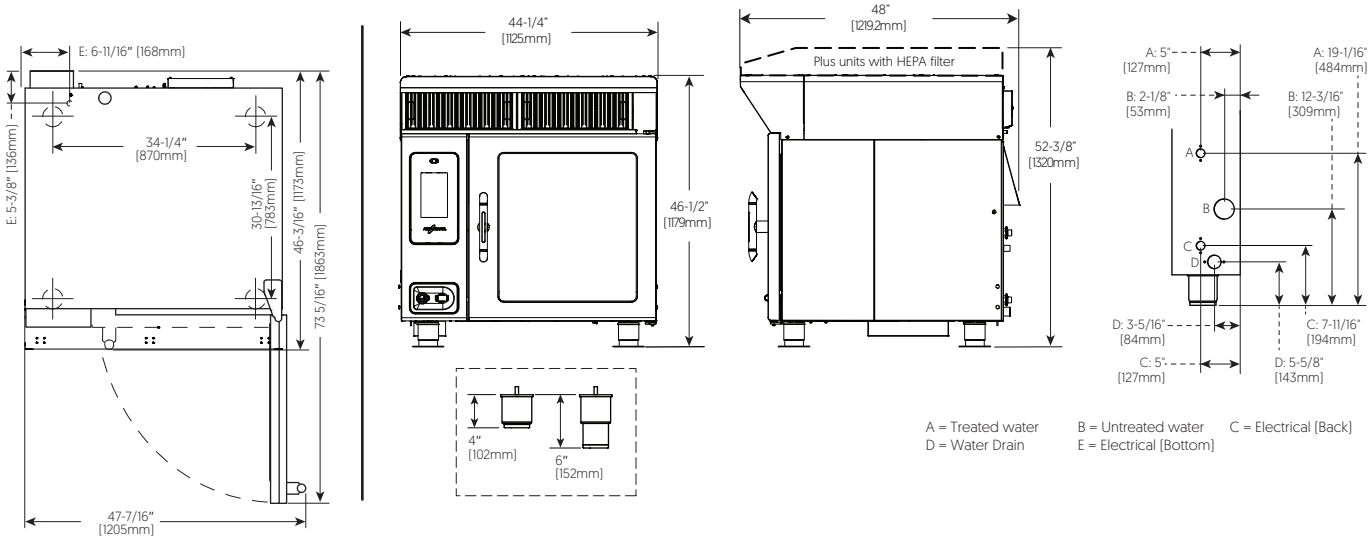
Installation options (select one)

- ☐ Alto-Shaam Combination Factory Authorized Installation Program - available in the U.S. and Canada only. Ventech hood field install extra
- ☐ Installation Start-Up Check - available through an Alto-Shaam authorized service agency

Combitherm® CTP7-20E

ALTO-SHAAM

Specification



DIMENSIONS

Model	Exterior with Ventech Hood (H x W x D)	Interior (H x W x D)
CTP7-20E	88-15/16" x 43-3/4" x 46-3/16" [2260mm x 1111mm x 1173mm]	23-1/4" x 24-1/4" x 32-3/4" [590mm x 616mm x 832mm]
		Net Weight
		801 lb [363 kg]
	Ship Dimensions (L x W x H)*	**Ship Weight***
CTP7-20E	56" x 49" x 108" [1422mm x 1245mm x 2743mm]	856 lb [388 kg]

*Domestic ground shipping information. Contact factory for export weight and dimensions.

Model	Ventech Hood Exterior (H x W x D)	
VH-20	11.12" x 44" x 46.5" [282mm x 1118mm x 1181mm]	**Net Weight**
		158 lb [72 kg]
	Ship Dimensions (L x W x H)*	**Ship Weight***
VH-20	56" x 49" x 20" [1422mm x 1245mm x 282mm]	276 lb [125 kg]

*Domestic ground shipping information. Contact factory for export weight and dimensions.

CLEARANCE

Top:	20" [508mm]
Left:	0" [0mm]
	18" [457mm] recommended service access
Right:	0" [0mm] Non-combustible surfaces
	2" [51mm] combustible surfaces
Bottom:	5-1/8" [130mm]
Back:	4" [102mm]
	4-5/16" [109mm] optional plumbing kit

CHECK FIRST

- Oven must be installed level.
- Water supply shut-off valve and back-flow preventer when required by local code.
- Drain must not be located directly underneath the appliance.

HEAT

Heat of rejection

CTP7-20E	Heat Gain qs, BTU/hr	Heat Gain qs, kW
	1,305	0.38

NOISE

Noise emissions
With hood system, a maximum 71 dBA was measured at 3.3 ft [1 m] from unit.

Combitherm® CTP7-20E

ALTO-SHAAM

ELECTRIC

					ECO Standard			PROpower™ Option**			
CTP7-20E	**V**	**Ph**	**Hz**	**Awg**	**A**	**Breaker**	**kW**	**A**	**Breaker**	**kW**	**Connection**
208–240V	208	1*	50/60	1	79.1	80	16.5	92.1	100	19.2	L1, L2/N, G
	240	1*	50/60	1/0	91.3	100	21.9	106.3	110	25.5	L1, L2/N, G
208–240V	208	3	50/60	4	45.7	50	16.5	58.7	60	19.2	L1, L2, L3, G
	240	3	50/60	3	52.7	60	21.9	67.7	70	25.5	L1, L2, L3, G
380–415V	380	3	50/60	6	28.0	32	18.7	41.7	63	21.4	L1, L2, L3, N, G
	415	3	50/60	4	30.4	32	21.9	45.4	63	25.5	L1, L2, L3, N, G
440–480V	440	3*	50/60	8	20.6	25	15.7	26.5	30	18.3	L1, L2, L3, G
	480	3*	50/60	8	22.4	25	18.7	28.8	35	21.8	L1, L2, L3, G

Electrical connections must meet all applicable federal, state, and local codes. No cord, no plug, dedicated circuit required.
*Electrical service charge applies.
**No-cost option on electric models.

WATER

Water requirements (per oven)

- Two cold water inlets - drinking quality
- One treated water inlet: 3/4" NPT connection. Line pressure 30 psi minimum dynamic and 90 psi maximum static (200-600 kPa) at a minimum flow rate of 0.26 gpm (1 L/min).
- One untreated water inlet: 3/4" NPT connection. Line pressure 30 psi minimum dynamic and 90 psi maximum static (200-600 kPa) at a minimum flow rate of 2.64 gpm (10 L/min). Water drain: 1-1/2" (40mm) connection with a vertical vent to extend above the exhaust vent. Materials must withstand temperatures up to 200°F (93°C).

CLEARANCE

Clearance requirements for water filtration system
Do not install a water filtration system behind unit.

Water Quality Standards

It is the sole responsiblity of the owner/operator/purchaser of this equipment to verify that the incoming water supply is comprehensively tested and, if required, a means of "water treatment" provided that would meet compliance requirements with the published water quality standards shown below. Non-compliance with these minimum standards will potentially damage this equipment and/or components and void the orginal equipment manufacturer's warranty. Alto-Shaam recommends using OptiPure (www.optipurewater.com) products to properly treat your water.

Inlet Water Requirements		
Contaminant	**Treated Water**	**Untreated Water**
Free Chlorine	Less than 0.1 ppm (mg/L)	Less than 0.1 ppm (mg/L)
Hardness	30-70 ppm	30-70 ppm
Chloride	Less than 30 ppm (mg/L)	Less than 30 ppm (mg/L)
pH	7.0 to 8.5	7.0 to 8.5
Silica	Less than 12 ppm (mg/L)	Less than 12 ppm (mg/L)
Total Dissolved Solids (tds)	50-125 ppm	50-360 ppm

North American Certificates and Listings

- Certificate File Number: E180237 – 20131227
- UL 710B, Standard for Recirculating Systems
- UL 197, Standard for Electric Commercial Cooking Appliances
- CSA C22.2 No. 109-M1981, Standards for Commercial Cooking Appliances
- NFPA 96
- NSF / ANSI-4
- EPA 202
- ANSI / UL 900
- ASTM F2800 Type 1 Hood

International Certificates and Listings

- EAC, EURASIAN ECONOMIC UNION DECLARATION OF CONFORMITY
- Australian Water Mark, WMTS-104-2005, Watermark Level 2
- RCM, Australian Regulatory Compliance
- CE, European Harmonized Performance and Safety Compliance
- IPX5, Ingress Protection Rating

CONTACT US
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Phone: 262.251.3800 | 800.558.8744 U.S.A./Canada | Fax: 262.251.7067 | **alto-shaam.com**

CTP7-SPC-0022-EN 04/20 Printed in U.S.A.

SPEC SHEET

"EPT6R5-SSK" STAINLESS STEEL PREP TABLE W/SINK

16GA Top w/Stainless Base & Adjustable Undershelf - 5" Riser

FEATURES:

- 16GA Stainless Steel Top w/5" Riser & Turndown
- Type 300 Stainless Steel With #4 Polish, Satin Finish
- 1-1/2" Stallion Edge On Front With Side Edges 90 Degree Bend Down For Table Line-Up
- (1) 16"x20"x12" Bowl
- Stainless Steel Base With Adjustable Undershelf
- Adjustable Bullet Feet
- Shipped Knocked-Down, Easy-To-Assemble
- Includes (1) Deck Mounted Faucet 4" O/C w/10" Swing Spout

SPECIFICATIONS:

- Top: Stainless Steel Tops Are Tig Welded, Exposed Welds Are Polished To Match Adjacent Surface
- Top: 16GA Stainless Steel Type 300 Stainless Steel With #4 Polish, Satin Finish
- Shelf: 18GA Stainless Steel,
- Legs: 1-5/8" Round O.D. 16GA Tubular Stainless Steel
- Gussets: Stainless Steel
- Feet: 1" Adjustable Stainless Bullet Feet

CERTIFICATIONS:

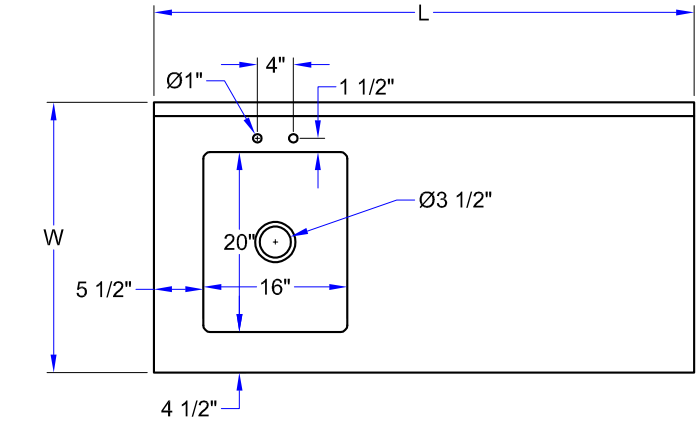
EPT6R5-3060SSK-R

"EPT6R5-SSK" STAINLESS STEEL PREP TABLE W/SINK

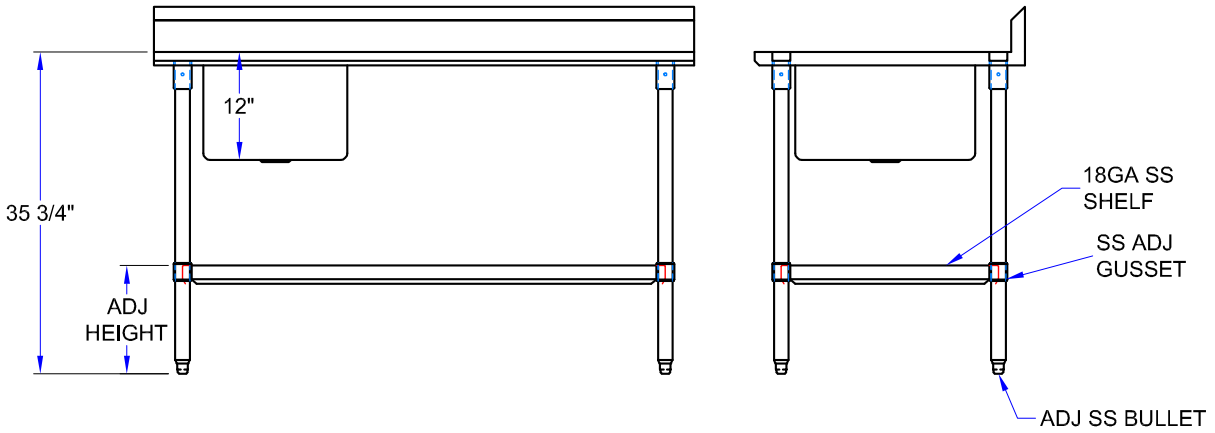
MODEL	SINK BOWL LOCATION	SIZE (L X W X H)	WEIGHT (LBS)
EPT6R5-3048SSK-L	Left	48"x30"x35-3/4"	145
EPT6R5-3048SSK-R	Right	48"x30"x35-3/4"	145
EPT6R5-3060SSK-L	Left	60"x30"x35-3/4"	171
EPT6R5-3060SSK-R	Right	60"x30"x35-3/4"	171
EPT6R5-3072SSK-L	Left	72"x30"x35-3/4"	202
EPT6R5-3072SSK-R	Right	72"x30"x35-3/4"	202

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

DETAILED SPECIFICATIONS



Units 7 Ft. & Larger Are
Furnished With Six Legs
Shelf Length = Length Minus 4.875"
Shelf Width = Width Minus 4.25"



MODEL # STRUCTURE

30 = Width Of Work Surface
5 = Ht. Of Riser w/Turndown
R = Riser Top Work Table
6 = 16GA Work Surface
EPT = Economy Prep Table

60 = Length Of Work Surface
SS = Stainless Steel Base & Shelf
K = Ships Knocked Down
L = Bowl Location

EPT6R5-3060SSK-L

"EPT6R5-SSK" STAINLESS STEEL PREP TABLE W/SINK

MODEL	SINK BOWL LOCATION	SIZE (L X W X H)	WEIGHT (LBS)
EPT6R5-3048SSK-L	Left	48"x30"x35-3/4"	145
EPT6R5-3048SSK-R	Right	48"x30"x35-3/4"	145
EPT6R5-3060SSK-L	Left	60"x30"x35-3/4"	171
EPT6R5-3060SSK-R	Right	60"x30"x35-3/4"	171
EPT6R5-3072SSK-L	Left	72"x30"x35-3/4"	202
EPT6R5-3072SSK-R	Right	72"x30"x35-3/4"	202

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

John BOOS Since 1887

ITEM #: _____ QTY: _____

MODEL #: _____

PROJECT NAME: _____

020121

3601 S. Banker St. Effingham, IL 62401 • P.O. BOX 609 • Ph: (888) 431-2667 • Fax: (800) 433-2667

FAUCETS & PARTS


PBF-FV2-SM-35GLF


PB-KV1-SM-35GLF


PB-KV1-DM-35GLF


PB-KV2-SM-35GLF


PB-KV2-DM-35GLF


PB-WR


PB-LWR-1


PB-PT1.5


PBF-SS-6

FAUCETS & PARTS

	MODEL #	QTY	DESCRIPTION	WT.
FOOT VALVE	PBF-FV2-SM-35GLF		W/ 3-1/2" GOOSENECK SPOUT (LOW LEAD)	3
KNEE VALVE	PBF-KV1-SM-35GLF		SINGLE PEDAL, SPLASH MOUNT, 3.5" GOOSE NECK (LOW LEAD)	3
	PBF-KV1-DM-35GLF		SINGLE PEDAL, DECK MOUNT, 3.5" GOOSE NECK (LOW LEAD)	2.5
	PBF-KV2-SM-35GLF		DOUBLE PEDAL, SPLASH MOUNT, 3.5" GOOSE NECK (LOW LEAD)	2
	PBF-KV2-DM-35GLF		DOUBLE PEDAL, DECK MOUNT, 3.5" GOOSE NECK (LOW LEAD)	4
WRIST BLADES	PB-WR		ADA, STAINLESS STEEL, (1 PAIR), USE W/ HEAVY DUTY FAUCETS ONLY	1
TWIST ACTION LEVER DRAINS	PB-LWR-1		FITS 3-1/2" DRAIN OPENING, 2" OUTLET	4
	PB-LWR-1OV		FITS 3-1/2" DRAIN OPENING, 2" OUTLET, W/ OVERFLOW	4
STRAIGHT ACTION LEVER DRAINS	PB-LWS-1		FITS 3-1/2" DRAIN OPENING, 2" OUTLET	4
	PB-LWS-1OV		W/ OVERFLOW, FITS 3-1/2" DRAIN OPENING	4
P-TRAPS	PB-PT1.5		FOR HAND SINKS, P-TRAP 1-1/2" & TAIL PIPE	7
MOP SINK FAUCET	PBF-SS-6		VACUUM BREAKER NOZZLE W/ 3-4" GARDEN HOSE THREAD, PAIL HOOK, TOP SUPPORT ARM, 1/2" NPT FEMALE FLANGED, W/ ADJUSTABLE INLET W/ SCREWDRIVER STOP	5
MOUNTING KIT	PB-DMMK		FOR DECK MOUNT, INCLUDES (2) 1/2" SUPPLY NIPPLES, (2) RETAINER NUTS, (2) LOCK WASHERS & (2) RUBBER WASHERS	1
	PB-SMMK-90		FOR SPLASH MOUNT, INCLUDES (2) 1/2" SUPPLY NIPPLES, (2) RETAINER NUTS, (2) LOCK WASHERS, (2) RUBBER WASHERS & (2) MALE & FEMALE SHORT 90° ELBOWS	1

SOME UNITS SHIP UNASSEMBLED FOR REDUCED SHIPPING COST. ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500"

John BOOS Since 1887

ITEM #: _____ QTY: _____

MODEL #: _____

PROJECT NAME: _____

090418

3601 S. Banker St. Effingham, IL 62401 • P.O. BOX 609 • Ph: (888) 431-2667 • Fax: (800) 433-2667

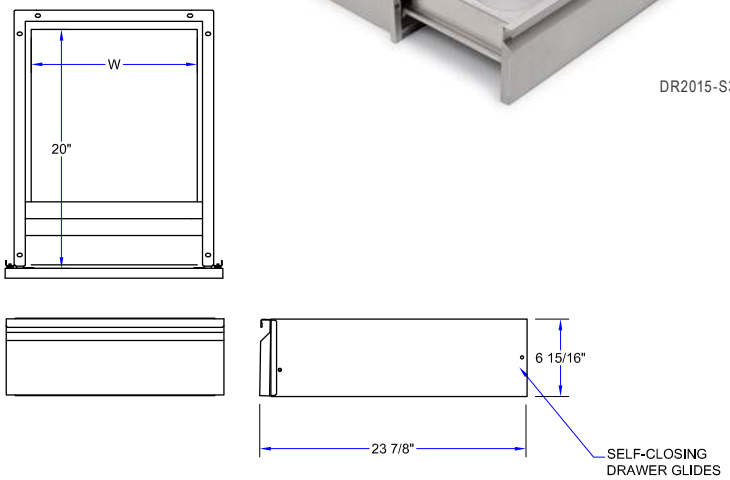
"DRSC" ROLLER BEARING DRAWERS - STAINLESS STEEL

SELF CLOSING

FEATURES:

- STAINLESS STEEL FRONT AND DRAWER PAN
- STAINLESS STEEL ROLLER BEARING SLIDES
- SELF CLOSING DRAWER

DR2015-S30



ROLLER BEARING DRAWERS - STAINLESS STEEL

WOOD TOP / SBO & SBS TABLES	QTY	STAINLESS STEEL TOP / POLY TOP TABLES	QTY	DESCRIPTION	WIDTH	DEPTH	WEIGHT (LBS)
DR2015SC-W		-		FOR WOOD TOP TABLES	15"	20"	20
-		DR2015SC-S24		FOR S/S AND POLY TOP TABLES 24" WIDE	15"	20"	20
-		DR2015SC-S30		FOR S/S AND POLY TOP TABLES 30" WIDE	15"	20"	20
-		DR2015SC-S36		FOR S/S AND POLY TOP TABLES 36" WIDE	15"	20"	20
DR2020SC-W		-		FOR WOOD TOP TABLES	20"	20"	25
-		DR2020SC-S24		FOR S/S AND POLY TOP TABLES 24" WIDE	20"	20"	25
-		DR2020SC-S30		FOR S/S AND POLY TOP TABLES 30" WIDE	20"	20"	25
-		DR2020SC-S36		FOR S/S AND POLY TOP TABLES 36" WIDE	20"	20"	25

SOME UNITS SHIP UNASSEMBLED FOR REDUCED SHIPPING COST. ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500"

SPEC SHEET

"ST6-SSK" STAINLESS STEEL TOP WORK TABLES

16GA Top & Stainless Steel Legs & Adjustable Undershelf

FEATURES:

- 16GA Stainless Steel Top
- Type 300 Stainless Steel With #4 Polish, Satin Finish
- Top Is Sound Deadened
- Reinforced With 1"x2" Channel Running Entire Length Of Table
- 1-1/2" Stallion Edge On Front And Rear With Side Edges 90 Degree Bend Down For Table Line-Up
- Stainless Base With Adjustable Undershelf
- Adjustable Bullet Feet
- Shipped Knocked-Down, Easy-To-Assemble

SPECIFICATIONS:

- Top: Stainless Steel Tops Are TIG Welded, Exposed Welds Are Polished To Match Adjacent Surface
- Top: 16GA Stainless Steel Type 300 Stainless Steel With #4 Polish, Satin Finish
- Shelf: 18GA Stainless Steel, (36" Wide Tables, 16GA Lower Shelf)
- Legs: 1-5/8" Round O.D. , 16GA Tubular Stainless Steel
- Gussets: Stainless Steel
- Feet: 1" Adjustable Stainless Bullet Feet

CERTIFICATIONS:

ST6-3048SSK

ACCESSORIES

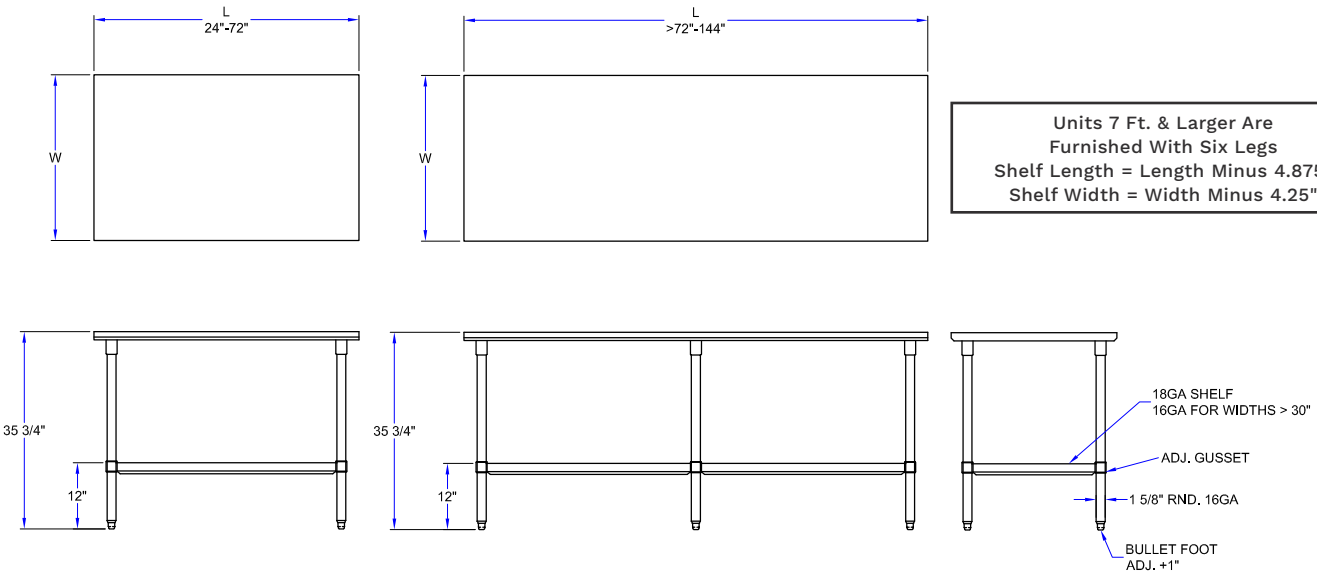
DESCRIPTION
Drawer
Drawer Lock
Casters
Overshelves
Sinks
Pot Rack

"ST6-SSK" STAINLESS STEEL TOP WORK TABLES

LENGTH	24" WIDE	WT (LBS)	30" WIDE	WT (LBS)	36" WIDE	WT (LBS)	48" WIDE	WT (LBS)
24"	**ST6-2424SSK**	42	**ST6-3024SSK**	47	**ST6-3624SSK**	56	-	-
30"	**ST6-2430SSK**	47	**ST6-3030SSK**	53	**ST6-3630SSK**	66	-	-
36"	**ST6-2436SSK**	53	**ST6-3036SSK**	60	**ST6-3636SSK**	73	-	-
48"	**ST6-2448SSK**	65	**ST6-3048SSK**	74	**ST6-3648SSK**	90	**ST6-4848SSK**	113
60"	**ST6-2460SSK**	76	**ST6-3060SSK**	88	**ST6-3660SSK**	107	**ST6-4860SSK**	134
72"	**ST6-2472SSK**	88	**ST6-3072SSK**	101	**ST6-3672SSK**	126	**ST6-4872SSK**	155
84"	**ST6-2484SSK**	107	**ST6-3084SSK**	123	**ST6-3684SSK**	152	**ST6-4884SSK**	189
96"	**ST6-2496SSK**	118	**ST6-3096SSK**	136	**ST6-3696SSK**	170	**ST6-4896SSK**	211
108"	**ST6-24108SSK**	130	**ST6-30108SSK**	149	**ST6-36108SSK**	187	**ST6-48108SSK**	234
120"	**ST6-24120SSK**	140	**ST6-30120SSK**	163	**ST6-36120SSK**	204	**ST6-48120SSK**	256
132"	**ST6-24132SSK**	152	**ST6-30132SSK**	177	**ST6-36132SSK**	221	**ST6-48132SSK**	281
144"	**ST6-24144SSK**	164	**ST6-30144SSK**	191	**ST6-36144SSK**	238	**ST6-48144SSK**	305

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

DETAILED SPECIFICATIONS



MODEL # STRUCTURE

24 = Width Of Work Surface
6 = 16GA Work Surface
ST = Stainless Steel Top
30 = Length Of Work Surface
SS = Stainless Legs & Shelf
K = Ships Knocked Down

ST6-2430SSK

"ST6-SSK" STAINLESS STEEL TOP WORK TABLES

LENGTH	24" WIDE	WT (LBS)	30" WIDE	WT (LBS)	36" WIDE	WT (LBS)	48" WIDE	WT (LBS)
24"	**ST6-2424SSK**	42	**ST6-3024SSK**	47	**ST6-3624SSK**	56	-	-
30"	**ST6-2430SSK**	47	**ST6-3030SSK**	53	**ST6-3630SSK**	66	-	-
36"	**ST6-2436SSK**	53	**ST6-3036SSK**	60	**ST6-3636SSK**	73	-	-
48"	**ST6-2448SSK**	65	**ST6-3048SSK**	74	**ST6-3648SSK**	90	**ST6-4848SSK**	113
60"	**ST6-2460SSK**	76	**ST6-3060SSK**	88	**ST6-3660SSK**	107	**ST6-4860SSK**	134
72"	**ST6-2472SSK**	88	**ST6-3072SSK**	101	**ST6-3672SSK**	126	**ST6-4872SSK**	155
84"	**ST6-2484SSK**	107	**ST6-3084SSK**	123	**ST6-3684SSK**	152	**ST6-4884SSK**	189
96"	**ST6-2496SSK**	118	**ST6-3096SSK**	136	**ST6-3696SSK**	170	**ST6-4896SSK**	211
108"	**ST6-24108SSK**	130	**ST6-30108SSK**	149	**ST6-36108SSK**	187	**ST6-48108SSK**	234
120"	**ST6-24120SSK**	140	**ST6-30120SSK**	163	**ST6-36120SSK**	204	**ST6-48120SSK**	256
132"	**ST6-24132SSK**	152	**ST6-30132SSK**	177	**ST6-36132SSK**	221	**ST6-48132SSK**	281
144"	**ST6-24144SSK**	164	**ST6-30144SSK**	191	**ST6-36144SSK**	238	**ST6-48144SSK**	305

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

John BOOS Since 1887

ITEM #: _____ QTY: _____

MODEL #: _____

PROJECT NAME: _____

021521

3601 S. Banker St. Effingham, IL 62401 • P.O. BOX 609 • Ph: (888) 431-2667 • Fax: (800) 433-2667

"CAS" CASTERS & FEET

CASTERS & FEET

MODEL #	QTY	ITEM	DESCRIPTION	SET OF
CAS01-R		CASTERS	5", HEAVY DUTY, LOCKING, FOR 1-5/8" DIAMETER LEGS	4
CAS02-R		CASTERS	5", HEAVY DUTY, LOCKING, FOR 1-5/8" DIAMETER LEGS	6
CAS03		CASTERS	2-1/2", HEAVY DUTY, LOCKING	4
CAS-RN		CASTERS	3", BLACK, LOCKING	4
CAS23-R		CASTERS	5", HEAVY DUTY, LOCKING, FOR 2" SQUARE TUBE	4
CUCCAS-DLGS		CASTERS	5", SWIVEL LOCKING PLATE CASTER	4
CAS05		FLANGE FEET	ADJUSTABLE, STAINLESS STEEL	4
CAS05H		FLANGE FEET	ADJUSTABLE WITH HOLES FOR ATTACHMENT TO FLOOR, STAINLESS STEEL	4
CASWS05-4		CASTERS	LOCKING W/ BUMPERS	4
CAS06		FLANGE FEET	ADJUSTABLE, STAINLESS STEEL	6
CAS06H		FLANGE FEET	ADJUSTABLE WITH HOLES FOR ATTACHMENT TO FLOOR, STAINLESS STEEL	6
CAS07		BULLET FOOT	ADJUSTABLE, STAINLESS STEEL	EACH
CAS07-4		BULLET FOOT	ADJUSTABLE, STAINLESS STEEL, ONE (1) EACH PER LEG OF TABLE	4
CAS07-6		BULLET FOOT	ADJUSTABLE, STAINLESS STEEL, FOR 1-5/8" DIA. LEG	6
CAS08		BULLET FOOT	ADJUSTABLE, STAINLESS STEEL, FOR 1-1/2" SQUARE LEG	EACH
CAS08-4		BULLET FOOT	ADJUSTABLE, STAINLESS STEEL, FOR 1-1/2" SQUARE LEG	4
CAS08-6		BULLET FOOT	ADJUSTABLE, STAINLESS STEEL, FOR 1-1/2" SQUARE LEG	6
CAS12-1		FLANGE FEET	ADJUSTABLE, STAINLESS STEEL, (W/ MOUNTING HOLES)	EACH
CAS14		CASTERS	5", HEAVY DUTY, LOCKING	4
CAS14-6		CASTERS	5", HEAVY DUTY, LOCKING	6
CAS15		FLANGE FEET	ADJUSTABLE, STAINLESS STEEL	EACH
CAS16		FLANGE FEET	ADJUSTABLE, STAINLESS STEEL, 3-1/2" DIA.	4
CAS17		FLANGE FEET	ADJUSTABLE, STAINLESS STEEL, 3-1/2" DIA., (TABLES 84" & LONGER WITH 6 LEGS)	6

CAS01-R

CAS03

CAS-RN

CASWS05-4

CAS07

SOME UNITS SHIP UNASSEMBLED FOR REDUCED SHIPPING COST. ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500"

John Boos & Co. is constantly engaged in a program of improving products and therefore reserves the right to change specifications without prior notice.

RN1A/RN2A-FS

One and Two Section Roll In Refrigerator

STEELHEART

RN1A-FS
02/19/20
Item # 13540

W x D x H	W x D x H
35” x 34.5” x 87.5”*	68” x 34.5” x 87.5”*

Item #: _____

Project: _____

Qty: _____

AIA#: _____

NATURAL REFRIGERANT

FACTORY WARRANTY * Parts & Labor 3 YR Entire Machine Parts 5 YR Compressor

Dimensions / Capacity	One Section RN1A-FS	Two Section RN2A-FS
Interior Storage Capacity (CF) (AHAM)	38.13 ft³	78.35 ft³
Overall Width x Depth (with ramp)	35” x 38.9”	68” x 38.9”
Height	87.5”	87.5”
Door Opening Width x Height	29.25” x 72.75”	29.25” x 72.75”
Depth with Door Open at 90°	65.25”	65.25”
Crated Shipping Weight	429 lbs	676 lbs
Crated Length x Depth x Height	40.5” x 39” x 93.5”	72” x 40.5” x 93.75”

Electrical / Refrigeration	One Section RN1A-FS	Two Section RN2A-FS
Voltage	115/60/1	115/60/1
HACR Breaker	15.0 Amps	15.0 Amps
Electrical Connection (NEMA)	5-15P	5-15P
Voltage Range	104-126	104-126
Ambient Temp. Range	45° to 100°F	45° to 100°F
Control Setpoint Range	31° to 52°F	31° to 52°F
Amperage	6.4	8.2
Energy Consumption (kWh/day) @ASHRAE	3.186	5.06
Heat Rejection (BTU/Hr.) @NSF	774	1376
Approx. Nominal Compres. BTU/HR (HP)	2750(1/2HP)	3730(1HP)
Refrigerant / Charge Amount (oz)	R290 / (4.6 oz)	R290 / (5.1 oz)

Warranty

* 3 Year - parts and Labor on entire machine.
5 Year - Parts on Compressor
Valid in United States, Canada, Puerto Rico and U.S. Territories. Contact factory for warranty in other countries.

Features

- **Stainless steel interior with stainless steel exterior front, sides and top**
- **Unique ducted air distribution system**
- **Environmentally friendly R290 hydrocarbon refrigerant**

- Refrigerant flow is controlled with thermostatic expansion valve
- Reinforced stainless steel ramp and floor accommodate roll in racks up to 72” tall (supplied by others)
- Energy efficient interior LED light
- Solid state digital controller with temperature alarms and LED display (Fahrenheit or Celsius)
- Cabinet and doors are insulated with 2-3/8” of CFC free, foamed in place polyurethane
- Stainless steel exterior and interior door come standard with locks
- Exclusive stepped door design to protect recessed door gasket
- Spring assisted self-closing doors with stay open feature
- Sturdy 8 gauge stainless steel hinge plate with welded hinge pin
- Extruded aluminum flush mount door handle
- Field reversible doors
- Evaporator coils are epoxy electrocoated (E-Coat) to help fight corrosion
- Energy efficient automatic hot gas condensate evaporator
- Top mount refrigeration comes standard with a condenser filter
- 10 ft. cord and plug

Note: Made to order. Allow 4-6 weeks.

Hoshizaki reserves the right to change specifications without notice.

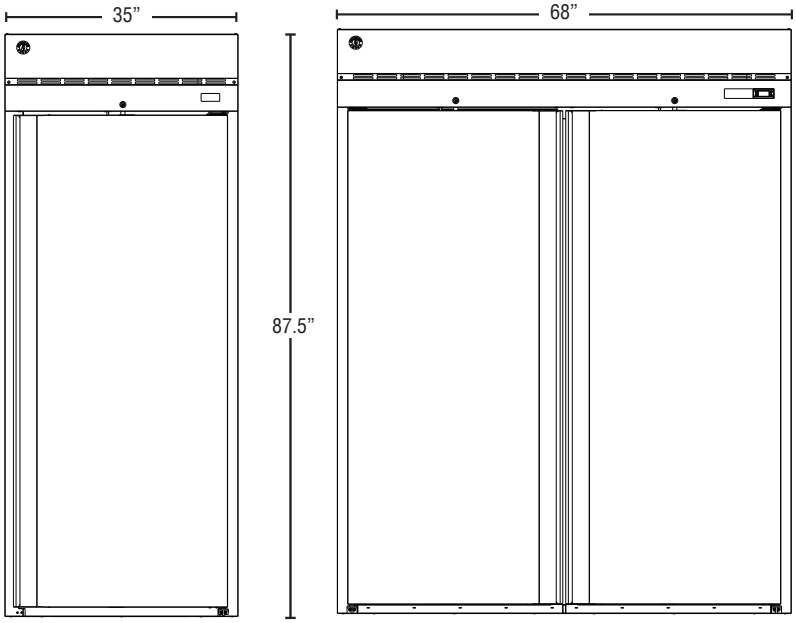
RN1A/RN2A-FS

One and Two Section Roll In Refrigerator

STEELHEART

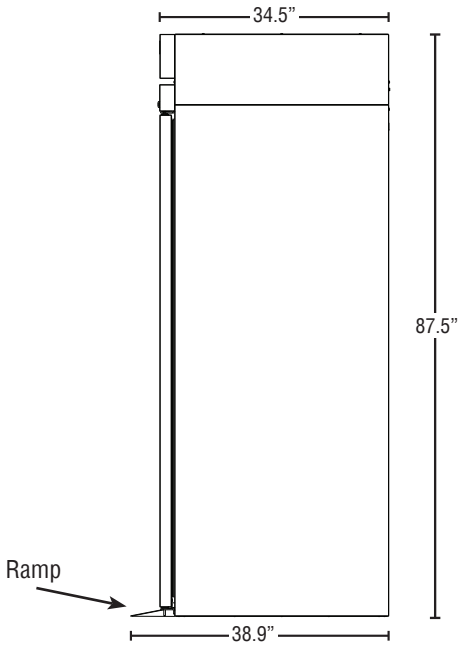
RN1A-FS
02/19/20
Item # 13540

FRONT VIEW

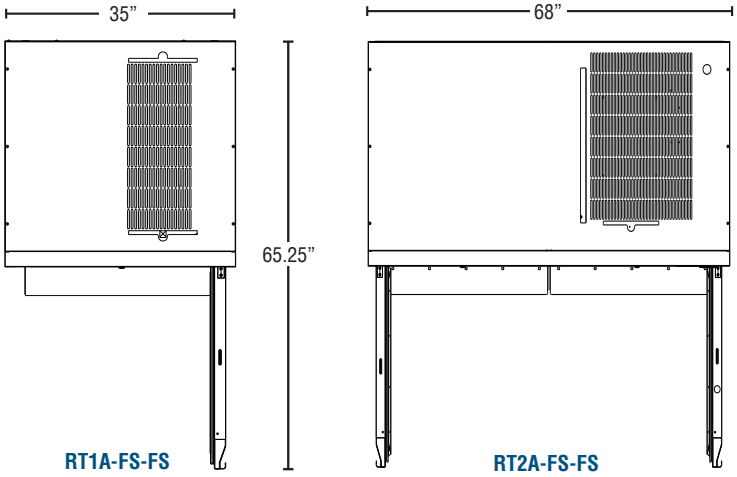


RT1A-FS-FS RT2A-FS-FS

SIDE VIEW



PLAN VIEW



RT1A-FS-FS RT2A-FS-FS

Cabinet Construction

The exterior cabinet front, sides, and top are constructed of high quality stainless steel. The exterior back, and bottom are constructed of coated steel. The cabinet interior is constructed of stainless steel. Cabinet walls and doors are insulated with 2-3/8” of environmentally friendly, CFC free, foamed in place polyurethane. An interior LED light is automatically activated when doors are opened. The reinforced ramp and floor has been designed to withstand loads up to 150 lbs. The interior cabinet is provided with stainless steel rack guides to assist with positioning roll-in racks. The cabinet can accommodate roll in carts up to 72” high.

Door Construction

Doors are constructed of a high grade stainless steel exterior and interior and are standard with locks. Hoshizaki’s exclusive “stepped” design protects the recessed gasket while product is being removed from the cabinet. Doors are provided with a one piece, full length extruded aluminum flush mount handle and are mounted on eight (8) gauge stainless steel hinge plates with a welded hinge pin. Spring assisted self-closing doors are equipped with a stay open feature past 90 degrees. Snap-in magnetic door gaskets are easily removed for cleaning. Door hinging is field reversible. The bottom gasket can be adjusted and comes factory installed.

Refrigeration System

The high efficiency refrigeration system is self-contained with an epoxy electrocoated (E-Coat) evaporator for extended life. Top mounted refrigeration system is easily accessible for service and includes a condenser filter with easy access from the top of the unit. The refrigeration system components are assembled on a high density expanded polypropylene platform that is removable from the main unit. A unique ducted air flow system achieves uniform air distribution within the cabinet to eliminate hot spots. Condensate removal is accomplished with a top mounted energy efficient non-electric evaporation system. A thermostatic expansion valve (TXV) controls the flow of environmentally friendly R290 refrigerant through the evaporator. Refrigeration system utilizes a time initiated off cycle defrost to eliminate any ice on the evaporator coil. Solid state digital controls monitor the operation and performance of the refrigeration system. The controls also provide visual high and low temperature and high and low voltage alarms. A LED display shows the cabinet temperature and is adjustable to Fahrenheit or Celsius. 115 volt units are equipped with a ten foot cord and plug (20.0 amps or less).

ER1A-FS/ER2A-FS

One and Two Section Full Stainless Refrigerator

ER1A-FS/ER2A-FS
10/30/20
Item # 13563

W x D x H
27" x 29.63" x 81.63"
(including 4" casters)

W x D x H
54.38" x 29.63" x 81.63"
(including 4" casters)

Item #: _____

Project: _____

Qty: _____

AIA#: _____

NSF / ANSI 7
2M75

c UL us LISTED
2M75

NATURAL REFRIGERANT

FACTORY WARRANTY *
Parts & Labor 2 YR Entire Machine
Parts 5 YR Compressor

Features

- Energy efficient interior LED light
- Environmentally friendly R290 hydrocarbon refrigerant
- Solid state digital controller with temperature alarms and LED display (Fahrenheit or Celsius)
- Self-closing door(s) is field reversible
- Stainless steel exterior door(s) come standard with lock(s)
- Stainless steel interior floor with aluminum sides, rear, and top
- Time initiated automatic defrost
- Energy efficient heated condensate removal
- Heavy duty grey epoxy coated shelves are adjustable in 1/2" increments; 3 per section. 105 lbs. capacity
- Aluminum shelf supports
- Standard with 4" casters (two with brakes)
- 9 ft. cord and plug
- Container Qty:
  ER1A-FS: 47
  ER2A-FS: 28

Dimensions / Capacity	One Section ER1A-FS	Two Section ER2A-FS
Interior Storage Capacity (CF) (AHAM)	17.8 ft³	38.61 ft³
Overall Width x Depth	27" x 29.63"	54.38" x 29.63"
Height (including 4" casters)	81.63"	81.63"
Door Opening (W x H)	22.25" x 52.1"	22.9" x 52.1"
Depth with Door Open at 90°	55.38"	55.38"
Adjustable Shelves	3	6
Shelf Dimensions (W x D)	21.5" x 23.1"	24.3" x 21.7"
Crated Shipping Weight	279 lbs	523 lbs
Crated Length x Depth x Height	31.5" x 28.75" x 84"	58" x 31.5" x 84"

Electrical / Refrigeration	One Section ER1A-FS	Two Section ER2A-FS
Voltage	115/60/1	115/60/1
HACR Breaker	15.0 Amps	15.0 Amps
Electrical Connection (NEMA)	5-15P	5-15P
Voltage Range	103-127	103-127
Ambient Temp. Range	45° to 100°F	45° to 100°F
Control Setpoint Range	33° to 39°F	33° to 39°F
Amperage	2	4.3
Energy Consumption (kWh/day) @ASHRAE	1.06	2.1
Appox. Nominal Compres. BTU/HR (HP)	1960(1/5HP)	4291(1/3HP)
Refrigerant / Charge Amount (oz.)	R290 / (2.3oz)	R290 / (3.7oz)

Options

Additional epoxy shelves
☐ HS-5511(1 section)
☐ HS-5512 (2 section)

Warranty

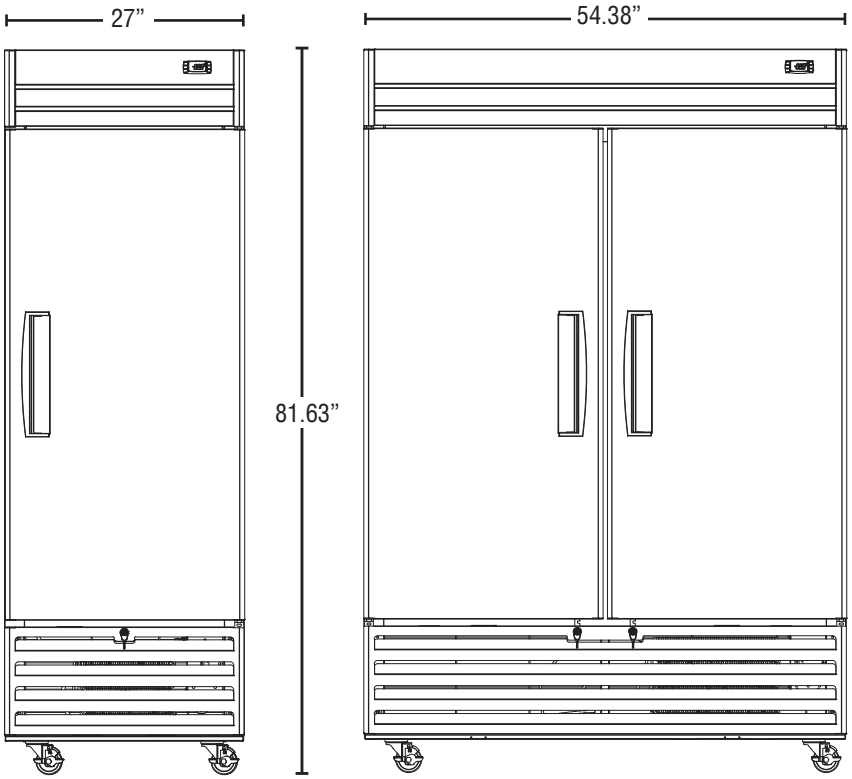
* 2 Year - Parts and Labor on entire machine.
5 Year - Parts on Compressor
Valid in United States, Canada, Puerto Rico and U.S. Territories. Contact factory for warranty in other countries.

We reserve the right to change specifications without notice.

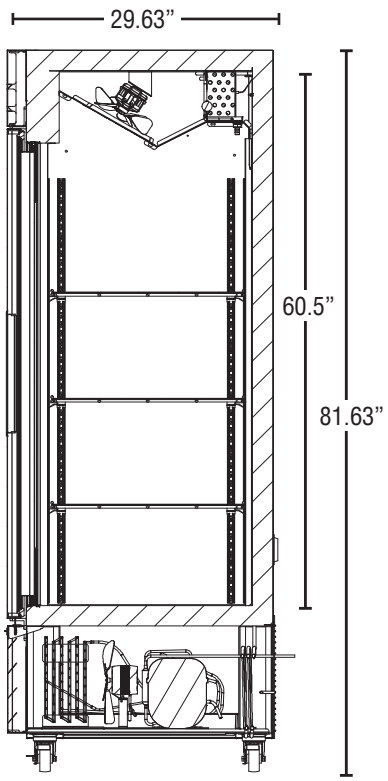
ER1A-FS/ER2A-FS

One and Two Section Full Stainless Refrigerator

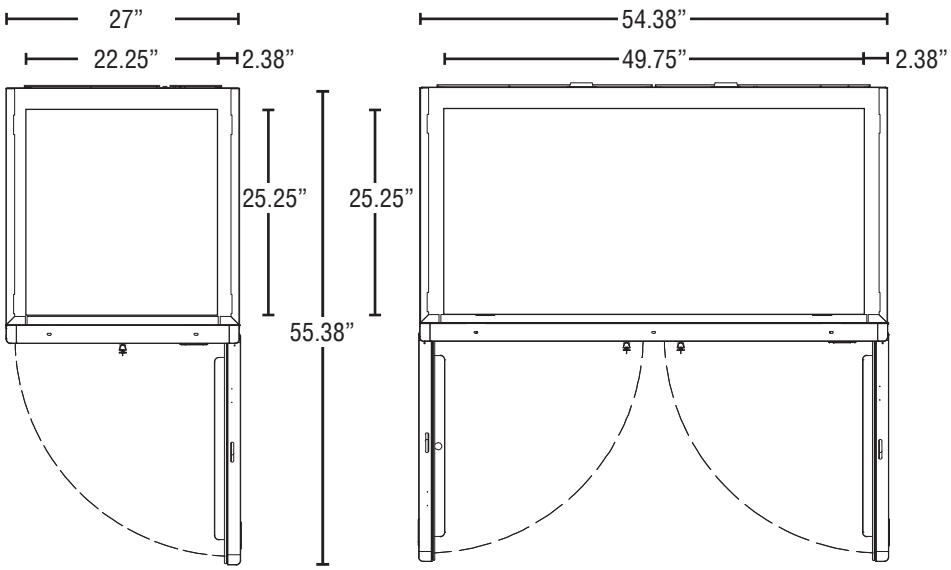
FRONT VIEW



SIDE VIEW



PLAN VIEW



EF1A-FS/EF2A-FS

One and Two Section Full Stainless Freezer

W x D x H
27" x 29.63" x 81.63"
(including 4" casters)

W x D x H
54.38" x 29.63" x 81.63"
(including 4" casters)

Item #: _____

Project: _____

Qty: _____

AIA#: _____

NSF / ANSI 7
2M75

2M75

NATURAL REFRIGERANT

FACTORY WARRANTY *
Parts & Labor 2 YR Entire Machine
Parts 5 YR Compressor

Features

- Energy efficient interior LED light
- Environmentally friendly R290 hydrocarbon refrigerant
- Solid state digital controller with temperature alarms and LED display (Fahrenheit or Celsius)
- Self-closing door(s) is field reversible
- Stainless steel exterior door(s) come standard with lock(s)
- Stainless steel interior floor with aluminum sides, rear, and top
- Time initiated automatic defrost
- Energy efficient heated condensate removal
- Heavy duty grey epoxy coated shelves are adjustable in 1/2" increments; 3 per section. 105 lbs. capacity
- Aluminum shelf supports
- Standard with 4" casters (two with brakes)
- 9 ft. cord and plug
- Container Qty:
  ER1A-FS: 47
  ER2A-FS: 28

Dimensions / Capacity	One Section EF1A-FS	Two Section EF2A-FS
Interior Storage Capacity (CF) (AHAM)	17.74 ft³	38.54 ft³
Overall Width x Depth	27" x 29.63"	54.38" x 29.63"
Height (including 4" casters)	81.63"	81.63"
Door Opening (W x H)	22.25" x 52.1"	22.9" x 52.1"
Depth with Door Open at 90°	55.38"	55.38"
Adjustable Shelves	3	6
Shelf Dimensions (W x D)	21.5" x 23.1"	24.3" x 21.7"
Crated Shipping Weight	279 lbs	523 lbs
Crated Length x Depth x Height	31.5" x 28.75" x 84"	58" x 31.5" x 84"

Electrical / Refrigeration	One Section EF1A-FS	Two Section EF2A-FS
Voltage	115/60/1	115/60/1
HACR Breaker	15.0 Amps	15.0 Amps
Electrical Connection (NEMA)	5-15P	5-15P
Voltage Range	103-127	103-127
Ambient Temp. Range	45° to 100°F	45° to 100°F
Control Setpoint Range	-5° to 5°F	-5° to 5°F
Amperage	3.2	4.7
Energy Consumption (kWh/day) @ASHRAE	4.62	8.8
Appox. Nominal Compres. BTU/HR (HP)	1399(1/3HP)	2074(1/2HP)
Refrigerant / Charge Amount (oz.)	R290 / (3.5oz)	R290 / (4.2oz)

Options

Additional epoxy shelves
☐ HS-5511(1 section)
☐ HS-5512 (2 section)

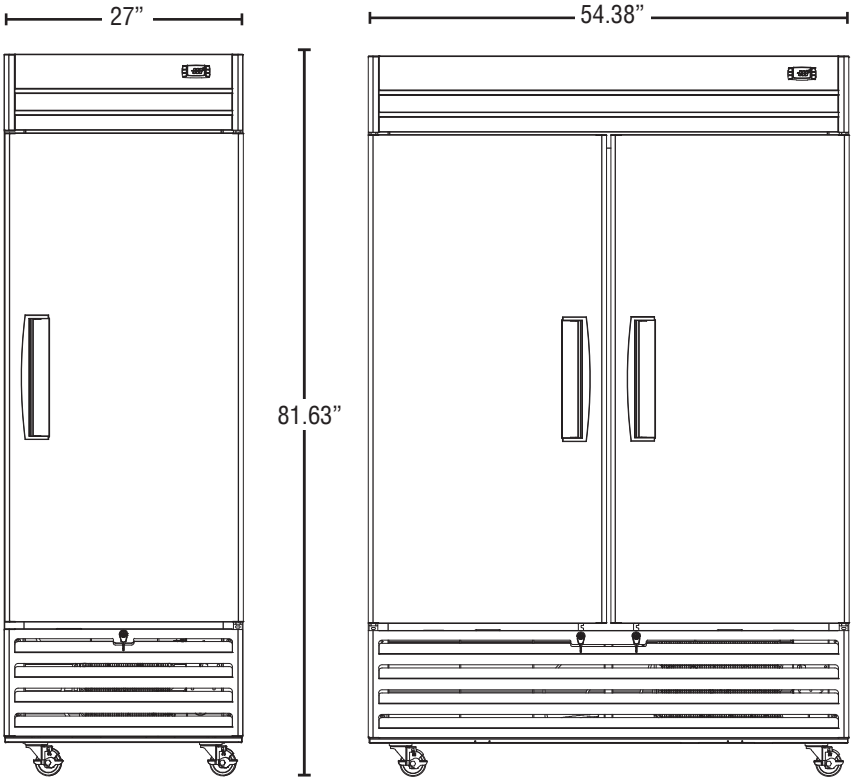
Warranty

* 2 Year - Parts and Labor on entire machine.
5 Year - Parts on Compressor
Valid in United States, Canada, Puerto Rico and U.S. Territories. Contact factory for warranty in other countries.

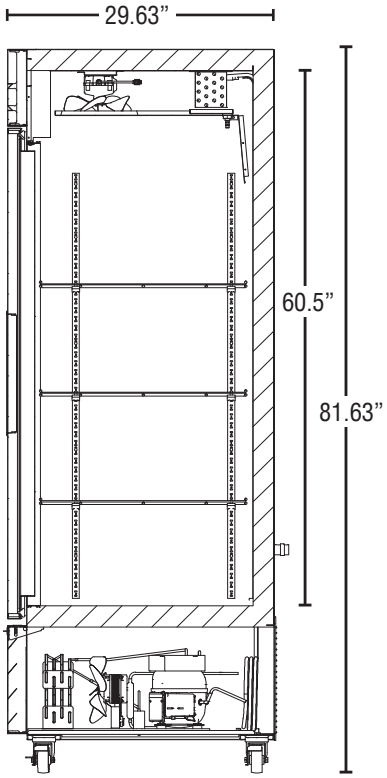
EF1A-FS/EF2A-FS

One and Two Section Full Stainless Freezer

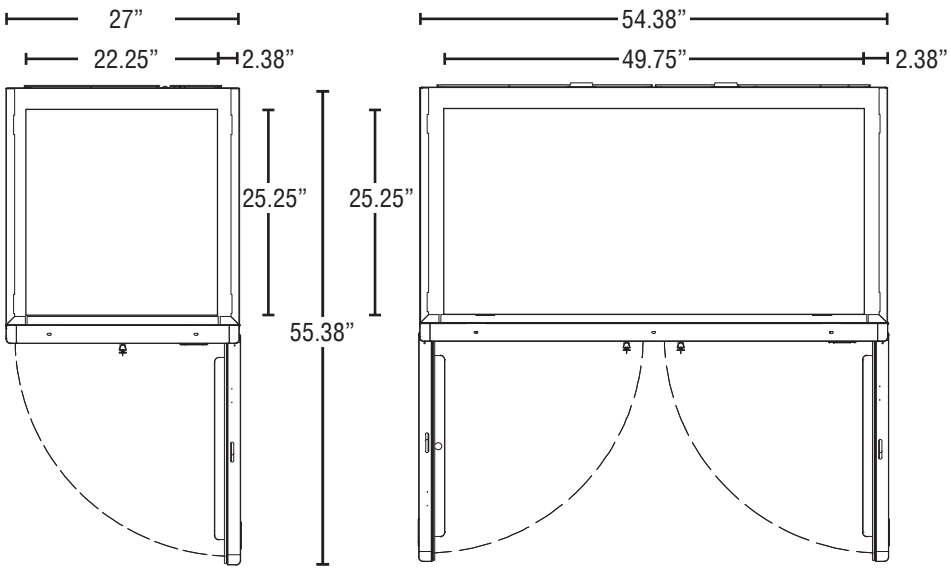
FRONT VIEW



SIDE VIEW



PLAN VIEW



Manitowoc

INDIGO NXT

iT0620 Ice Cube Machine

iT0620 Ice Cube Machine

Models

☐ IRT0620A ☐ IDT0620A ☐ IYT0620A ☐ IDT0620W ☐ IYT0620W

ENERGY STAR

Indigo NXT Series iT0620
Ice Machine on D420 Bin
*Ice machine and Bin sold separately

Designed for operators who know that ice is critical to their business, the Indigo®w Series ice machine's preventative diagnostics continually monitor itself for reliable ice production. Improvements in cleanability and programmability make your ice machine easy to own and less expensive to operate.

- **Space-Saving Design** – Measures only 16.5" high (42 cm) and 30" wide (76.20 cm) allowing it to fit on top of dispensers when a low ceiling is an issue.
- **easyTouch® Display**- New icon based touch screen takes the guess work out of owning and operating an ice machine.
- **Programmable Ice Production** – Now its super easy to program your ice machine to be off at certain times of the day to save money with fluctuating electrical rates. Also programmable by daily ice production volume and night time programming.
- **Easy to Clean Foodzone** – Hinged front door swings out for easy access. Removable water-trough, distribution tube, curtain, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **Intelligent Diagnostics** – Provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** – Unique patented technology allows for reliable operation in challenging water conditions and environments.
- **DuraTech™ Exterior** – Provides superior corrosion resistant above stainless steel. Innovative clear-coat resists fingerprints and dirt making it easier to keep clean.
- **Available LuminIce II Virus and Bacteria Inhibitor**- Controls viruses, bacteria, mold and yeast within the food zone to keep the ice machine clean longer. A new sanitation icon lets you know the operational status.
- **Active sense** - Insures consistent ice harvest in all environmental conditions. This software solution works in conjunction with the acoustical ice sensing probe improving reliability and performance.

COMMERCIAL WARRANTY

ICE MAKER	EVAPORATOR	COMPRESSOR
3 YEAR PARTS AND LABOR	5 YEAR	5 YEAR PARTS 3 YEAR LABOR

Ice Machine Electric

115/60/1 standard
(208-230/60/1also available)

Minimum circuit ampacity:
Air-cooled: 12.2, 115v 5.9, 208-230V
Water-cooled: 11.6,-115v, 5.6,-208-230v

Maximum fuse size:
Air-cooled: 20A for 115v, 15A for 208-230v
Water-cooled: 20A, 115v and 15A, 208-230v

Specifications

BTU Per Hour:
5,400 (average),
and 6,300 (peak)

Refrigerant:
R410A CFS - Free
Lowers global warming by 48%

Operating Limits:

- Ambient Temperature Range:
  40 to 110 F (4.4 to 43.3 C)
  Water Temperature Range:
  40 to 90 F (4.4 to 32.2 C)
- Potable Water Pressure:
  Min. 20 psi (137.9 kPA)
  Max. 80 psi (551.1 kPA)
- Condenser Water Pressure:
  Min. 20 psi (137.9 kPA)
  Max. 276 psi (1902.95 kPA)

Ice Shape

Dice
⅞" x ⅞" x ⅞"
(2.22 x 2.22 x 2.22 cm)

Half Dice
⅜" x 1⅛" x ⅞"
(.95 x 2.86 x 2.22 cm)

Regular
1⅛" x 1⅛" x ⅞"
(2.86 x 2.86 x 2.22 cm)

CALIFORNIA LOW LEAD QUALIFIED Conforms to NSF-61 Annex G | AHRI CERTIFIED | NSF c UL US LISTED | CE | AQ | ISO 9001:2015 Certification

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

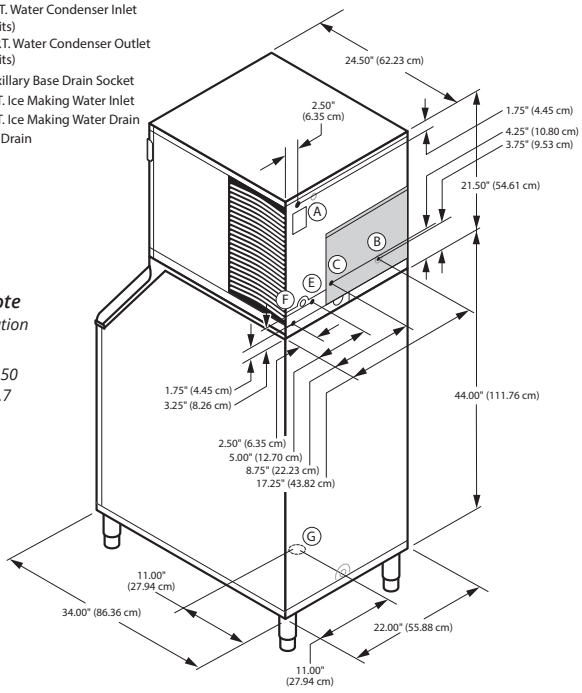
www.manitowocice.com

Manitowoc®

Indigo® NXT™ iT0620 Ice Cube Machine

iT0620 on D420 Storage Bin

Ⓐ Electrical Entrance (2) Options
Ⓑ 3/8" (0.95 cm) F.P.T. Water Condenser Inlet (water-cooled units)
Ⓒ 1/2" (1.27 cm) F.P.T. Water Condenser Outlet (water-cooled units)
Ⓓ 1/2" (1.27 cm) Auxillary Base Drain Socket
Ⓔ 3/8" (0.95 cm) F.P.T. Ice Making Water Inlet
Ⓕ 1/2" (1.27 cm) F.P.T. Ice Making Water Drain
Ⓖ 3/4" (1.91 cm) Bin Drain



Installation Note
Minimum installation clearance:

Top/side: 12" (30.50 cm)Back is 5" (12.7 cm)

Space-Saving Design

	iT0620 D-400	iT0620 D-420
Height	59.50" 151.13 cm	71.50" 181.61 cm
Width	30.00" 76.20 cm	22.00" 55.88 cm
Depth	34.00" 86.30 cm	34.00" 86.30 cm
Bin Storage	365 lbs. 166 kgs.	383 lbs. 174 kgs.

Height includes adjustable bin legs 6.00" to 8.00", (15.24 to 20.32 cm) set at 6.00" (15.24 cm).
Bin capacity is based on 90% of the volume x 33 lbs/ft3 average density of ice.

K00443 bin adapter required for D400 bin. Sold separately

Specifications

	Model	Ice Shape	Ice Production 24 Hours		Power Usage kWh/100 lbs. @90°Air/70°F	Potable Water Usage/100 lbs. 45.4 kgs. of Ice
			70°Air/ 50°F Water	90°Air/ 70°F Water	1 Ph	
AIR COOLED	IRT0620A	regular	525 lbs.	410 lbs.	5.29	19.9 Gal.
			238 kgs	186 kgs		75.3 L
	IDT0620A	dice	560 lbs.	450 lbs.	5.18 ★	19.9 Gal.
			254 kgs	204 kgs		75.3 L
	IYT0620A	half-dice	575 lbs.	465 lbs.	4.87 ★	19.9 Gal.
			261 kgs	211 kgs		75.3 L
WATER COOLED	IDT0620W	dice	530 lbs.	450 lbs.	4.13	19.9 Gal.
			240 kgs	204 kgs		75.3 L
	IYT0620W	half-dice	560 lbs.	485 lbs.	3.87	19.9 Gal.
			254 kgs.	220 kgs		75.3 L
	-Water-cooled Condenser Water Usage / 100 lbs. /45.4 kgs. Of Ice: 140 gal/ 530 L. -Water-cooled models are excluded from ENERGY STAR qualification.					

Order separately: Ice storage bin for all units
★ *ENERGY STAR® 3.0 qualified*

Accessories

LuminIce® II Viruses and Bacteria Inhibitor
controls viruses and bacteria in the ice machine

External Scoop holder
protect the ice scoop with the NSF approved versatile scoop holder.

Arctic Pure® Plus
reduce sediments and chlorine contaminants down to .5 microns.
Use with Pre-filter recommended

iAuCS®
schedules and performs routine ice machine cleaning automatically.

Manitowoc Ice reserves the right to make changes to the design or specifications without prior notice.

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com
6408D 6/22

Manitowoc

ICE MACHINE WARRANTY

Manitowoc Ice, Inc. (hereinafter referred to as the "COMPANY") warrants for a period of thirty-six months from the installation date (except as limited below) that new ice machines manufactured by the COMPANY shall be free of defects in material or workmanship under normal and proper use and maintenance as specified by the COMPANY and upon proper installation and start-up in accordance with the instruction manual supplied with the ice machine. The COMPANY'S warranty hereunder with respect to the compressor shall apply for an additional twenty-four months, excluding all labor charges, and with respect to the evaporator for an additional twenty-four months, including labor charges.

The obligation of the COMPANY under this warranty is limited to the repair or replacement of parts, components, or assemblies that in the opinion of the COMPANY are defective. This warranty is further limited to the cost of parts, components or assemblies and standard straight time labor charges at the servicing location.

Time and hourly rate schedules, as published from time to time by the COMPANY, apply to all service procedures. Additional expenses including without limitation, travel time, overtime premium, material cost, accessing or removal of the ice machine, or shipping are the responsibility of the owner, along with all maintenance, adjustments, cleaning, and ice purchases. Labor covered under this warranty must be performed by a COMPANY Contracted Service Representative or a refrigeration service agency as qualified and authorized by the COMPANY'S local Distributor. The COMPANY'S liability under this warranty shall in no event be greater than the actual purchase price paid by customer for the ice machine.

The foregoing warranty shall not apply to (1) any part or assembly that has been altered, modified, or changed; (2) any part or assembly that has been subjected to misuse, abuse, neglect, or accidents; (3) any ice machine that has been installed and/or maintained inconsistent with the technical instructions provided by the COMPANY; or (4) any ice machine initially installed more than five years from the serial number production date. This warranty shall not apply if the Ice Machine's refrigeration system is modified with a condenser, heat reclaim device, or parts and assemblies other than those manufactured by the COMPANY, unless the COMPANY approves these modifications for specific locations in writing.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR GUARANTEES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In no event shall the COMPANY be liable for any special, indirect, incidental or consequential damages. Upon the expiration of the warranty period, the COMPANY'S liability under this warranty shall terminate.

The foregoing warranty shall constitute the sole liability of the COMPANY and the exclusive remedy of the customer or user. To secure prompt and continuing warranty service, the warranty registration card or register on line within five (5) days from the installation date.

MANITOWOC ICE, INC.
2110 So. 26th St., P.O. Box 1720, Manitowoc, WI 54221-1720
Telephone: 920-682-0161 • Fax: 920-683-7585
Web Site - www.manitowocice.com
Form 80-0373-3 Rev. 01/02

Manitowoc

Arctic Pure Plus

Premium Water Filters for Ice Machines

arctic pure+

Arctic Pure Plus

Premium Water Filters for Ice Machines

Models

☐ AR-PRE-P ☐ AR-10000-P ☐ AR-20000-P ☐ AR-40000-P

AR-PRE-P

- Pre-filter, removes hard sediments, sand, dirt and rust from water, and protects solenoids, valves and inlets to the ice maker
- Compatible with **all** models

AR-10000-P

- Chlorine Reduction
- SLOW PHOS scale inhibitor
- 0.5 Microns filtration
- 15,000 gallon capacity
- Models 0-600 lbs/day

AR-20000-P

- Chlorine Reduction
- SLOW PHOS scale inhibitor
- 0.5 Microns filtration
- 20,000 gallon capacity
- Models 601-1000 lbs/day

AR-40000-P

- Chlorine Reduction
- SLOW PHOS scale inhibitor
- 0.5 Microns filtration
- 40,000 gallon capacity
- Models 1001-2500 lbs/day

Standard Features and Benefits

- 95% average reduction of chlorine from incoming water supply assures the ice tastes and smells fresher, clearer and more enjoyable
- Silver impregnated carbon block provides antimicrobial protection against potential bacteria microorganisms, algae, mold and slime on ice machine surfaces
- Engineered with SLOW PHOS (slowly soluble polyphosphate) to inhibit scale formation and corrosion
- Reduces dirt, submicron particles (down to 0.5 microns) and eliminates contaminates such as cryptosporidium and giardia cysts.
- Ultra-fine filtration (0.5 Microns) with silver impregnated carbon block and slowly soluble polyphosphates provides triple protection from harmful contaminates that can affect your ice machine's performance
- Reduces ice machine cost and maintenance frequency by reducing scale, impurities, and contaminates that can enter the machine.
- Extends the life of the ice machine, when the filters are changed every 6 months or when water pressure is below 20 psi.
- Optimizes the daily performance of the machine, allowing it run at full capacity producing the freshest and purist ice possible
- Cartridges are easy to install, safe, sanitary and can be changed out rapidly, "on the fly" without turning off the water supply
- **Certified to NSF/ANSI Standard 42, 53, 372, and CSA B483.1** by IAPMO and meets CUPC requirements.

IAPMO R&T Certifications

System Model #	Replace. Cartridge	Std. 42 Claims	Std. 53 Claims	Chlorine Red. Cap
AR-PRE-P	K00496	Part. Class 3	None	None
AR-10000-P	K00493	Chlorine & Part. Class 1	Cyst	15,000 gal
AR-20000-P	K00494	Chlorine & Part. Class 1	Cyst	20,000 gal
AR-40000-P	K00495	Chlorine & Part. Class 1	Cyst	40,000 gal

- CSAB483.1:For Canadian water standards
- *NSF/ANSI 53 cyst claim only valid at or below rated flow rate
- Warning : Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfections before or after the unit. For cold water use only. Not for residential use.

Note on Pre-filter: A pre-filter is recommended for all applications to achieve maximum filtration efficiency and cartridge life.

Warranty

3-Year parts and labor warranty on head, shroud, hardware, and mounting assembly.
(water filter cartridge not included).
Residential Warranty - 1 Year

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com

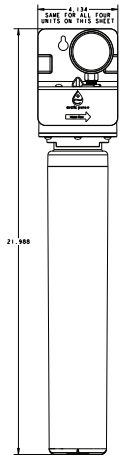
Manitowoc

arctic pure+

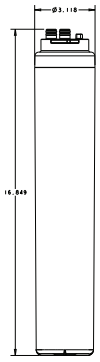
Arctic Pure Plus

Premium Water Filters for Ice Machines

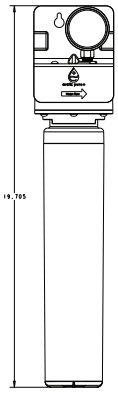
Dimensions



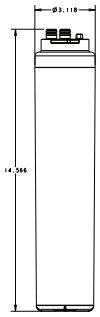
AR-PRE-P SYSTEM
4.13"W x 4.48"D x 22"H
10.5 x 11.37 x 55.9 cm



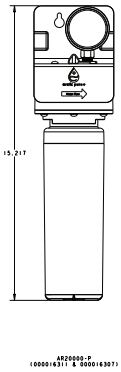
K00496 REP. CART.
3.1"W x 3.1"D x 16.8"H
7.9 x 7.9 x 42.6 cm



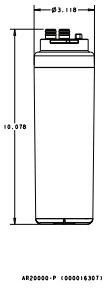
AR-10000-P SYSTEM
4.13"W x 4.48"D x 19.7"H
10.5 x 11.37 x 50.04 cm



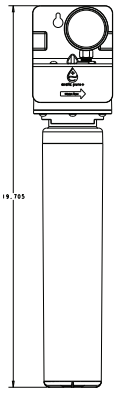
K00493 REP. CART.
3.1"W x 3.1"D x 14.6"H
7.9 x 7.9 x 37.08 cm



AR-20000-P SYSTEM
4.13"W x 4.48"D x 15.2"H
10.5 x 11.37 x 38.6 cm



K00494 REP. CART.
3.1"W x 3.1"D x 10.1"H
7.9 x 7.9 x 25.6 cm



AR-40000-P SYSTEM
4.13"W x 4.48"D x 19.7"H
10.5 x 11.37 x 50.04 cm

K00495 REP. CART.
3.1"W x 3.1"D x 14.6"H
7.9 x 7.9 x 37.08 cm

Usage Matrix

Filter System (Replacement Cartridges)	AR-PRE-P (K00496)	AR-10000-P (K00493)	AR-20000-P (K00494)	AR-40000-P (K00495)
All Under Counters (Cubers, Flakers & Nuggets) Counter Top Nugget	X	X		
Modular Cubers: IT0300-IT750, IBF0620 Modular Flaker: RFF0320 Modular Nugget: RNF320	X	X		
Modular Cubers: IT0900, IBF0820C & IBT1020C Modular Flaker: RFF0620 RFF1220C, RFF1300 Modular Nuggets: RNF0620, RNF1020C, RNF1100	X		X	
Modular Cubers: IT1200, IT1500 & IT1900, IF1400C &IF1800C Modular Flaker: RFF2200C Modular Nugget: RNF2000C	X			X

Specifications and Shipping

System	Replacement Cartridge	Filtration level	Capacity gal	Service Flow Rate (max. gpm (lpm)	Operating Air Temp F (C)	Operating Water Temp F (C)	Operating Pressure psi (bar)	Mtg. Holes from Center in (cm)	Approx. Shipping Weight lbs (kg)	Qty System Lots	Qty Cartridge Lots
AR-PRE-P	K00496	5 Micron	NA	1.5 (5.7)	40°-110°F (4.4°- 43.3°)	40°-90°F (4.4°- 32.2°)	35 -125 (2.41-8.61)	1.5 (3.81)	4 (1.81)	6	12
AR-10000-P	K00493	0.5 Microns	15,000	0.75 (2.84)				1.5 (3.81)	5 (2.26)	6	12
AR-20000-P	K00494	0.5 Microns	20,000	1.25 (4.73)				1.5 (3.81)	4 (1.81)	6	12
AR-40000-P	K00495	0.5 Microns	40,000	2.0 (7.6)				1.5 (3.81)	5 (2.26)	6	12

Installation Tips

- Install vertically with cartridge hanging down
- Allow 2.5" (6.35cm) clearance below the cartridge for easy replacement
- Flush cartridge by running water through filter for ten (10) minutes
- Use copper or polyethylene 3/8" hose for Quick Connect fitting
- Always follow local plumping codes

Operation Tips

- Change cartridge every 6 months or when pressure gauge indicates below 35 psi (which ever comes first)
- Twist 1/4 turn to left to remove cartridge. Twist 1/4 turn to the right to install cartridge (Water can be left on)
- Protect from freezing—Failure to do so may result in cracking of the filter housing and cause water leakage
- When using non-Manitowoc ice makers, consult the ice machine's manufactures for water supply usage requirements.
- It is recommended to have your water supply tested by a professional to determine your water treatment needs.

2110 South 26th Street
Manitowoc, WI 54220

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www.manitowocice.com
7805B_ArcticPurePlus
06/22

ArcticPure™ Accessory Warranty

Manitowoc Ice, Inc. (hereinafter referred to as the "COMPANY") warrants for a period of thirty-six months from the installation date (except as limited below) that new ArcticPure™ Accessory sold by the COMPANY shall be free of defects in material or workmanship under normal and proper use and maintenance as specified by the COMPANY and upon proper installation and start-up in accordance with the instruction manual supplied with the ArcticPure™ Accessory.

The obligation of the COMPANY under this warranty is limited to the repair or replacement of parts, components, or assemblies that in the opinion of the COMPANY are defective. This warranty is further limited to the cost of parts, components or assemblies and standard straight time labor charges at the servicing location.

Time and hourly rate schedules, as published from time to time by the COMPANY, apply to all service procedures. Additional expenses including without limitation, travel time, overtime premium, material cost, accessing or removal of the ArcticPure™ Accessory, or shipping are the responsibility of the owner, along with all maintenance, adjustments, and cleaning costs. Labor covered under this warranty must be performed by a COMPANY Contracted Service Representative or a refrigeration service agency as qualified and authorized by the COMPANY'S local Distributor. The COMPANY'S liability under this warranty shall in no event be greater than the actual purchase price paid by the customer for the ArcticPure™ Accessory.

The foregoing warranty shall not apply to (1) any part or assembly that has been altered, modified, or changed; (2) any part or assembly that has been subjected to misuse, abuse, neglect, or accidents; (3) wear items such as cartridges or o-rings; (4) any ArcticPure™ Accessory that has been installed and/or maintained inconsistent with the technical instructions provided by the COMPANY; or (5) any ArcticPure™ Accessory initially installed more than five years from the serial number production date.

The ArcticPure™ Accessory is designed to operate only with COMPANY'S ice machines.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR GUARANTEES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. In no event shall the COMPANY be liable for any special, indirect, incidental or consequential damages. Upon the expiration of the warranty period, the COMPANY'S liability under this warranty shall terminate. The foregoing warranty shall constitute the sole liability of the COMPANY and the exclusive remedy of the customer or user.

To secure prompt and continuing warranty service, the warranty registration card must be completed and sent to the COMPANY within five (5) days from the installation date.

Complete the following and retain for your record:

Distributor/Dealer _____

Model Number _____ Serial Number _____

Installation Date _____

MANITOWOC ICE, INC.
2110 So. 26th St., P.O. Box 1720, Manitowoc, WI 54221-1720
Telephone: 920-682-0161 · Fax: 920-683-7585
Web Site - www.manitowocice.com
Form 80-1464-3 06/03

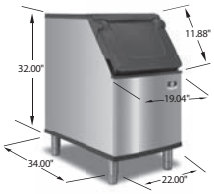
Ice Storage Bins

Model

☐ D320 ☐ D400 ☐ D420 ☐ D570 ☐ D970

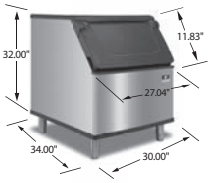
D Bins

.75" (1.90 cm) Bin drain

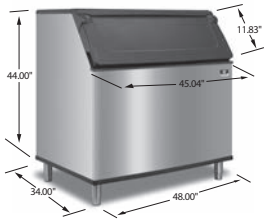


D320
264 lbs. (120 kgs)

D570
532 lbs. (241 kgs)



D400
365 lbs. (166 kgs)



D970
882 lbs (400 kgs)

D420
383 lbs. (174 kgs)

Ergonomic NSF approved sanitary ice scoop included

D Bin Features

New Sanitary Scoop Ergonomic NSF approved sanitary ice scoop included with each bin. Built-in knuckle and thumb guard. Unique molded retaining lip allows maximum scooping every time. Per scoop capacity approximately 5.3/ lbs (2.4 kg)

Scoop Holder options New built-in scoop holder, keeps the ice scoop handle above the ice, or purchases the optional NSF approved External Scoop Holder Kit # K00461.

New Door design Clever built in side grips allow you to lift the bin door from anywhere you are standing (left, right or center) even when you have just one hand free.

Foamed Insulated Door Insulates the ice bin, reduces sweat on the door, helps keep ice lasting longer.

Stay up door Unique cammed bin door self-latch keeps the door in the open position and keeps the employee safe when scooping ice.

Ergonomic Door design Door is angled 53 degrees to allow for easier access to the ice in the bin especially when scooping from the bottom.

Duratech Metal Finish Manitowoc exterior material has better corrosion resistance than stainless steel, is smudge resistant and easy to keep clean.

New Bin liner Polyurethane Artic Blue bin liner accentuates the crisp clear ice from a Manitowoc Ice Machine.

Warranty

Bin & Accessories: 3 Year Parts & Labor.

	D-Bin Capacities				D-Bin Dimensions					
	*Application Capacity		**2018 AHRI Capacity		Height		Width		Depth	
D Bin Model	lbs.	kgs	Cu. ft	Cu. M	in.	cm	in.	cm	in.	cm
D320	264	119.90	8.9	0.25	38	96.5	22	55.9	34	86.4
D420	383	173.79	12.9	0.37	50	127	22	55.9	34	86.4
D400	365	165.70	12.3	0.35	38	96.5	30	76.2	34	86.4
D570	532	241.14	17.9	0.51	50	127	30	76.2	34	86.4
D970	882	400.11	29.7	0.84	50	127	48	121.9	34	86.4

*Application Capacity based on 90% of the total volume x 33 lbs/ ft3 average density of ice.
Ice must be managed
***2018 AHRI certified measurement for bin capacity

Above bin heights include leg height of of 6" / 15.24 cm
All bins include a sanitary plastic scoop and one set of adjustable legs chrome legs (6-7.75in/15.24-20.32cm).
External Scoop holder order separately Kit # K00461
Metal Scoop order separately Kit # K00463

Manitowoc Ice reserves the right to make changes to the design or specifications without prior notice.

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com
6453E
6/22

Manitowoc

D Bins

Indigo Ice Machines Series												
Machine			iT420	iT620	iT0300	iT450	iT0500 &iF0500N	iF0600N, iF0600C, iT0750	iF0900N, iT0900, iF0900C	iT1200, iT1200C	iF1400C, iF1800C	iT1500, iT1900
Machine Capacity @90/70 F			375	465	240	378	440	555, 530	710, 714	950, 1000	1200 1470 1600	1360, 1455
Bins	Bin Cap	Width	22"	22"	30"	30"	30"	30"	30"	30"	30"	48"
D320	264	22"	*	*								
D420	383	22"	*	*								
D400	365	30"	K00472	K00472	*	*	*	*	NR	NR	NR	
D570	532	30"	K00472	K00472	*	*	*	*	*	*	NR	
D970	882	48"	NR	NR	NR	K00470	K00470	K00470	K00470	K00470	K00471 + K00470	*

Manitowoc Flaker and Nugget Machines											
		Machine	RNP0320	RFP0320	RNP0620	RFP0620	RNF1020	RFF1220C	RNF1100	RFF1300 & RNF2000C	RFF2200C
Machine cap			251	286	451	540	825	958	825	874	1702
Bins	Bin cap	Width	22"	22"	22"	22"	22"	22"	30"	30"	36.7"
D320	264	22"	*	*	NR	NR	NR	NR			
D420	383	22"	*	*	*	*	NR	NR			
D400	365	30"	K00472	K00472	K00472	K00472	NR	NR	NR	NR	
D570	532	30"	NR	K00472	K00472	K00472	NR	NR	*	*	
D970	882	48"	NR	NR	K00473	K00473	K00473 if 2 used.	K00473 if 2 used.	K00470	K00470	K00470

An optional adapter is required when putting a narrower ice machine on a wider bin.
* No adapter is needed
NR= Not Recommend. Bin too small or too large for application.
Putting a wider machine on narrower bin is not an option.
Machines side by side must be water cooled, remote, or use a top air discharge for self-contained air cooled.
Application Bin Capacity shown in lbs using the AHRI rating based on 90% of total volume x 33 lbs/ft3 average density of ice.
Machine capacity shown in lbs/24hrs using the AHRI rating base at 90F ambient, 70F water temperature

Available Accessories

See price book for replacement: scoops, legs, specialty legs and casters

K00146 Convenient Ice Bagger

Includes bagger, D-bin adapter, and 250 bags and ties (Not for D320 or D400) Order K00068 replacement bags

K00461 External Scoop Holder

NSF approved. Can be mounted on the left or right side of bins, horizontally or vertically or on a wall.

K00463 Metal Scoop

Indestructible NFS approved aluminum alloy with sanitary knuckle and thumb guard. Works with K00461external scoop holder or hangs inside the D-Bin series. Limited life time guarantee.

K00462 Secure Fastening Kit

Securely fast the Indigo NXT ice machine head to the pre-drilled inserts on the back of the D-bin series. Stainless steel flanged feet attach to bin and can be screwed to the floor

Ice Storage Bins

Manitowoc Ice reserves the right to make changes to the design or specifications without prior notice.

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com
6453E
6/22

Manitowoc

LIMITED WARRANTY FOR ICE STORAGE BIN & DISPENSERS

LIMITED WARRANTY

Manitowoc Ice a division of Manitowoc FSG Operations, LLC, ("Company") warrants that new Ice Storage Bins or Dispensers sold by Company shall be free of defects in material or workmanship under normal and proper use and maintenance as specified by the Company and upon proper installation and start-up in accordance with the instruction manual supplied.

WHAT IS COVERED

- Parts and Labor for a period of three (3) years.
- Accessory Ice Transport Carts for two (2) years parts and labor.

The Ice Storage Bin / Dispenser warranty begins on the date of the original installation. This warranty shall not apply to any Ice Storage Bin or Dispenser initially installed more than five (5) years from the serial number production date.

The obligation of the Company under this warranty is limited to the repair or replacement of parts, components, or assemblies that in the sole opinion of the Company are defective. This warranty is further limited to the cost of parts, components or assemblies and standard straight time labor charges at the servicing location.

Time and hourly rate schedules, as published from time to time by the Company, apply to all service procedures. Additional expenses including without limitation, travel time, overtime premium, material cost, accessing or removal of the Ice Storage Bin / Dispenser, or shipping are the responsibility of the purchaser, along with all maintenance, adjustments, cleaning, and ice purchases. Labor covered under this warranty must be performed by an approved Company contracted Service Representative or a refrigeration service agency as qualified and authorized by the Company's local Distributor. The Company's liability under this warranty shall in no event be greater than the actual purchase price paid by purchaser for the Ice Storage Bin or Dispenser.

EXCLUSIONS FROM COVERAGE

- Repair or replacement of parts required because of misuse, improper care or storage, negligence, alteration, use of incompatible supplies or lack of specified maintenance shall be excluded.
- Normal maintenance items.
  Failures caused by adverse environmental, water conditions, or improper drainage.
- Improper or unauthorized repair.
- Any Ice Storage Bin / Dispenser that has been installed and/or maintained inconsistent with the instructions provided by the Company.
- Parts subject to damage beyond the control of Company, or to Ice Storage Bin's / Dispenser's which have been subject to accidents, damage in shipment, fire, floods, other hazards or acts of God that are beyond the control of the Company.
- This Limited Warranty shall not apply if the Ice Storage Bin / Dispenser is modified with parts and assemblies other than those manufactured by the Company, unless the Company approves these modifications for specific locations in writing prior to the commencement of such modification.

LIMITATIONS OF LIABILITY

The preceding paragraphs set forth the exclusive remedy for all claims based on failure of, or defect in, Ice Storage Bins or Dispensers sold hereunder, whether the failure or defect arises before or during the warranty period, and whether a claim, however instituted, is based on contract, indemnity, warranty, tort (including negligence), strict liability, implied by statute, common-law or otherwise , and Company and agents shall not be liable for any claims for personal injuries or consequential damages or loss, howsoever caused. Upon the expiration of the warranty period, all such liability shall terminate. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, IMPLIED OR STATUTORY NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY, COMPANY DOES NOT WARRANT ANY PRODUCTS OR SERVICES OF OTHERS

REMEDIES

The liability of Company for breach of any warranty obligation hereunder is limited to: (i) the repair or replacement of the Ice Storage Bin or Dispenser on which the liability is based, or with respect to services, re-performance of the services; or (ii) at Company's option, the refund of the amount paid for said equipment or services. Any breach by Company with respect to any item or unit of equipment or services shall be deemed a breach with respect to that item or unit or service only

WARRANTY CLAIM PROCEDURE

Customer shall be responsible to:

- Complete and return warranty registration card or register on line within five (5) days from the installation date.
- All warranty service must be preformed by an approved Manitowoc contracted or authorized Service Representative. To schedule a service appointment contact your local Manitowoc Service Representative or visit us at www.manitowocice.com to find a Service Representative near you.

GOVERNING LAW

This Limited Warranty shall be governed by the laws of the state of Wisconsin, USA, excluding their conflicts of law principles. The United Nations Convention on Contracts for the International Sale of Goods is hereby excluded in its entirety from application to this Limited Warranty

COMPLETE AND RETAIN FOR YOUR RECORD:

Distributor/Dealer _____

Model Number _____

Serial Number _____

Installation Date _____

Manitowoc Ice
2110 South 26th Street
P.0. Box 1720
Manitowoc, WI 54221-1720
Web site: www.manitowocice.com

Rev 2 1/2/2012

John BOOS Since 1887

ITEM #: _____ QTY: _____

MODEL #: _____

PROJECT NAME: _____

071619

3601 S. Banker St. Effingham, IL 62401 • P.O. BOX 609 • Ph: (888) 431-2667 • Fax: (800) 433-2667

"DT3B" CLEAN DISHTABLE/POT SINKS

FEATURES:

- 16GA STAINLESS STEEL
- TYPE 300 STAINLESS STEEL WITH #4 POLISH, SATIN FINISH
- 14" DEEP BOWLS
- ALL CORNERS, BOTH VERTICAL AND HORIZONTAL, COVED AT 3/4" RADIUS
- BOTTOMS OF BOWLS FORMED FOR DRAINAGE TO 3-1/2" DIAMETER DIE STAMPED OPENING
- FULL LENGTH **10" HIGH BOXED BACKSPLASH,** WITH 2" RETURN TO WALL AT 45 DEGREE AND 1" TURNED DOWN REAR LIP
- 8" ON-CENTER WITH 1" FAUCET HOLES IN BACKSPLASH
- ALL OUTSIDE CORNERS OF ASSEMBLY ARE BULLNOSED
  TO PROVIDE SAFE, CLEAN, AND POLISHED EDGE
- STANDARD STAINLESS STEEL LEGS 1-5/8" DIAMETER
- LEGS LOCATED DIRECTLY UNDER SINK BOWLS, PROVIDING INCREASEDE STABILITY AND MAX WEIGHT SUPPORT

CONSTRUCTION:

- TOP: STAINLESS STEEL SINKS ARE TIG WELDED, EXPOSED WELDS ARE POLISHED TO MATCH ADJACENT SURFACE
- BASE: STAINLESS STEEL BASES ARE MIG WELDED

MATERIAL:

- BOWLS & TOP: 16GA TYPE 300 STAINLESS STEEL WITH #4 POLISH, SATIN FINISH
- LEGS: 1-5/8" ROUND O.D. STAINLESS STEEL
- BRACING: 1-1/4" ROUND O.D. STAINLESS STEEL
- GUSSETS: STAINLESS STEEL
- FEET: 1" ADJUSTABLE STAINLESS STEEL BULLET FEET

DT3B18244-2D18L

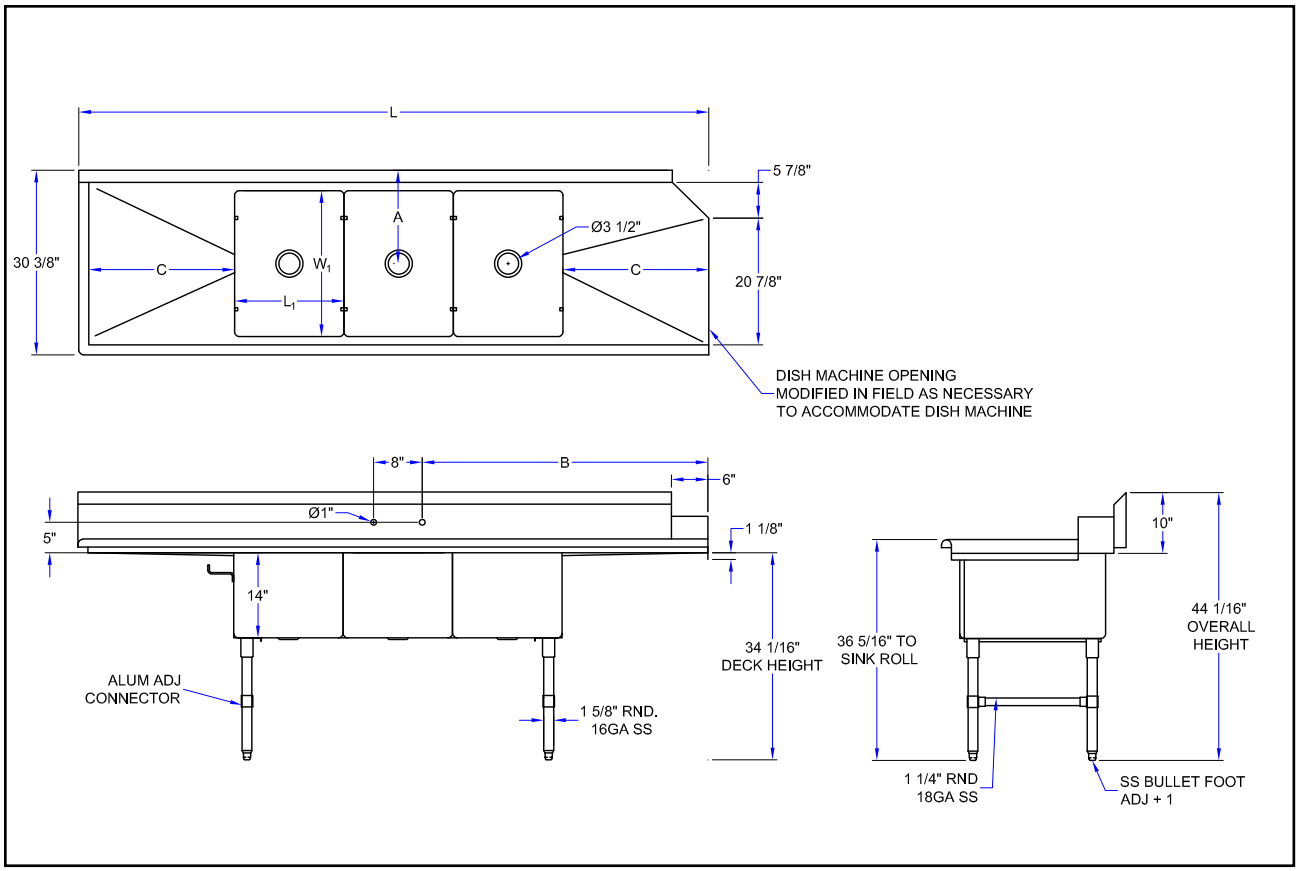
STANDARD 16GA "DT3B" SINK

MODEL	BOWL SIZE (LxWxD)	QTY
DT3B18244-2D18L	18" X 24" X 14"	
DT3B18244-2D18R	18" X 24" X 14"	
DT3B18244-2D24L	18" X 24" X 14"	
DT3B18244-2D24R	18" X 24" X 14"	
DT3B244-2D24L	24" X 24" X 14"	
DT3B244-2D24R	24" X 24" X 14"	

OPTIONAL ACCESSORIES

DESCRIPTION	QTY
FAUCETS	
ADD-A-FAUCETS	
PRE-RINSE UNITS	
LEVEL WASTE	
OVERSHELVES	
POT RACK	

DETAILED SPECIFICATIONS



STANDARD 16GA "DT3B" "B" SINK

MODEL	L	L1	W1	A	B	C
DT3B18244-2D18L	91-5/8"	18"	24"	15-3/8"	41"	18"
DT3B18244-2D18R	91-5/8"	18"	24"	15-3/8"	41"	18"
DT3B18244-2D24L	103-5/8"	18"	24"	15-3/8"	47"	24"
DT3B18244-2D24R	103-5/8"	18"	24"	15-3/8"	47"	24"
DT3B244-2D24L	121-5/8"	24"	24"	15-3/8"	56"	24"
DT3B244-2D24R	121-5/8"	24"	24"	15-3/8"	56"	24"

SOME UNITS SHIP UNASSEMBLED FOR REDUCED SHIPPING COST. ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500"

SPEC SHEET

"PB-PRW" PRE-RINSE FAUCETS

Splash Mount, 8" O.C.

FEATURES:

- Triple-Ply Hose Rated To 300 PSI
- 12" Wall Bracket
- 1/4 Turn Ceramic Cartridges
- Integral Check Valves
- Color Coded Hot & Cold Indicators
- 1/2" Female Inlets

CERTIFICATIONS:

ADA Compliant

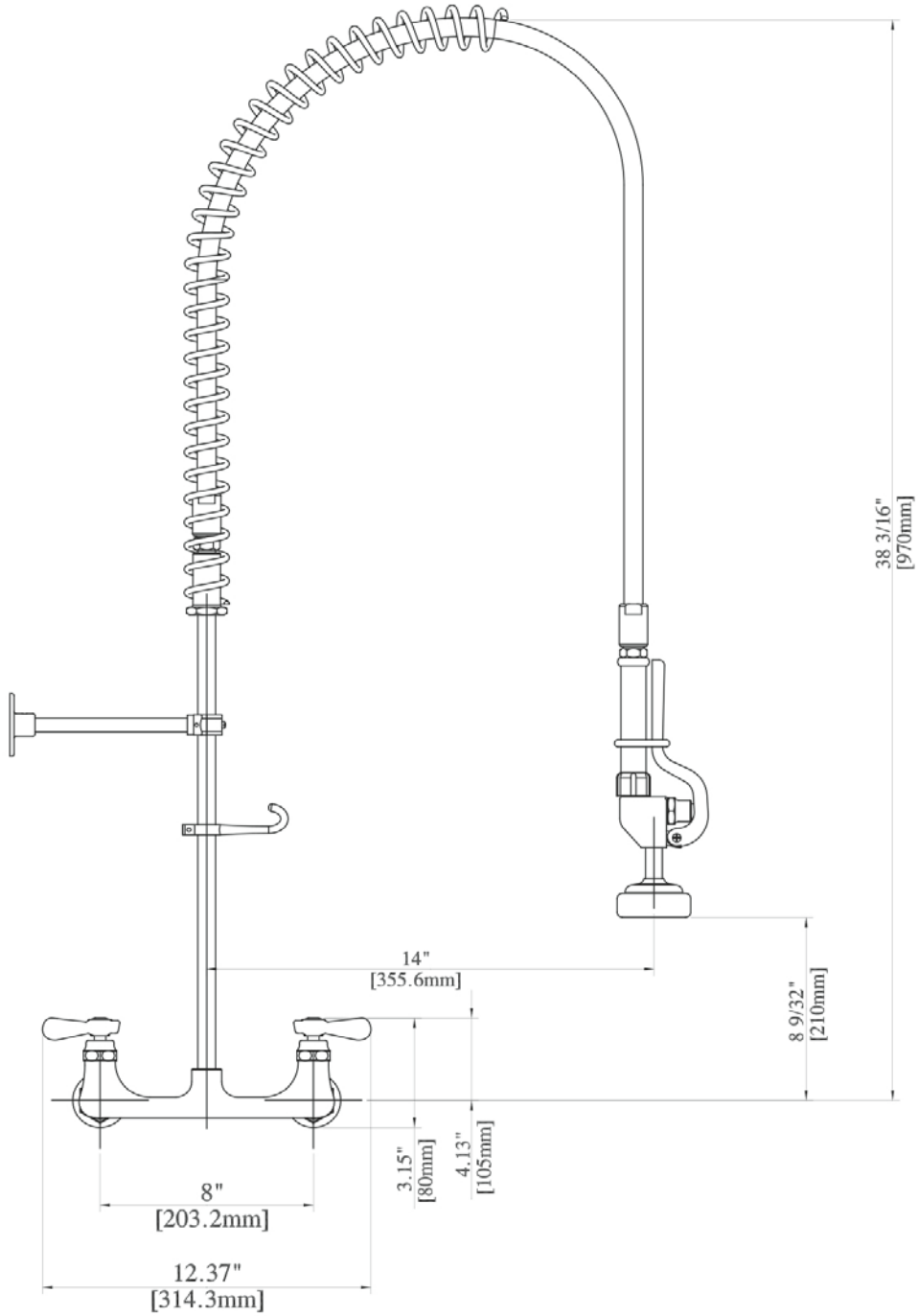
PB-PRW-1LF

"PB-PRW" PRE-RINSE FAUCETS

MODEL	DESCRIPTION	O/C	WEIGHT (LBS)
PB-PRW-1LF	Splash Mount	8"	8

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

DETAILED SPECIFICATIONS



"PB-PRW" PRE-RINSE FAUCETS

MODEL	DESCRIPTION	O/C	WEIGHT (LBS)
PB-PRW-1LF	Splash Mount	8"	8

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

John BOOS Since 1887

ITEM #: _____ QTY: _____

MODEL #: _____

PROJECT NAME: _____

103020

3601 S. Banker St. Effingham, IL 62401 • P.O. BOX 609 • Ph: (888) 431-2667 • Fax: (800) 433-2667

LOW-LEAD FAUCETS


PBF-8-S


PBF-18-DJSLF


PB-PRW-1


PB-AD-8


PBF-4DM-5G


PBF-4DM-12


PBF-8HD-X-S


PBF-4-D


PBF-4SM-XG


PBF-4SM-5G


PB-MV


PBF-4DM-XG

LOW-LEAD FAUCETS

	MODEL #	QTY
PRE-RINSE UNITS	PB-PRW-1LF	
	PB-PRD-2LF	
HEAVY DUTY 8" O/C SPLASHMOUNT	PBF-8-SLF	
	PBF-10-SLF	
	PBF-12-SLF	
	PBF-14-SLF	
	PBF-16-SLF	
	PBF-18-DJSLF	
HEAVY DUTY 8" O/C DECKMOUNT	PBF-8HD-8-SLF	
	PBF-8HD-12-SLF	
ECONOMY DECKMOUNT	PBF-4-D-LF	
	PBF-4-D-10LF	
ECONOMY SPLASHMOUNT	PBF-4-S-LF	
	PBF-4-S-6LF	
	PBF-W2-6LF	
	PBF-W2-8LF	
	PBF-W2-10LF	
	PBF-W2-3GLF	
ADD-ON	PB-AD-6LF	
	PB-AD-8LF	
	PB-AD-10LF	
	PB-AD-12LF	
	PB-AD-14LF	
	PB-AD-16LF	
	PB-MV	
HEAVY DUTY 4" O/C DECKMOUNT	PBF-4DM-3GLF	
	PBF-4DM-5GLF	
	PBF-4DM-8GLF	
	PBF-4DM-10LF	
	PBF-4DM-12LF	

LOW-LEAD FAUCETS

	MODEL #	QTY
HEAVY DUTY 4" O/C SPLASHMOUNT	PBF-4SM-3GLF	
	PBF-4SM-3MGLF	
	PBF-4SM-5GLF	
	PBF-4SM-8GLF	
	PBF-4SM2-6LF	
	PBF-4SM2-8LF	
	PBF-4SM2-10LF	
	PBF-4SM2-3GLF	
	PBF-4SM2-5GLF	

	MODEL #	QTY
SINGLE HOLE SPLASHMOUNT	PBF-SEF3GLF	

	MODEL #	DESCRIPTION	WT. (LBS)
PRE-RINSE UNITS	PB-PRW-1LF	SPLASH MOUNT 8" ON-CENTER	8
	PB-PRD-2LF	DECKMOUNT	8
HEAVY DUTY 8" O/C SPLASHMOUNT	PBF-8-SLF	8" SWING SPOUT	4
	PBF-10-SLF	10" SWING SPOUT	4
	PBF-12-SLF	12" SWING SPOUT	4
	PBF-14-SLF	14" SWING SPOUT	5
	PBF-16-SLF	SINK MIXING, W/ 16" SWING NOZZLE, WALL MOUNTED, W/ 1/2" NPT	4
	PBF-18-DJSLF	18" DOUBLE JOINTED SWING SPOUT	5
HEAVY DUTY 8" O/C DECKMOUNT	PBF-8HD-8-SLF	SINK MIXING, W/ 8" SWING SPOUT, W/ 1/2" NPT	4
	PBF-8HD-12-SLF	SINK MIXING, W/ 12" SWING SPOUT, W/ 1/2" NPT	4
ECONOMY DECKMOUNT	PBF-4-D-LF	4" CENTERS, 3-1/2" GOOSENECK SPOUT (WRIST BLADES NOT AVAILABLE)	4
	PBF-4-D-10LF	4" CENTERS, 10" SWING NOZZLE, W/ 1/2" NPT	6
ECONOMY SPLASHMOUNT	PBF-4-S-LF	4" CENTERS, 3-1/2" GOOSENECK SPOUT, (WRIST BLADES NOT AVAILABLE)	2
	PBF-4-S-6LF	4" CENTERS,6 " SWING SPOUT, (WRIST BLADES NOT AVAILABLE)	
	PBF-W2-6LF	4" CENTERS, 6" SWING SPOUT (WRIST BLADES NOT INCLUDED)	2
	PBF-W2-8LF	4" CENTERS, 8" SWING SPOUT (WRIST BLADES NOT INCLUDED)	3
	PBF-W2-10LF	4" CENTERS, 10" SWING SPOUT (WRIST BLADES NOT AVAILABLE)	3
	PBF-W2-3GLF	4" CENTERS, 3-1/2" GOOSENECK SPOUT (WRIST BLADES NOT AVAILABLE)	2.5
ADD-ON	PB-AD-6LF	6" SPOUT, FITS ON PB-PRW-1LF OR PB-PRD-2LF PRE-RINSE UNITS	3
	PB-AD-8LF	8" SPOUT, FITS ON PB-PRW-1LF OR PB-PRD-2LF PRE-RINSE UNITS	3
	PB-AD-10LF	10" SPOUT, FITS ON PB-PRW-1LF OR PB-PRD-2LF PRE-RINSE UNITS	3
	PB-AD-12LF	12" SPOUT, FITS ON PB-PRW-1LF OR PB-PRD-2LF PRE-RINSE UNITS	3
	PB-AD-14LF	14" SWING SPOUT	3
	PB-AD-16LF	16" SPOUT, FITS ON PB-PRW-1LF OR PB-PRD-2LF PRE-RINSE UNITS	4
	PB-MV	TEMPERING VALVE	
HEAVY DUTY 4" O/C DECKMOUNT	PBF-4DM-3GLF	SINK MIXING, W/ 3" GOOSENECK SPOUT, W/ 1/2" NPT	4
	PBF-4DM-5GLF	SINK MIXING, W/ 5" GOOSENECK SPOUT, W/ 1/2" NPT	5
	PBF-4DM-8GLF	SINK MIXING, W/ 8" GOOSENECK SPOUT, W/ 1/2" NPT	5
	PBF-4DM-10LF	SINK MIXING, W/ 10" SWING SPOUT, W/ 1/2" NPT	6
	PBF-4DM-12LF	SINK MIXING, W/ 12" SWING SPOUT, W/ 1/2" NPT	7
HEAVY DUTY 4" O/C SPLASHMOUNT	PBF-4SM-3GLF	SINK MIXING, W/ 3-1/2" GOOSE S SPOUT, W/ 1/2" NPT	4
	PBF-4SM-3MGLF	SINK MIXING, W/ 3" MINI GOOSE S SPOUT, W/ 1/2" NPT	4
	PBF-4SM-5GLF	SINK MIXING, W/ 5" GOOSENECK SPOUT, W/ 1/2" NPT	4
	PBF-4SM-8GLF	SINK MIXING, W/ 8" GOOSENECK SPOUT, W/ 1/2" NPT	5
	PBF-4SM2-6LF	SHALLOW SOLID BODY W/ 6" SWING SPOUT	6
	PBF-4SM2-8LF	SHALLOW SOLID BODY W/ 8" SWING SPOUT	4
	PBF-4SM2-10LF	SHALLOW SOLID BODY W/ 10" SWING SPOUT	6
	PBF-4SM2-3GLF	SHALLOW SOLID BODY W/ 3-1/2" GOOSENECK SPOUT	2.5
	PBF-4SM2-5GLF	SHALLOW SOLID BODY W/ 5" GOOSENECK SPOUT	4
SINGLE HOLE SPLASHMOUNT	PBF-SEF3GLF	SINK MIXING, W/ 3-1/2" GOOSE NECK SPOUT, W/ ELECTRONIC EYE, W/ 1/2" NPT	5

SOME UNITS SHIP UNASSEMBLED FOR REDUCED SHIPPING COST. ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500"

John Boos & Co. is constantly engaged in a program of improving products and therefore reserves the right to change specifications without prior notice.

Champion®
The Dishwashing Machine Specialists

Project _____
Item No. _____
Quantity _____

DH-6000T WITH HEAT RECOVERY

STANDARD FEATURES

- **Factory authorized startup**
- **Ventless Heat Recovery**
- **HMI – Operator Touch Screen Interface**
- **On-Board Service Diagnostics**
- **Field Convertible – single to three, or three to single phase**
- **Sleep Programable - All internal heaters shut off after selected time is reached**
- **Door Interlock – locks door closed during cycle**
- Auto delime with delime notification
- Built-in booster configured to ensure 180° rinse
- Field convertible from straight to corner operation
- Dual NSF listed as both a dishwasher and potwasher
- Rinse Sentry – ensures 180°F final rinse
- Cycle counter
- Auto start – starts unit when hood is closed
- Single or dual point electrical connection
- High efficiency 2 HP pump
- Self draining pump
- Automatic tank fill
- Automatic drain valve – drains wash tank when power is off
- PRV (Mounted Pressure Reducing Valve)
- 4 selectable cycles
- 27" [686mm] extended clearance

DH-6000T

with Ventless Heat-Recovery and Condensate Removal

Ventless Heat Recovery Condensate Removal

Photo is for general visual representation only. Please refer to specifications for the latest detailed product information.

OPTIONS & ACCESSORIES

- ☐ ***NEW*** Built in detergent and rinse aid pumps
- ☐ Drain Water Tempering Kit (unmounted)
- ☐ Racks
  - ☐ Peg
  - ☐ Flat
- ☐ Corner operation splash baffle
- ☐ ***NEW*** Champion ION scale prevention system

SPECIFIER STATEMENT

Specified unit will be Champion model DH-6000T with Ventless Heat-Recovery and Condensate Removal, high temperature, high-hood type dishwashing machine. Features HMI controls, Rinse Sentry, Auto Start, up to 40 racks/hour, 0.73 US gals/rack [2.76 liters/rack, 0.61 imp. gals/rack].

1 year parts and labor warranty.

Champion Industries, Inc.
3765 Champion Blvd., Winston-Salem, NC 27105
Tel: 336/661-1556 Fax: 336/661-1979

2674 N. Service Road
Jordan Station, Ontario, Canada L0R 1S0
Tel: 800/263-5798 Fax: 905/562-4618

www.ChampionIndustries.com

(1M) 7/21 Printed in U.S.A.

DH-6000T WITH HEAT RECOVERY

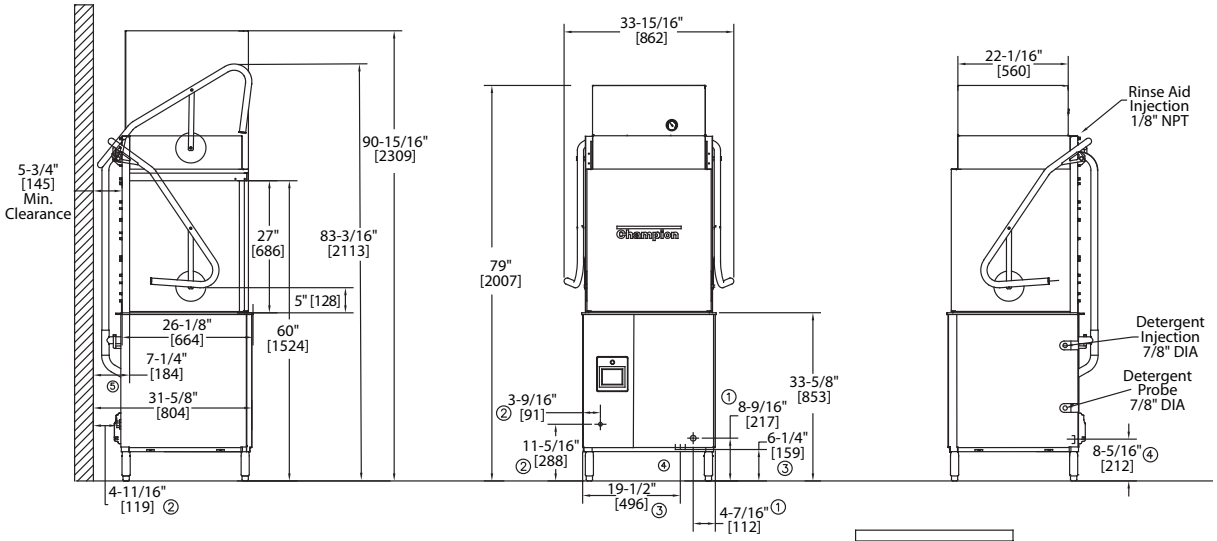
DH-6000T

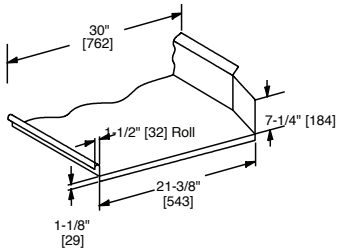
with Ventless Heat-Recovery
and Condensate Removal

Champion®
The Dishwashing Machine Specialists

Shipping weight crated: 350 lbs.

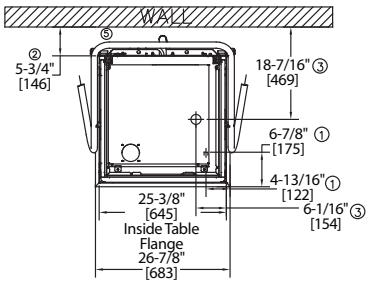
Dimensions shown in inches and [mm]

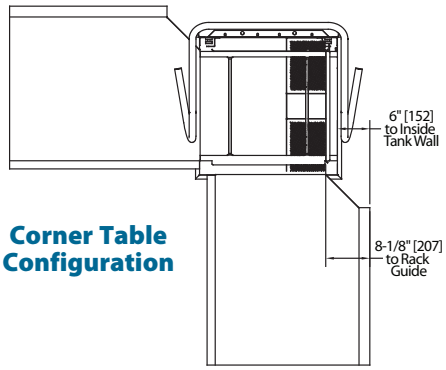




Typical Table Construction

Plan View





Corner Table Configuration

UTILITIES	
1	**Electrical** Machine Connection (See Electrical Box)
2	**Cold Water** 3/4" NPT Cold Water 50° - 75°F 45 PSI dynamic min. incoming Final rinse 18 PSI
3	**Drain** 1" NPT Connection Gravity flow, 15 GPM max flow
4	**Drain Water Tempering** 1/2" Cold water line with customer supplied cut-off valve (optional)
5	**Integrated Detergent System** Detergent bottle supply connections (optional)

Warning: Plumbing, electrical connections should be made by qualified personnel who will observe all the applicable plumbing, sanitary and safety codes and the National Electrical Code.

Note: Optional Drain Tempering: 1/2" NPT cold water connection required. 1/2" NPT drain connection from back flow preventer to house drain. (FIELD INSTALLED and PLUMBED).

Due to an ongoing value analysis program at Champion, specifications contained in this catalog are subject to change without notice.

Champion Industries, Inc.,
3765 Champion Blvd., NC 27105
336/661-1556 • Fax: 336/661-1979
ChampionIndustries.com

Machine & Built-in Booster (Standard)

Voltage	Rated Amps	Minimum Supply Circuit Ampacity	Maximum Overcurrent Protective Device
208-240/60/1	77-68	100	100
208-240/60/3	46-41	60	60
480/60/3	20	30	30

Machine Only
(two point electrical connection or no built-in booster)

Voltage	Rated Amps	Minimum Supply Circuit Ampacity	Maximum Overcurrent Protective Device
208-240/60/1	38-34	50	50
208-240/60/3	25-23	30	30
480/60/3	11	15	15

Booster Only (two point electrical connection)

Voltage	Rated Amps	Minimum Supply Circuit Ampacity	Maximum Overcurrent Protective Device
208-240/60/1	39-34	50	50
208-240/60/3	21-18	25	25
480/60/3	9	15	15

Note: Water Hammer Arrestor (meeting ASSE-1010 standard or equivalent) to be supplied (by others) in common water supply line at service connection.

SPECIFICATIONS

Capacities
- Racks per hr. (NSF rated) 40
- Wash tank (gal.) 10

Motor horsepower 2 HP

Water consumption
- Gal. per hr. 29
- Gal. per rack 0.73

Temperature °F
- Wash 150
- Rinse 180

Heating
- Tank heat, electric 5.2 kW
- Electric Booster 7.5 kW

	Dish-washer Mode	Pot & Pan Mode		
Selectable cycle times in minutes	1	2	4	6
Time cycles in seconds				
Wash	36	94	214	334
Rinse	8	10	10	10
Sanitary Dwell	16	16	16	16
Vent Fan	30	30	30	30
Total	**90**	**150**	**270**	**390**

John BOOS Since 1887

ITEM #: _____ QTY: _____

MODEL #: _____

PROJECT NAME: _____

073118

3601 S. Banker St. Effingham, IL 62401 • P.O. BOX 609 • Ph: (888) 431-2667 • Fax: (800) 433-2667

"CDT-S" CLEAN STRAIGHT DISHTABLES PRO-BOWL

FEATURES:

- TYPE 300 STAINLESS STEEL WITH # 4 POLISH, SATIN FINISH
- FULL LENGTH **10" HIGH BOXED BACKSPLASH,** WITH 2" RETURN TO WALL AT 45 DEGREE AND 1/2" TURNED DOWN REAR LIP
- ALL OUTSIDE CORNERS OF ASSEMBLY ARE BULLNOSED TO PROVIDE SAFE, CLEAN, AND POLISHED EDGE
- STANDARD 1-5/8" DIAMETER LEGS

CONSTRUCTION:

- TOP: STAINLESS STEEL TOPS ARE TIG WELDED, EXPOSED WELDS ARE POLISHED TO MATCH ADJACENT SURFACE.

MATERIAL:

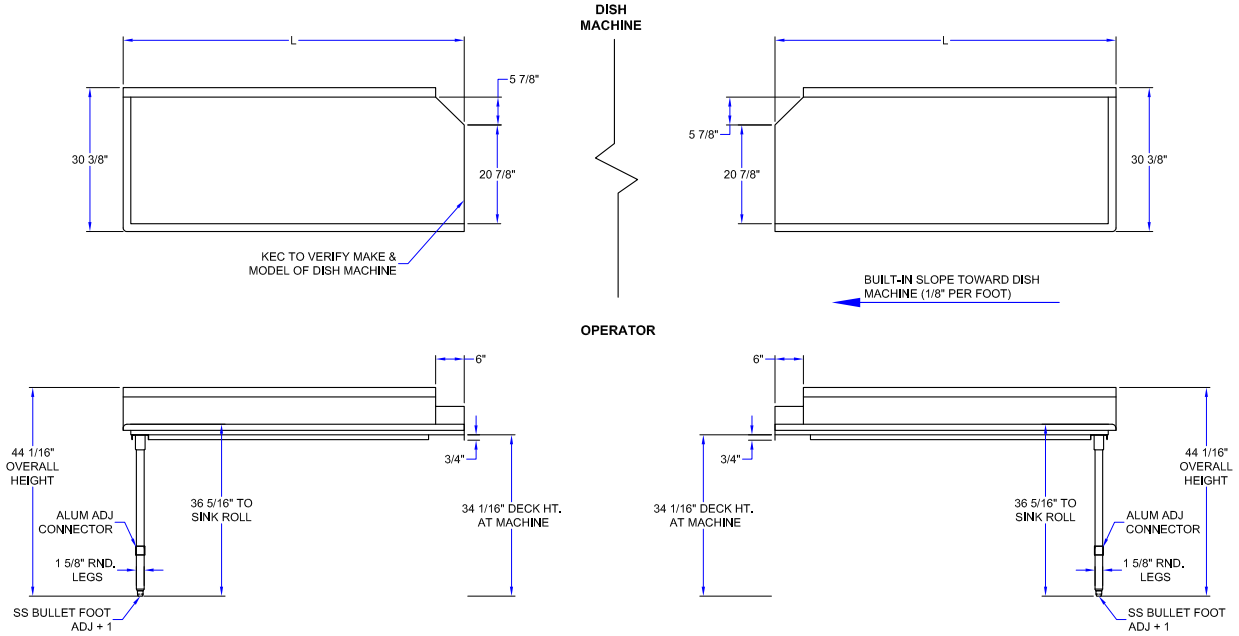
- TOP: STAINLESS STEEL TYPE 300 STAINLESS STEEL WITH #4 POLISH, SATIN FINISH
- FEET: 1" ADJUSTABLE STAINLESS STEEL BULLET FEET

14 GAUGE 304 16 GA. STAINLESS STEEL LEGS		16 GAUGE 304 16 GA. STAINLESS STEEL LEGS		16 GAUGE GALVANIZED LEGS	
PREMIUM	QTY	STANDARD	QTY	VALUE	QTY
CDT4-S24SBK-L OR R		CDT6-S24SBK-L OR R		CDT6-S24GBK-L OR R	
CDT4-S36SBK-L OR R		CDT6-S36SBK-L OR R		CDT6-S36GBK-L OR R	
CDT4-S48SBK-L OR R		CDT6-S48SBK-L OR R		CDT6-S48GBK-L OR R	
CDT4-S60SBK-L OR R		CDT6-S60SBK-L OR R		CDT6-S60GBK-L OR R	
CDT4-S72SBK-L OR R		CDT6-S72SBK-L OR R		CDT6-S72GBK-L OR R	
CDT4-S84SBK-L OR R		CDT6-S84SBK-L OR R		CDT6-S84GBK-L OR R	
CDT4-S96SBK-L OR R		CDT6-S96SBK-L OR R		CDT6-S96GBK-L OR R	
CDT4-S108SBK-L OR R		CDT6-S108SBK-L OR R		CDT6-S108GBK-L OR R	
CDT4-S120SBK-L OR R		CDT6-S120SBK-L OR R		CDT6-S120GBK-L OR R	
CDT4-S132SBK-L OR R		CDT6-S132SBK-L OR R		CDT6-S132GBK-L OR R	
CDT4-S144SBK-L OR R		CDT6-S144SBK-L OR R		CDT6-S144GBK-L OR R	

OPTIONAL ACCESSORIES

DESCRIPTION	MODEL #	QTY
OVER SHELF		
UNDER SHELF		

DETAILED SPECIFICATIONS



- UNITS 7 FT. AND LARGER ARE FURNISHED WITH SIX LEGS.

	14 GAUGE 304 16 GA. STAINLESS STEEL LEGS		16 GAUGE 304 16 GA. STAINLESS STEEL LEGS		16 GAUGE GALVANIZED LEGS	
LENGTH	PREMIUM	WT. (LBS)	STANDARD	WT. (LBS)	VALUE	WT. (LBS)
24"	CDT4-S24SBK-L OR R	46	CDT6-S24SBK-L OR R	37	CDT6-S24GBK-L OR R	37
36"	CDT4-S36SBK-L OR R	59	CDT6-S36SBK-L OR R	47	CDT6-S36GBK-L OR R	47
48"	CDT4-S48SBK-L OR R	78	CDT6-S48SBK-L OR R	62	CDT6-S48GBK-L OR R	62
60"	CDT4-S60SBK-L OR R	90	CDT6-S60SBK-L OR R	72	CDT6-S60GBK-L OR R	72
72"	CDT4-S72SBK-L OR R	109	CDT6-S72SBK-L OR R	87	CDT6-S72GBK-L OR R	87
84"	CDT4-S84SBK-L OR R	130	CDT6-S84SBK-L OR R	104	CDT6-S84GBK-L OR R	104
96"	CDT4-S96SBK-L OR R	143	CDT6-S96SBK-L OR R	113	CDT6-S96GBK-L OR R	114
108"	CDT4-S108SBK-L OR R	174	CDT6-S108SBK-L OR R	139	CDT6-S108GBK-L OR R	139
120"	CDT4-S120SBK-L OR R	205	CDT6-S120SBK-L OR R	164	CDT6-S120GBK-L OR R	164
132"	CDT4-S132SBK-L OR R	236	CDT6-S132SBK-L OR R	189	CDT6-S132GBK-L OR R	189
144"	CDT4-S144SBK-L OR R	268	CDT6-S144SBK-L OR R	214	CDT6-S144GBK-L OR R	214

MODEL # STRUCTURE

60 = TOTAL WIDTH OF DISHTABLE
S = STRAIGHT DISHTABLE
6 = 16GA WORK SURFACE
CDT = CLEAN DISHTABLE

SB = STAINLESS LEGS & BRACING
K = K.D. W/ ADJUSTABLE BRACING
L OR R = LEFT OR RIGHT DISHTABLE

CDT6-S60SBK-L

SOME UNITS SHIP UNASSEMBLED FOR REDUCED SHIPPING COST. ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500"
John Boos & Co. is constantly engaged in a program of improving products and therefore reserves the right to change specifications without prior notice.

SPEC SHEET

"BHS-TS" SORTING SHELVES

Tubular Construction, Wall Mount

FEATURES:

- Dual Purpose Open Design, Wall Mounted Sorting Shelf

SPECIFICATIONS:

- Unit Is Shipped With Assembly Hardware, No Welding
- Brackets: 16GA Type 300 Stainless Steel
- Tubing: 1-5/8" Diameter 16GA Type 300 Stainless Steel

CERTIFICATIONS:

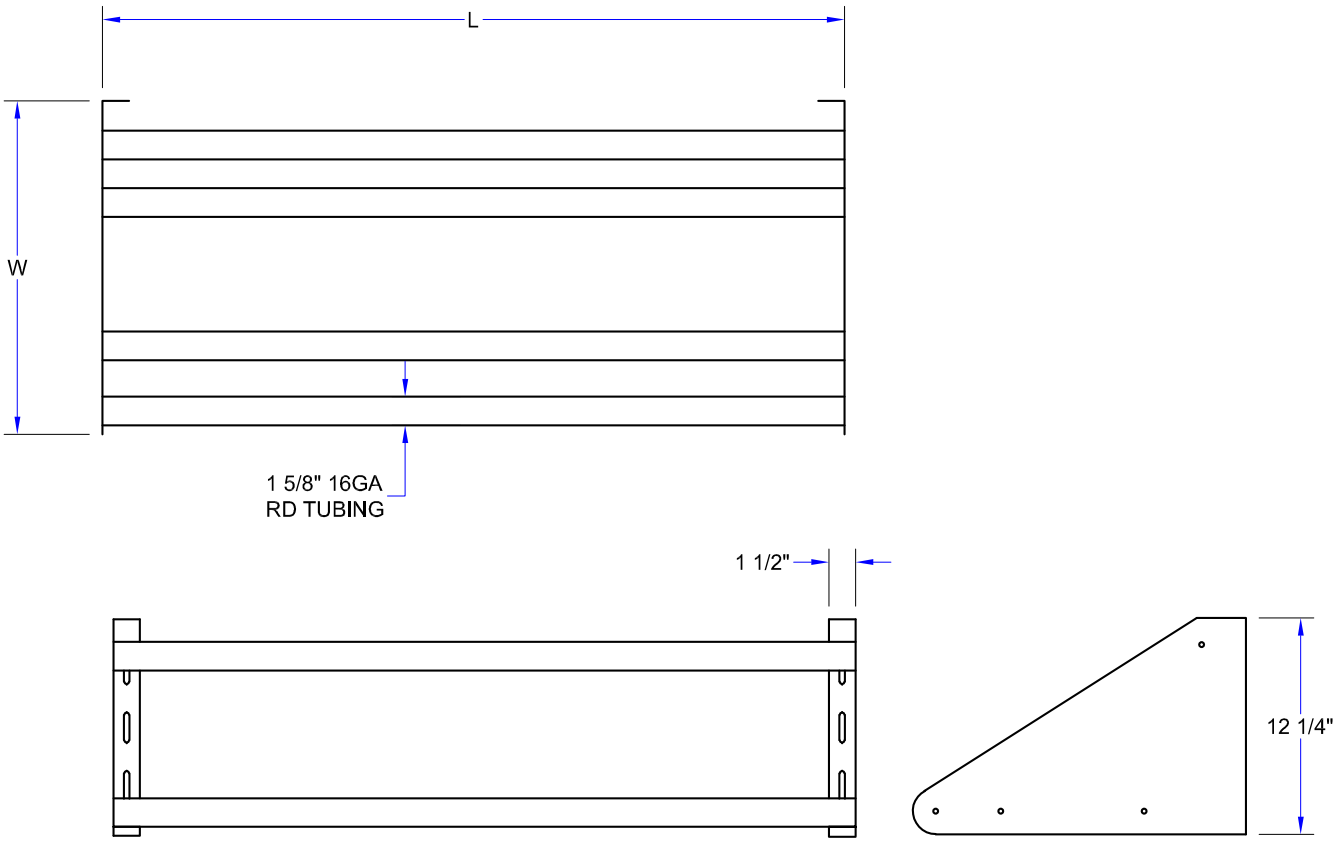
BHS1822-TS

"BHS-TS" SORTING SHELVES

MODEL	SIZE (L X W X H)	WEIGHT (LBS)
BHS1822-TS	22"x 18"x 12-1/4"	20
BHS1842-TS	42"x 18"x 12-1/4"	23
BHS1863-TS	63"x 18"x 12-1/4"	35
BHS1882-TS	82"x 18"x 12-1/4"	38

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

DETAILED SPECIFICATIONS



"BHS-TS" SORTING SHELVES

MODEL	SIZE (L X W X H)	WEIGHT (LBS)
BHS1822-TS	22"x 18"x 12-1/4"	20
BHS1842-TS	42"x 18"x 12-1/4"	23
BHS1863-TS	63"x 18"x 12-1/4"	35
BHS1882-TS	82"x 18"x 12-1/4"	38

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

SPEC SHEET

"PBHS-14-1" PRO-BOWL HAND SINKS

Wall Mount, (1) 14"x10"x5" Deep Bowl

FEATURES:

- One Piece Deep Drawn Bowl
- All Sink Bowls Have Large Liberal Radii Corners
- Includes Basket Drain
- Splash Mount - One Faucet Hole On-Center

SPECIFICATIONS:

- Bowl: Stainless Steel Tops Are TIG Welded, Exposed Welds Are Polished To Match Adjacent Surface
- Bowl: Type 300 Stainless Steel Polish, Satin Finish
- Bracket: Type 300 Stainless Steel Polish, Satin Finish
- Drain: 2" Drain Opening, With 1-1/2" NPS Outlet Connection

CERTIFICATIONS:

PBHS-W-1410-1

ACCESSORIES

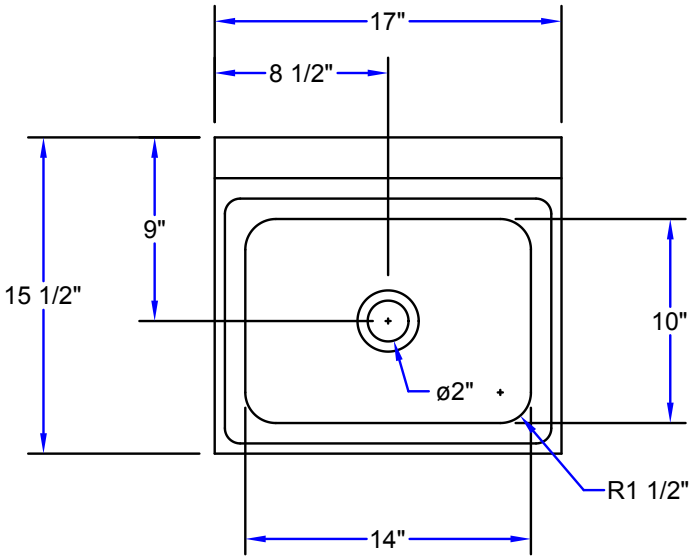
MODEL
Faucets
ADA Wrist Blades
Side Splashes
Towel Dispenser
Soap Dispenser
Lever Wastes
Over Flows
P-Traps

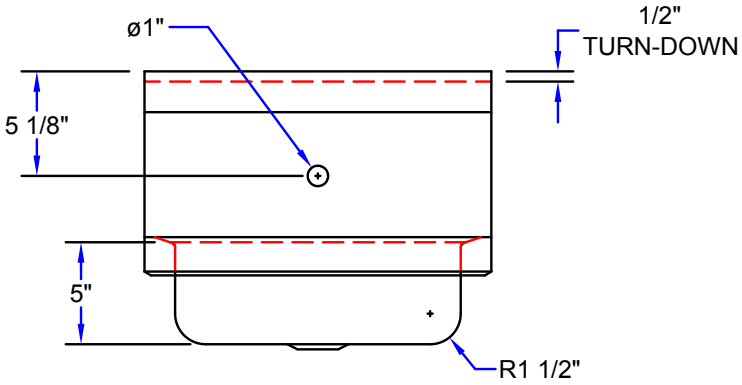
"PBHS-14-1" PRO-BOWL HAND SINKS

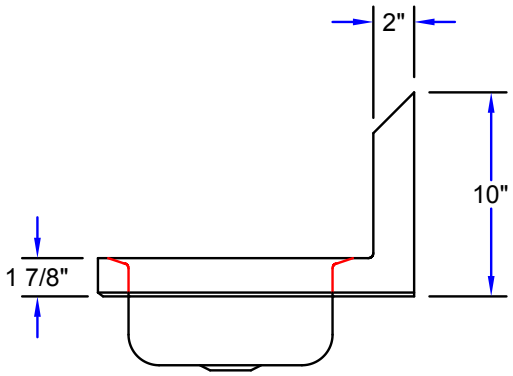
MODEL	BOWL SIZE (L X W X H)	OVERALL SINK SIZE (L X W X H)	WEIGHT (LBS)
PBHS-W-1410-1	14"x10"x5"	17"x15-1/2"x13-1/8"	8

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

DETAILED SPECIFICATIONS







"PBHS-14-1" PRO-BOWL HAND SINKS

MODEL	BOWL SIZE (L X W X H)	OVERALL SINK SIZE (L X W X H)	WEIGHT (LBS)
PBHS-W-1410-1	14"x10"x5"	17"x15-1/2"x13-1/8"	8

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

WIRE SHELVING

DESIGN: The open wire design of these shelves minimizes dust accumulation and allows free circulation of air, greater visibility of stored items and greater light penetration.

CONSTRUCTION: All welded wire shelves and posts are constructed of heavy-gauge carbon steel or Type 304 stainless steel.

CHOICE OF FINISHES:

- ***Chrome*** *- is a plating process which deposits hard chrome OVER a copper, nickel surface. This process is VERY durable and allows product to be used in any application in a dry storage ENVIRONMENT. 1 year limited warranty to not rust or corrode when used in dry and non-humid ENVIRONMENTS.*

- ***Stainless Steel*** *- 304 Stainless with an electro-polish finish represents the highest industry standard in the PREVENTION of corrosion. This finish is highly EFFECTIVE for CORROSIVE, high humidity or clean room ENVIRONMENTS. Lifetime warranty for 304 stainless steel electro-polish finish.*

- ***Proform Green, Gray and Black Epoxy*** *- are an ideal solution for high humidity, wet, or walk-in-cooler applications. The carbon steel is treated with an iron phosphate and the powder coated epoxy is electrostatically applied, baked and cured to a hard surface. All three colors are antimicrobial. 15 year limited warranty for antimicrobial finish to not rust or corrode.*

Chrome

Stainless Steel

Proform Green Epoxy

Gray Epoxy

Black Epoxy

ADAPTABLE: Wire shelving can adapt to your changing needs. By using various accessories, hundreds of shelving configurations become possible.

QUICK, EASY ASSEMBLY: Posts have a double groove visual guide feature every 8", circular grooves at 1" increments, and are numbered at 1" intervals. Tapered split sleeve snaps together around each post. Tapered openings in the shelf corners slide over the tapered split sleeves providing a positive lock. Shelf is assembled in minutes without the use of any special tools.

ADJUSTABLE: Shelves can be adjusted at 1" intervals along length of the post.

WIRE TRUSSES: Architectural wire trusses increase shelf capacity.

TOP MAT WIRES: Run front to back to slide items easily off and on the shelf.

SHELF ACCESSIBILITY: Shelves can be loaded/unloaded easily from all sides. This open construction allows maximum use of storage cube.

ADJUSTABLE FOOT: 3/8-16 leveling bolt compensate for irregular floor surfaces.

NSF

Note: *Stainless stationary posts are equipped with stainless steel LEVELING feet.*

Highest Quality, Lowest Price Guaranteed!

QUANTUM FOOD SERVICE
15800 NW 15TH AVENUE, MIAMI, FLORIDA 33169 **TOLL-FREE: (888) 993-3370 FAX:** (954) 369-2512
E-MAIL: *SALES@QUANTUMFOODSERVICE.COM* WWW.**QUANTUMFOODSERVICE**.COM

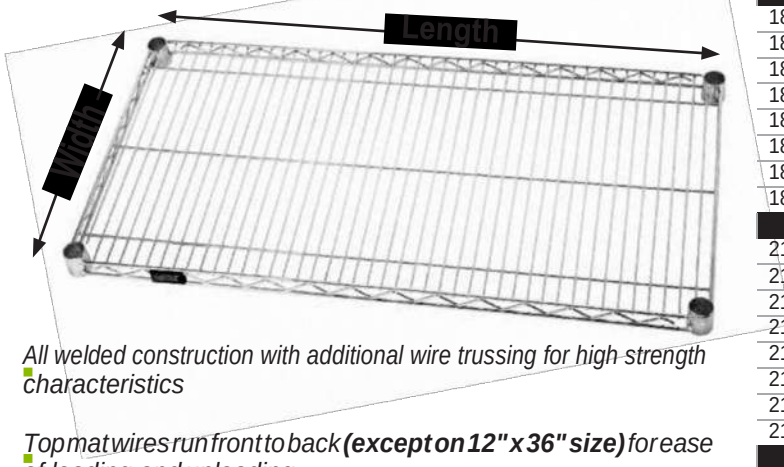
QUANTUM FOODSERVICE

WIRE SHELVING

WIRE SHELVES

- ***Plastic Split Sleeves*** *- are included with each shelf*
  Replacements are available:
  Model No: **WR-SS** *(4 Pairs)*
- ***Plastic Conductive Split Sleeves*** *- are available for conductive applications*
  Model No: **WR-SSCO** *(4 Pairs)*
- ***Aluminum Split Sleeves*** *- are recommended for extreme mobile applications and conductive applications*
  Model No: **ESD-SS** *(4 Pairs)*
- *Load capacity* ***(evenly distributed)*** *per shelf*

Widths: 12" to 36"
Lengths: **800 lbs.** for 18" to 48"
600 lbs. for 54" or longer except heavy-duty
1,000 lbs. for 60" or 72" on chrome heavy-duty



- *All welded construction with additional wire trussing for high strength characteristics*
- *Top mat wires run front to back* ***(except on 12" x 36" size)*** *for ease of loading and unloading*
- *Numbered grooved posts on 1" increments for quick assembly*
- *Wire allows air to circulate and light to penetrate for increased product visibility*
- *Minimal dirt accumulation*
- *Adjustable foot levelers*
- *No tools required for assembly*
- *Durable finishes*
- *Aesthetically pleasing*
- *National Sanitation Foundation* ***(NSF)*** *Approved*
- *Shipped KD Class 70*


Split Sleeve


Aluminum Split Sleeve

		CHROME	STAINLESS STEEL	EPOXY		
				PROFORM GREEN	GRAY	BLACK
SHELF W" x L"	SHIP WGT	MODEL NO.	MODEL NO.	MODEL NO.	MODEL NO.	MODEL NO.
12" Deep - Wire Shelves						
12" x 24"	6 lbs	1224C	-	1224P	1224GY	1224BK
12" x 30"	6 lbs	1230C	-	1230P	1230GY	1230BK
12" x 36"	7 lbs	1236C	1236S	1236P	1236GY	1236BK
12" x 42"	8 lbs	1242C	-	1242P	1242GY	1242BK
12" x 48"	9 lbs	1248C	1248S	1248P	1248GY	1248BK
12" x 60"	14 lbs	1260C	1260S	1260P	1260GY	1260BK
12" x 72"	17 lbs	1272C	1272S	1272P	1272GY	1272BK
14" Deep - Wire Shelves						
14" x 24"	6 lbs	1424C	-	1424P	1424GY	1424BK
14" x 30"	7 lbs	1430C	1430S	1430P	1430GY	1430BK
14" x 36"	8 lbs	1436C	1436S	1436P	1436GY	1436BK
14" x 42"	10 lbs	1442C	1442S	1442P	1442GY	1442BK
14" x 48"	11 lbs	1448C	1448S	1448P	1448GY	1448BK
14" x 54"	12 lbs	1454C	1454S	1454P	1454GY	1454BK
14" x 60"	14 lbs	1460C	1460S	1460P	1460GY	1460BK
14" x 72"	17 lbs	1472C	1472S	1472P	1472GY	1472BK
18" Deep - Wire Shelves						
18" x 24"	7 lbs	1824C	1824S	1824P	1824GY	1824BK
18" x 30"	8 lbs	1830C	1830S	1830P	1830GY	1830BK
18" x 36"	10 lbs	1836C	1836S	1836P	1836GY	1836BK
18" x 42"	11 lbs	1842C	1842S	1842P	1842GY	1842BK
18" x 48"	14 lbs	1848C	1848S	1848P	1848GY	1848BK
18" x 54"	15 lbs	1854C	1854S	1854P	1854GY	1854BK
18" x 60"	17 lbs	1860C	1860S	1860P	1860GY	1860BK
18" x 72"	20 lbs	1872C	1872S	1872P	1872GY	1872BK
21" Deep - Wire Shelves						
21" x 24"	8 lbs	2124C	2124S	2124P	2124GY	2124BK
21" x 30"	9 lbs	2130C	2130S	2130P	2130GY	2130BK
21" x 36"	11 lbs	2136C	2136S	2136P	2136GY	2136BK
21" x 42"	12 lbs	2142C	2142S	2142P	2142GY	2142BK
21" x 48"	14 lbs	2148C	2148S	2148P	2148GY	2148BK
21" x 54"	16 lbs	2154C	2154S	2154P	2154GY	2154BK
21" x 60"	18 lbs	2160C	2160S	2160P	2160GY	2160BK
21" x 72"	24 lbs	2172C	2172S	2172P	2172GY	2172BK
24" Deep - Wire Shelves						
24" x 24"	9 lbs	2424C	2424S	2424P	2424GY	2424BK
24" x 30"	11 lbs	2430C	2430S	2430P	2430GY	2430BK
24" x 36"	13 lbs	2436C	2436S	2436P	2436GY	2436BK
24" x 42"	15 lbs	2442C	2442S	2442P	2442GY	2442BK
24" x 48"	16 lbs	2448C	2448S	2448P	2448GY	2448BK
24" x 54"	18 lbs	2454C	2454S	2454P	2454GY	2454BK
24" x 60"	21 lbs	2460C	2460S	2460P	2460GY	2460BK
24" x 66"	23 lbs	2466C	-	2466P	2466GY	-
24" x 72"	26 lbs	2472C	2472S	2472P	2472GY	2472BK
24" Deep Heavy-Duty - Wire Shelves *(1,000 lb. capacity)*						
24" x 60"	25 lbs	2460CHD	-	-	-	-
24" x 72"	30 lbs	2472CHD	-	-	-	-
30" Deep - Wire Shelves						
30" x 36"	15 lbs	3036C	3036S	3036P	3036GY	3036BK
30" x 42"	18 lbs	3042C	3042S	3042P	3042GY	3042BK
30" x 48"	21 lbs	3048C	3048S	3048P	3048GY	3048BK
30" x 60"	27 lbs	3060C	3060S	3060P	3060GY	3060BK
30" x 72"	31 lbs	3072C	3072S	3072P	3072GY	3072BK
36" Deep - Wire Shelves						
36" x 36"	18 lbs	3636C	3636S	3636P	3636GY	3636BK
36" x 48"	23 lbs	3648C	3648S	3648P	3648GY	3648BK
36" x 60"	29 lbs	3660C	3660S	3660P	3660GY	3660BK
36" x 72"	35 lbs	3672C	3672S	3672P	3672GY	3672BK

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QUANTUM FOODSERVICE

WIRE SHELVING

POSTS

All posts are fabricated from 16 gauge carbon steel with locating grooves on 1" increments and printed numbers between the grooves. Post also have doubled grooves every 8" for fast identification. Leveling legs are enclosed with all posts. Leveling legs cannot be used in conjunction with stem casters. Custom post heights are available.

STATIONARY POSTS ARE EQUIPPED WITH:

- ***Post Leveler Insert & Leveling Bolt*** *- use to account for uneven floors, it adjusts up or down allowing height flexibility*
  Replacements are available:
  Insert
  Model No: **W-PLI**
  Leveling Bolt
  Model No: **W-PLB**

- ***Foot Plates*** *- triangular plate allows additional surface to disperse weight. It may be ordered separately and installed in place of leveling foot*
  Model No: **FP**

- ***Floor Guides*** *- Serves as protection to prevent marring of floors*
  Model No: **FG** *(Pack of 4)*

- ***Fully Threaded Stud Connector*** *- can be utilized to connect two posts enabling any post height to be achieved*
  Model No: **W-PC-STUD**

- ***Post Cap*** *- Plastic caps are included with each post*
  Replacements are available:
  Model No: **W-PC** *(Pack of 4)*

- ***Shelf Collar Plug*** *- Shelf Collar Plug covers shelf collar when post is not being used*
  Model No: **WR-SP** *(Pack of 4)*

- ***S-Hook*** *- For continuous runs of shelving. Two hooks should be placed per shelf where two posts are not utilized.*
  Model No: **S-HOOK** *(Pack of 8)*

FINISHES:
Chrome, Stainless Steel, Proform and Epoxy Green, Gray, Black

		CHROME	STAINLESS STEEL	EPOXY		
				PROFORM GREEN	GRAY	BLACK
DESCRIPTION	SHIP WGT	MODEL NO.	MODEL NO.	MODEL NO.	MODEL NO.	MODEL NO.
6"H Post	1 lb	P6C	P6S	P6P	P6GY	P6BK
14"H Post	1 lb	P14C	P14S	P14P	P14GY	P14BK
34"H Post	2 lbs	P34C	P34S	P34P	P34GY	P34BK
36"H Post	2 lbs	P36C	-	-	-	-
39"H Post	2 lbs	P39C	-	-	-	P39BK
42"H Post	2 lbs	-	P42S	-	-	-
54"H Post	3 lbs	P54C	P54S	P54P	P54GY	P54BK
63"H Post	4 lbs	P63C*	P63S	P63P*	P63GY*	P63BK*
74"H Post	4 lbs	P74C*	P74S	P74P*	P74GY*	P74BK*
86"H Post	5 lbs	P86C*	P86S	P86P*	P86GY*	P86BK*
96"H Post	6 lbs	P96C	P96S	P96P	P96GY	P96BK

*For easy installation, 63", 74" and 86" posts are available with pre-inserted leveler and bolt by adding an **X** to the Model No. **P74CX**

Highest Quality, Lowest Price Guaranteed!

QUANTUM FOOD SERVICE
15800 NW 15TH AVENUE, MIAMI, FLORIDA 33169 **TOLL-FREE: (888) 993-3370 FAX:** (954) 369-2512
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QUANTUM FOODSERVICE

WIRE SHELVING

SHELVING UNITS

Heavy-duty shelving units allows up to 800 lb. shelf capacity. Starter kits come complete with 4 posts and 4 shelves. Additional shelves may be purchased separately.

Additional Add-On kits allows you to expand your starter kit by sharing a set of posts. Configuration options include side to side, back to back and right angles *(L-Shape)*. Add-On kits come complete with 2 posts, 4 shelves and 8 S-Hooks. Additional shelves and posts may be purchased separately. Units with Add-on kits cannot be made mobile.

ADD SUFFIX TO THE END OF EACH MODEL NO. WHEN REFERENCING TO PART FINISHES
CHROME C · STAINLESS S · EPOXY: GREEN P · GRAY GY · BLACK BK

DB
Donut Bumper
Non-marking donut bumper used to protect walls and help cushion impact. Sold individually. Measures 3" diameter

WR-00HS
Polyurethane Stainless Steel Casters w/ Zerk Grease Fittings
Sold as a set of 4 casters, 2 with brake. Measures 5" x 1-1/4"

WR-00H
Polyurethane Casters
Sold as a set of 4 casters, 2 with brake. Measures 5" x 1-1/4"

63"H STARTER KIT UNITS			63"H ADD-ON KIT UNITS		
DIMENSIONS	SHIP WGT	MODEL NO.	DIMENSIONS	SHIP WGT	MODEL NO.
12" x 36" x 63"	44	WR63-1236	12" x 36" x 63"	37	AD63-1236C
12" x 42" x 63"	48	WR63-1242	12" x 42" x 63"	41	AD63-1242C
12" x 48" x 63"	52	WR63-1248	12" x 48" x 63"	45	AD63-1248C
12" x 60" x 63"	60	WR63-1260	12" x 60" x 63"	53	AD63-1260C
12" x 72" x 63"	68	WR63-1272	12" x 72" x 63"	61	AD63-1272C
14" x 24" x 63"	40	WR63-1424	14" x 24" x 63"	33	AD63-1424C
14" x 30" x 63"	44	WR63-1430	14" x 30" x 63"	37	AD63-1430C
14" x 36" x 63"	48	WR63-1436	14" x 36" x 63"	41	AD63-1436C
14" x 42" x 63"	56	WR63-1442	14" x 42" x 63"	49	AD63-1442C
14" x 48" x 63"	60	WR63-1448	14" x 48" x 63"	53	AD63-1448C
14" x 54" x 63"	64	WR63-1454	14" x 54" x 63"	57	AD63-1454C
14" x 60" x 63"	72	WR63-1460	14" x 60" x 63"	65	AD63-1460C
14" x 72" x 63"	84	WR63-1472	14" x 72" x 63"	77	AD63-1472C
18" x 24" x 63"	44	WR63-1824	18" x 24" x 63"	37	AD63-1824C
18" x 30" x 63"	48	WR63-1830	18" x 30" x 63"	41	AD63-1830C
18" x 36" x 63"	54	WR63-1836	18" x 36" x 63"	49	AD63-1836C
18" x 42" x 63"	58	WR63-1842	18" x 42" x 63"	53	AD63-1842C
18" x 48" x 63"	62	WR63-1848	18" x 48" x 63"	57	AD63-1848C
18" x 54" x 63"	74	WR63-1854	18" x 54" x 63"	69	AD63-1854C
18" x 60" x 63"	82	WR63-1860	18" x 60" x 63"	77	AD63-1860C
18" x 72" x 63"	94	WR63-1872	18" x 72" x 63"	89	AD63-1872C
21" x 24" x 63"	46	WR63-2124	21" x 24" x 63"	41	AD63-2124C
21" x 30" x 63"	50	WR63-2130	21" x 30" x 63"	45	AD63-2130C
21" x 36" x 63"	58	WR63-2136	21" x 36" x 63"	53	AD63-2136C
21" x 42" x 63"	62	WR63-2142	21" x 42" x 63"	57	AD63-2142C
21" x 48" x 63"	70	WR63-2148	21" x 48" x 63"	65	AD63-2148C
21" x 54" x 63"	78	WR63-2154	21" x 54" x 63"	73	AD63-2154C
21" x 60" x 63"	86	WR63-2160	21" x 60" x 63"	81	AD63-2160C
21" x 72" x 63"	110	WR63-2172	21" x 72" x 63"	105	AD63-2172C
24" x 24" x 63"	50	WR63-2424	24" x 24" x 63"	45	AD63-2424C
24" x 30" x 63"	58	WR63-2430	24" x 30" x 63"	53	AD63-2430C
24" x 36" x 63"	66	WR63-2436	24" x 36" x 63"	61	AD63-2436C
24" x 42" x 63"	74	WR63-2442	24" x 42" x 63"	69	AD63-2442C
24" x 48" x 63"	78	WR63-2448	24" x 48" x 63"	73	AD63-2448C
24" x 54" x 63"	86	WR63-2454	24" x 54" x 63"	81	AD63-2454C
24" x 60" x 63"	98	WR63-2460	24" x 60" x 63"	93	AD63-2460C
24" x 72" x 63"	118	WR63-2472	24" x 72" x 63"	113	AD63-2472C
30" x 36" x 63"	74	WR63-3036	30" x 36" x 63"	69	AD63-3036C
30" x 42" x 63"	86	WR63-3042	30" x 42" x 63"	81	AD63-3042C
30" x 48" x 63"	98	WR63-3048	30" x 48" x 63"	93	AD63-3048C
30" x 60" x 63"	122	WR63-3060	30" x 60" x 63"	117	AD63-3060C
30" x 72" x 63"	138	WR63-3072	30" x 72" x 63"	133	AD63-3072C
36" x 36" x 63"	86	WR63-3636	36" x 36" x 63"	81	AD63-3636C
36" x 48" x 63"	106	WR63-3648	36" x 48" x 63"	101	AD63-3648C
36" x 60" x 63"	130	WR63-3660	36" x 60" x 63"	125	AD63-3660C
36" x 72" x 63"	138	WR63-3672	36" x 72" x 63"	133	AD63-3672C

74" H STARTER KIT UNITS			74" H ADD-ON KIT UNITS		
DIMENSIONS	SHIP WGT	MODEL NO.	DIMENSIONS	SHIP WGT	MODEL NO.
12" x 36" x 74"	44	WR74-1236	12" x 36" x 74"	38	AD74-1236
12" x 42" x 74"	48	WR74-1242	12" x 42" x 74"	42	AD74-1242
12" x 48" x 74"	52	WR74-1248	12" x 48" x 74"	46	AD74-1248
12" x 60" x 74"	60	WR74-1260	12" x 60" x 74"	54	AD74-1260
12" x 72" x 74"	68	WR74-1272	12" x 72" x 74"	62	AD74-1272
14" x 24" x 74"	40	WR74-1424	14" x 24" x 74"	34	AD74-1424
14" x 30" x 74"	44	WR74-1430	14" x 30" x 74"	38	AD74-1430
14" x 36" x 74"	48	WR74-1436	14" x 36" x 74"	42	AD74-1436
14" x 42" x 74"	56	WR74-1442	14" x 42" x 74"	50	AD74-1442
14" x 48" x 74"	60	WR74-1448	14" x 48" x 74"	54	AD74-1448
14" x 54" x 74"	64	WR74-1454	14" x 54" x 74"	58	AD74-1454
14" x 60" x 74"	72	WR74-1460	14" x 60" x 74"	66	AD74-1460
14" x 72" x 74"	84	WR74-1472	14" x 72" x 74"	78	AD74-1472
18" x 24" x 74"	44	WR74-1824	18" x 24" x 74"	38	AD74-1824
18" x 30" x 74"	48	WR74-1830	18" x 30" x 74"	42	AD74-1830
18" x 36" x 74"	56	WR74-1836	18" x 36" x 74"	50	AD74-1836
18" x 42" x 74"	60	WR74-1842	18" x 42" x 74"	54	AD74-1842
18" x 48" x 74"	64	WR74-1848	18" x 48" x 74"	58	AD74-1848
18" x 54" x 74"	76	WR74-1854	18" x 54" x 74"	70	AD74-1854
18" x 60" x 74"	84	WR74-1860	18" x 60" x 74"	78	AD74-1860
18" x 72" x 74"	96	WR74-1872	18" x 72" x 74"	90	AD74-1872
21" x 24" x 74"	48	WR74-2124	21" x 24" x 74"	42	AD74-2124
21" x 30" x 74"	52	WR74-2130	21" x 30" x 74"	46	AD74-2130
21" x 36" x 74"	60	WR74-2136	21" x 36" x 74"	54	AD74-2136
21" x 42" x 74"	64	WR74-2142	21" x 42" x 74"	58	AD74-2142
21" x 48" x 74"	72	WR74-2148	21" x 48" x 74"	66	AD74-2148
21" x 54" x 74"	80	WR74-2154	21" x 54" x 74"	74	AD74-2154
21" x 60" x 74"	88	WR74-2160	21" x 60" x 74"	82	AD74-2160
21" x 72" x 74"	112	WR74-2172	21" x 72" x 74"	106	AD74-2172
24" x 24" x 74"	52	WR74-2424	24" x 24" x 74"	46	AD74-2424
24" x 30" x 74"	60	WR74-2430	24" x 30" x 74"	54	AD74-2430
24" x 36" x 74"	68	WR74-2436	24" x 36" x 74"	62	AD74-2436
24" x 42" x 74"	76	WR74-2442	24" x 42" x 74"	70	AD74-2442
24" x 48" x 74"	80	WR74-2448	24" x 48" x 74"	74	AD74-2448
24" x 54" x 74"	88	WR74-2454	24" x 54" x 74"	82	AD74-2454
24" x 60" x 74"	100	WR74-2460	24" x 60" x 74"	94	AD74-2460
24" x 72" x 74"	120	WR74-2472	24" x 72" x 74"	114	AD74-2472
30" x 36" x 74"	76	WR74-3036	30" x 36" x 74"	70	AD74-3036
30" x 42" x 74"	88	WR74-3042	30" x 42" x 74"	82	AD74-3042
30" x 48" x 74"	100	WR74-3048	30" x 48" x 74"	94	AD74-3048
30" x 60" x 74"	124	WR74-3060	30" x 60" x 74"	118	AD74-3060
30" x 72" x 74"	140	WR74-3072	30" x 72" x 74"	134	AD74-3072
36" x 36" x 74"	88	WR74-3636	36" x 36" x 74"	82	AD74-3636
36" x 48" x 74"	108	WR74-3648	36" x 48" x 74"	102	AD74-3648
36" x 60" x 74"	132	WR74-3660	36" x 60" x 74"	126	AD74-3660
36" x 72" x 74"	140	WR74-3672	36" x 72" x 74"	134	AD74-3672

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E-MAIL: *SALES@QUANTUMFOODSERVICE.COM* WWW.**QUANTUMFOODSERVICE**.COM

ADD YOUR CASTER KIT TO YOUR UNIT FOR MOBILITY

1,200-3,200 lb.
MOBILE LOAD CAPACITY

Donut Bumper

Non-marking, 3" diameter plastic bumper used to protect walls and help cushion impact.

MODEL NO.	DESCRIPTION	SHIP WGT
DB	One 3" Diameter Donut Bumper	1 lb

Casters

MODEL NO.	DESCRIPTION	LOAD CAPACITY PER CASTER	SHIP WGT
	Stem Casters		
WR-00H	Four Swivel 5" x 1-1/4" Thermoplastic Resin Casters, 2 with brake	300 lbs	10 lbs
WR-00HS	Four Swivel 5" x 1-1/4" Thermoplastic Resin Stainless Steel Casters with Zerk Grease Fittings, 2 with brake	300 lbs	12 lbs
WR-00CO	Four Swivel ESD/Conductive 5" x 1-1/4" Casters, 2 with brake	300 lbs	12 lbs
WR-SB2R2*	Two Swivel 5" x 1-1/4" Thermoplastic Resin Caster with brake, 2 Rigid	300 lbs	12 lbs
WR-3	Four Swivel 3" Polyurethane Casters, all with brake	200 lbs	8 lbs
WR-RG*	One Rigid 5" x 1-1/4" Thermoplastic Resin Caster	300 lbs	3 lbs
WR-PS	One Swivel 8" x 2-1/2" Pneumatic Caster	325 lbs	4 lbs
	Plate Casters		
PT-PS	One Swivel 5" x 1-1/4" Thermoplastic Resin Caster	300 lbs	3 lbs
PT-PR	One Rigid 5" x 1-1/4" Thermoplastic Resin Caster	300 lbs	3 lbs
PT-PSB	One Swivel 5" x 1-1/4" Thermoplastic Resin Caster with brake	300 lbs	3 lbs
PT-PS-S	One Swivel 5" x 1-1/4" Polyurethane Stainless Steel Caster with Zerk Grease Fittings	300 lbs	3 lbs
PT-PR-S	One Rigid 5" x 1-1/4" Polyurethane Stainless Steel Caster with Zerk Grease Fittings	300 lbs	3 lbs
PT-PSB-S	One Swivel 5" x 1-1/4" Polyurethane Stainless Steel Caster with brake with Zerk Grease Fittings	300 lbs	3 lbs
PT-PS6	One Swivel 6" x 2" Polyurethane Caster	800 lbs	5 lbs
PT-PR6	One Rigid 6" x 2" Polyurethane Caster	800 lbs	5 lbs
PT-PSB6	One Swivel 6" x 2" Polyurethane Caster with brake	800 lbs	5 lbs
PT-NS	One Swivel 8" x 2-1/2" Pneumatic Caster	325 lbs	4 lbs
PT-NR	One Rigid 8" x 2-1/2" Pneumatic Caster	325 lbs	4 lbs

*Requires Tie Bars for rigid alignment *(See pg. 147)*

WR-00H
Shown with and without brake
Sold as a set of 4 casters, 2 with brake

WR-00CO
Shown with and without brake
Sold as a set of 4 casters, 2 with brake

WR-00HS
Shown with and without brake
Sold as a set of 4 casters, 2 with brake

PT-PR

PT-PS

PT-PSB

PT-PR6

PT-PS6

PT-PSB6

WR-3
Sold as a set of
4 casters, all with brake

WR-PS

PT-NR

PT-NS

WR-RG
Requires Tie Bar
(See chart pg. 147)

ADD YOUR CASTER KIT TO YOUR UNIT FOR MOBILITY

1,200-3,200 lb.
MOBILE LOAD CAPACITY

Donut Bumper

Non-marking, 3" diameter plastic bumper used to protect walls and help cushion impact.

MODEL NO.	DESCRIPTION	SHIP WGT
DB	One 3" Diameter Donut Bumper	1 lb

Casters

MODEL NO.	DESCRIPTION	LOAD CAPACITY PER CASTER	SHIP WGT
	Stem Casters		
WR-00H	Four Swivel 5" x 1-1/4" Thermoplastic Resin Casters, 2 with brake	300 lbs	10 lbs
WR-00HS	Four Swivel 5" x 1-1/4" Thermoplastic Resin Stainless Steel Casters with Zerk Grease Fittings, 2 with brake	300 lbs	12 lbs
WR-00CO	Four Swivel ESD/Conductive 5" x 1-1/4" Casters, 2 with brake	300 lbs	12 lbs
WR-SB2R2*	Two Swivel 5" x 1-1/4" Thermoplastic Resin Caster with brake, 2 Rigid	300 lbs	12 lbs
WR-3	Four Swivel 3" Polyurethane Casters, all with brake	200 lbs	8 lbs
WR-RG*	One Rigid 5" x 1-1/4" Thermoplastic Resin Caster	300 lbs	3 lbs
WR-PS	One Swivel 8" x 2-1/2" Pneumatic Caster	325 lbs	4 lbs
	Plate Casters		
PT-PS	One Swivel 5" x 1-1/4" Thermoplastic Resin Caster	300 lbs	3 lbs
PT-PR	One Rigid 5" x 1-1/4" Thermoplastic Resin Caster	300 lbs	3 lbs
PT-PSB	One Swivel 5" x 1-1/4" Thermoplastic Resin Caster with brake	300 lbs	3 lbs
PT-PS-S	One Swivel 5" x 1-1/4" Polyurethane Stainless Steel Caster with Zerk Grease Fittings	300 lbs	3 lbs
PT-PR-S	One Rigid 5" x 1-1/4" Polyurethane Stainless Steel Caster with Zerk Grease Fittings	300 lbs	3 lbs
PT-PSB-S	One Swivel 5" x 1-1/4" Polyurethane Stainless Steel Caster with brake with Zerk Grease Fittings	300 lbs	3 lbs
PT-PS6	One Swivel 6" x 2" Polyurethane Caster	800 lbs	5 lbs
PT-PR6	One Rigid 6" x 2" Polyurethane Caster	800 lbs	5 lbs
PT-PSB6	One Swivel 6" x 2" Polyurethane Caster with brake	800 lbs	5 lbs
PT-NS	One Swivel 8" x 2-1/2" Pneumatic Caster	325 lbs	4 lbs
PT-NR	One Rigid 8" x 2-1/2" Pneumatic Caster	325 lbs	4 lbs

*Requires Tie Bars for rigid alignment *(See pg. 147)*

WR-00H
Shown with and without brake
Sold as a set of 4 casters, 2 with brake

WR-00CO
Shown with and without brake
Sold as a set of 4 casters, 2 with brake

WR-00HS
Shown with and without brake
Sold as a set of 4 casters, 2 with brake

PT-PR

PT-PS

PT-PSB

PT-PR6

PT-PS6

PT-PSB6

WR-3
Sold as a set of
4 casters, all with brake

WR-PS

PT-NR

PT-NS

WR-RG
Requires Tie Bar
(See chart pg. 147)

John BOOS Since 1887

ITEM #: _____ QTY: _____

MODEL #: _____

PROJECT NAME: _____

082120

3601 S. Banker St. Effingham, IL 62401 • P.O. BOX 609 • Ph: (888) 431-2667 • Fax: (800) 433-2667

"PBJC-48" DELUXE JANITOR CABINET WITH MOP SINK

FEATURES:

- TYPE 300 STAINLESS STEEL WITH #4 POLISH SATIN FINISH
- ALL EXPOSED HARDWARE IS TAMPER PROOF
- (2) SWING LOCKABLE LOUVERED DOORS
- AVAILABLE IN LEFT SIDE OR RIGHT SIDE CONFIGURATION
- INCLUDES (1) HEAVY DUTY SERVICE FAUCET (PBF-SS-6)
- INCLUDES (1) 10" SERVICE FAUCET HOSE (PB-HOSE-120)
- MOP SINK COMPARTMENT SIDE INCLUDES
  - (1) OVERSIZED MOP SINK 20" X 16" X 12"
  - (1) OVERHEAD STORAGE SHELF
  - (2) SHELF MOUNTED MOP HOLDERS WITH LOCKING CAMS
  - PANEL LESS BACK
  - STORAGE COMPARTMENT SIDE INCLUDES
  - (3) STORAGE SHELVES
  - BOTTOM STORAGE AREA

CONSTRUCTION:

- CABINET: STAINLESS STEEL CABINETS TIG WELDED, EXPOSED EDGES ARE POLISHED TO MATCH ADJACENT SURFACE

MATERIAL:

- CABINET: 18GA TYPE 300 STAINLESS STEEL WITH #4 POLISH, SATIN FINISH
- 18 GAUGE TYPE 300 CABINET
- 16 GAUGE TYPE 300 SINK BOWL AND DECK

PBJC-224884-L

DELUXE JANITOR CABINET WITH MOP SINK

MODEL	QTY
PBJC-224884-L	
PBJC-224884-R	

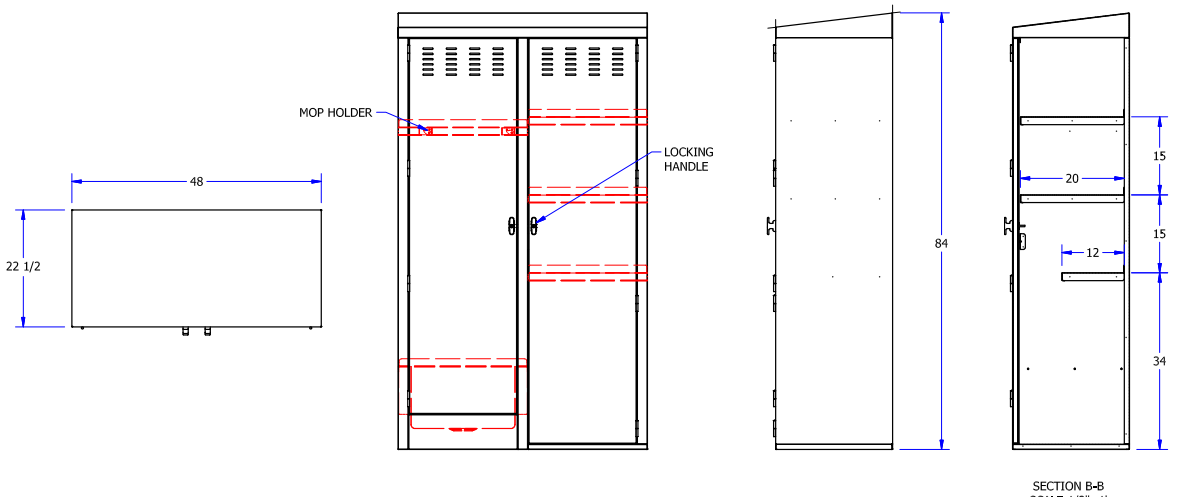
PBF-SS-6

PB-HOSE-120

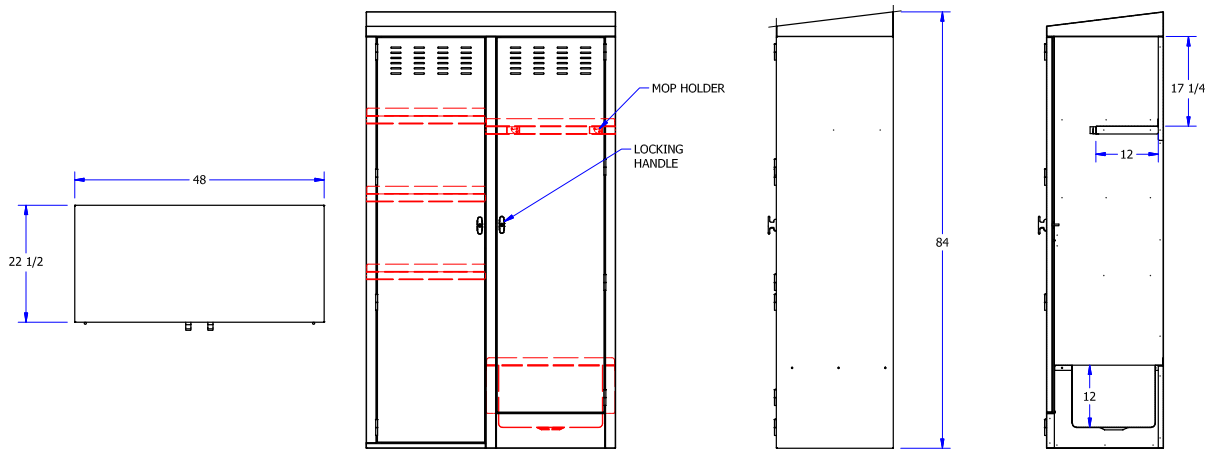
608

DETAILED SPECIFICATIONS

PBJC-224884-L



PBJC-224884-R



DELUXE JANITOR CABINET WITH MOP SINK

MODEL	OVERALL SIZE (LxWxH)	MOP SINK SIZE (LxWxD)	MOP SINK LOCATION	WEIGHT (LBS)
PBJC-224884-L	48" X 22-1/2" X 84"	20" X 16" X 12"	LEFT	292
PBJC-224884-R	48" X 22-1/2" X 84"	20" X 16" X 12"	RIGHT	292

SOME UNITS SHIP UNASSEMBLED FOR REDUCED SHIPPING COST. ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500"

John Boos & Co. is constantly engaged in a program of improving products and therefore reserves the right to change specifications without prior notice.

CHANNEL MANUFACTURING, INC.

Item No. _____

Quantity_____

Job Name_____

Spec No. _____

UTILITY CARTS

UTILITY/BUSSING CARTS

STAINLESS CONSTRUCTION

US1827-3

Model	Shelves	H	W	D	Weight
US1524-3	3	34"	27-1/4"	16"	39
US1827-3	3	34"	30-3/4"	18"	42
US2135-3	3	37-1/4"	39-1/2"	22"	68

SPECIFICATIONS:

- Designed as a mobile multi-purpose all-welded 18 gauge, 304 Series stainless steel cart.
- 500 lb. distributed weight capacity.
- Standard 5" full swivel non-marking casters. Casters are securely bolted to frame to facilitate replacements
- Fully assembled and ready for use. Includes corner bumpers.

MADE IN THE USA NSF

Notes

55 Channel Drive • Port Washington, NY11050-2216
8891 NW 102nd Street • Medley, FL 33178
Tel: 516-944-6271 • Fax: 516-944-0625
Toll Free: 866-712-7283
www.channelmfg.com • Email: sales@channelmfg.com

CHANNEL MANUFACTURING, INC.

Item No. _____

Quantity _____

Job Name _____

Spec No. _____

UTR-12

BUN PAN RACKS

BUN PAN / STEAMTABLE PAN RACKS

ALUMINUM CONSTRUCTION

Custom Sizes Available

Model	Spacing/Capacity	H	W	D	Weight
UTR-20	3"/20 Pans	70"	20½"	26"	54
UTR-15	4"/15 Pans	70"	20½"	26"	50
UTR-12	5"/12 Pans	70"	20½"	26"	44
UTR-10	6"/10 Pans	70"	20½"	26"	41
UTR-18	3"/18 Pans	64"	20½"	26"	50
UTR-11	5"/11 Pans	64"	20½"	26"	37
UTR-9	3"/9 Pans	36"	20½"	26"	29
UTR-5	5"/5 Pans	36"	20½"	26"	26

Options:

- ❑ /011 Caster Brakes (2)
- ❑ /052 5x2 Caster upgrade
- ❑ /5B HD Caster Brakes (2)
- ❑ /CC Card Clip Aluminum
- ❑ /022 Corner Bumpers (2)
- ❑ /024 Corner Bumpers (4)
- ❑ /PB Perimeter Bumper
- ❑ /VB Vertical Bumpers
- ❑ /009 Pan Stop Aluminum
- ❑ /BA Solid Bottom Aluminum
- ❑ /A Solid Top Aluminum
- ❑ /008 X Bracing

APPLICATIONS: Mobile multi-purpose racks for holding, storing and transporting of 18" X 26" bun pans and 12" X 20" steamtable pans.

CONSTRUCTION: Heavy duty, high tensile extruded aluminum. Type 6063-T5 alloy. Lifetime guarantee against rust.

TRAY SLIDES: 3-1/4" wide pan slides to accommodate 18" X 26" tray and 12" X 20" steamtable pans.

FRAME AND CROSS SUPPORTS: Vertical and horizontal frame sections are extruded 1" square tubular aluminum.

CASTERS: Standard 5" full swivel non-marking casters. Casters are securely bolted to frame to facilitate replacements.

MADE IN THE USA NSF

Notes

55 Channel Drive • Port Washington, NY11050-2216
8891 NW 102nd Street • Medley, FL 33178
Tel: 516-944-6271 • Fax: 516-944-0625
Toll Free: 866-712-7283
www.channelmfg.com • Email: sales@channelmfg.com

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U.S.A. FOODSERVICE DIVISION
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Parts Dept. (800)424-TRUE • Parts Dept. Fax# (636)272-9471 • www.truemfg.com

Project Name: _____
Location: _____
Item #: _____ Qty: _____
Model #: _____

AIA #
SIS #

Model:
TH-23G~FGD01

TH Series:
Reach-In Glass Swing Door Heated Cabinet~Framed Glass Door Version 01

TH-23G~FGD01

- Provides cabinet holding temperature of 80°F to 180°F (26.6°C to 82.2°C).
- Internal fan provides low velocity, forced-air heat distribution to assure even temperatures throughout the cabinet.
- Stainless steel, tube heating element for uniform generation of electric heat. Cabinet comes with a total of 850 watts. Heating element sheathed for corrosion resistance.
- Exterior - stainless steel front and door. Anodized quality aluminum ends. Corrosion resistant GalFan coated steel back.
- Interior - Stainless steel interior liner and floor.
- Energy efficient, triple pane, thermal insulated glass door.
- Cabinet comes standard with three (3), adjustable, heavy duty chrome plated wire shelves.
- entire cabinet structure is foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest ⅛" (millimeters rounded up to next whole number).

Model	Doors	Cabinet Dimensions (inches) (mm) L	D†	H*	Watts	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
TH-23G~FGD01	1	27 686	29¾ 756	78⅜ 1991	850	115/60/1	7.8 N/A	5-15P	9 2.74	290 132

* Height does not include 5" (127 mm) for castors or 6" (153 mm) for optional legs.
* Height does not include 1" (26 mm) for ventilator cap.
† Depth does not include 1⅜" (35 mm) for door handle.

MADE WITH INNOVATION IN THE USA

6/18-A Printed in U.S.A.

APPROVALS:

AVAILABLE AT:

Model:
TH-23G~FGD01

TH Series:
Reach-In Glass Swing Door Heated Cabinet
~Framed Glass Door Version 01

STANDARD FEATURES

DESIGN
- True's solid door reach-in heated cabinets are designed with enduring quality that protects your long term investment.

HEATER SYSTEM
- Cabinet is designed to provide holding temperatures of 80°F to 180°F (26.6°C to 82.2°C). Heating system controlled by exterior on/off switch and temperature control dial.
- Stainless steel, tube heating element for uniform generation of electric heat. Cabinet comes with a total of 850 watts. Heating element sheathed for corrosion resistance.
- Low-velocity fans to assure even temperature distribution throughout the cabinet.
- Manually controlled vent located on top of the cabinet for positive humidity control.
- Exterior dial thermometer; accurate, direct reading of internal cabinet temperature.

CABINET CONSTRUCTION
- Exterior - Stainless steel front. Anodized quality aluminum ends. Corrosion resistant GalFan coated steel back.
- Interior- Stainless steel interior liner and floor.
- Insulation - entire cabinet structure is foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- Welded, heavy duty steel frame rail, black powder coated for corrosion protection.
- Frame rail fitted with 4" diameter stem castors - locks provided on front set.

DOOR
- Energy efficient, triple pane, thermal insulated glass door assembly with extruded aluminum frame.
- Door fitted with 12" (305 mm) extruded aluminum handle.
- Positive seal self-closing door. Lifetime guaranteed door hinges and torsion type closure system.
- Magnetic door gasket of one piece construction, removable without tools for ease of cleaning.

SHELVING
- Three (3) adjustable, heavy duty chrome plated wire shelves 21 7/16"L x 23 1/4"D (545 mm x 591 mm). Four (4) chrome plated shelf clips included per shelf.
- Anodized aluminum shelf support pilasters. Shelves are adjustable on ½" (13 mm) increments.

LIGHTING
- Incandescent Interior lighting; safety shielded.

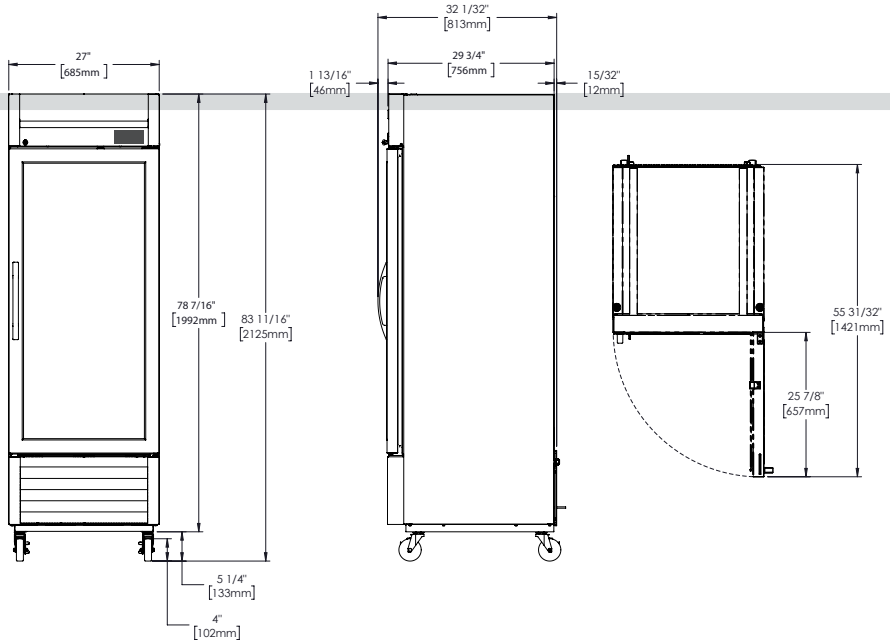
MODEL FEATURES
- 12"L x 20"W x 1"D (305 mm x 508 mm x 26 mm) humidity pan standard for contents requiring high humidity.
- True heated cabinets are designed to hold warm baked or cooked food. Cabinets are not designed to heat ambient or cold products.
- NSF/ANSI Standard 4 compliant for open food product.

ELECTRICAL
- True requires that a sole use circuit be dedicated for the unit.
- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

115/60/1
NEMA-5-15R

OPTIONAL FEATURES/ACCESSORIES
Upcharge and lead times may apply.
- ❑ 6" (153 mm) standard legs.
- ❑ 6" (153 mm) seismic/flanged legs.
- ❑ 2½" (64mm) castors.
- ❑ Alternate door hinging (factory installed).
- ❑ Additional shelves.

PLAN VIEW



WARRANTY
Three year warranty on all parts and labor. (U.S.A. only)

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Model	Elevation	Right	Plan	3D	Back
TH-23G~FGD01					

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Project Name: _____
Location: _____
Item #: _____ Qty: _____
Model #: _____

AIA #
SIS #

Model:
T-35G-HC~FGD01

T-Series:
Reach-In Glass Swing Door Refrigerator with Hydrocarbon Refrigerant~Framed Glass Door Version 01

T-35G-HC~FGD01

- True's glass door reach-in's are designed with enduring quality that protects your long term investment.
- Designed using the highest quality materials and components to provide the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- Stainless steel front. The finest stainless available with higher tensile strength for fewer dents and scratches.
- Energy efficient, "Low-E", double pane thermal glass doors.
- LED interior lighting provides more even lighting throughout the cabinet. Safety shielded.
- Adjustable, heavy duty PVC coated shelves.
- Positive seal self-closing doors. Lifetime guaranteed door hinges and torsion type closure system.

Bottom mounted units feature:

- "No stoop" lower shelf.
- Storage on top of cabinet.
- Compressor performs in coolest, most grease free area of kitchen.
- Easily accessible condenser coil for cleaning.

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest ⅛" (millimeters rounded up to next whole number).

Model	Doors	Shelves	Cabinet Dimensions (inches) (mm) W	D†	H*	HP	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
T-35G-HC~FGD01	2	6	39⅝ 1007	29⅞ 759	78⅜ 1991	⅓ N/A	115/60/1	5.6 N/A	5-15P	9 2.74	415 189

† Depth does not include 1⅜" (35 mm) for door handle. Depth does not include ½" (13mm) for rear mechanical components.
* Height does not include 5" (127 mm) for castors or 6" (153 mm) for optional legs.

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5/20 Printed in U.S.A.

APPROVALS:

AVAILABLE AT:

Model:
T-35G-HC~FGD01

T-Series:
Reach-In Glass Swing Door Refrigerator with Hydrocarbon Refrigerant~Framed Glass Door Version 01

STANDARD FEATURES

DESIGN
- True's commitment to using the highest quality materials and oversized refrigeration systems provides the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.

REFRIGERATION SYSTEM
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- State of the art, electronically commutated evaporator and condenser fan motors. ECM motors operate at higher peak efficiencies and move a more consistent volume of air which produces less heat, reduces energy consumption and provides greater motor reliability.
- Bottom mounted condensing unit positioned for easy maintenance. Compressor runs in coolest and most grease free area of the kitchen. Allows for storage area on top of unit.

CABINET CONSTRUCTION
- Exterior - Stainless steel front. Anodized quality aluminum ends. Corrosion resistant GalFan coated steel back.
- Interior - attractive, NSF approved, clear aluminum liner. Stainless steel floor with coved corners.
- Insulation - entire cabinet structure is foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- Welded, heavy duty steel frame rail, black powder coated for corrosion protection.
- Frame rail fitted with 4" (102 mm) diameter stem castors - locks provided on front set.

DOORS
- "Low-E", double pane thermal glass assemblies with extruded aluminum frames. Door lock standard.
- Each door fitted with 15" (381 mm) long extruded aluminum handle.
- Positive seal self-closing doors. Lifetime guaranteed door hinges and torsion type closure system.
- Magnetic door gaskets of one piece construction, removable without tools for ease of cleaning.

SHELVING
- Six (6) adjustable, heavy duty PVC coated wire shelves 17½"L x 22⅜"D (445 mm x 569 mm). Four (4) chrome plated shelf clips included per shelf.
- Shelf support pilasters made of same material as cabinet interior; shelves are adjustable on ½" (13 mm) increments.

LIGHTING
- LED interior lighting provides more even lighting throughout the cabinet. Safety shielded.

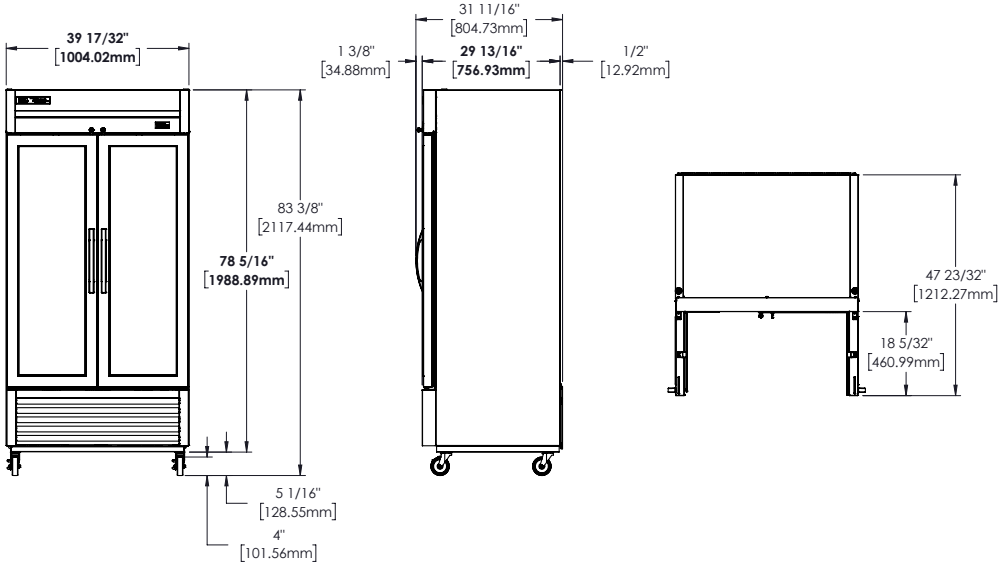
MODEL FEATURES
- Exterior temperature display.
- Evaporator is epoxy coated to eliminate the potential of corrosion.
- NSF/ANSI Standard 7 compliant for open food product.

ELECTRICAL
- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

115/60/1
NEMA-5-15R

OPTIONAL FEATURES/ACCESSORIES
Upcharge and lead times may apply.
- ❑ 6" (153 mm) standard legs.
- ❑ 6" (153 mm) seismic/flanged legs.
- ❑ Alternate Door Hinging (Factory Installed).
- ❑ Additional shelves.

PLAN VIEW



3 YEAR PARTS + LABOR 7 YEAR COMPRESSOR
WARRANTY
(U.S.A. only)

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Model	Elevation	Right	Plan	3D	Back
T-35G-HC~FGD01					

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Project Name	*Location*	
Item #	*Qty*	*AIA #*
Model #		*SIS #*

Models TGM-DZ-59-SC/SC-B-W TGM-DZ-59-SC/SC-W-W TGM-DZ-59-SC/SC-S-W TGM-DZ-59-SC/SC-S-S

True Glass Merchandiser — Curved Glass, Solid Colored End Dual Zone

TGMDZ-59-SC/SC-B-W

FEATURES

- True's dual zone glass merchandisers combine efficient, high volume merchandising and exceptional refrigeration with an elegant curved glass front for sophisticated presentation of high end desserts and pastries.
- Refrigerated section features factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- Refrigerated section features high capacity, factory balanced refrigeration system. Standard temperature range maintains cabinet temperatures of 33°F to 41°F (.5°C to 5°C), ideally suited for refrigerated bakery and cold deli products.
- Two (2) rear sliding glass doors for back access.
- Exterior - powder coated FDA black rounded front and back, solid wood sides with aluminum cover and front panels. Color options available (upcharge may apply) - white or stainless.
- Interior - powder coated FDA white over CRS material. Color options available (upcharge may apply) - black or stainless.
- Three (3) tiered levels of adjustable wire cantilever shelves that match cabinet interior color. Chrome plated wire shelves standard on stainless units.
- Curved glass front is single pane tempered glass with extra large viewing area to maximize product presentation.
- LED interior lighting provides more even lighting throughout the cabinet. Safety shielded.

STANDARD OPTIONS

Exterior Color	Black, White, or Stainless Steel
Interior Color	Black, White, or Stainless Steel
Solid Mirrored End (SM)	Solid Exterior Sides & Mirrored interior sides
Shelving	White, Black, Chrome, or Mezzanine

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest ⅛" (millimeters rounded up to next whole number).

Model	Rear Doors	Shelves	Cabinet Dimensions (inches) (mm) W	D	H	HP	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight White/Black Model (lbs.) (kg)	Crated Weight Stainless Model (lbs.) (kg)
TGM-DZ-59-SC/SC-Δ-Δ	2	6	59¼ 1505	39 990	49⅛ 1247	¼	115/60/1	10.0	5-15P	9 2.74	770 350	TBD TBD

Δ Represents Exterior/Interior (B-black, W-White, S-Stainless)

MADE WITH INNOVATION IN THE USA · 5 YEAR COMPRESSOR WARRANTY USA · c UL us · natural refrigerant.

10/18 Printed in U.S.A.

APPROVALS:

AVAILABLE AT:

Models:	
TGM-DZ-59-SC/SC-B-W	TGM-DZ-59-SC/SC-W-W
TGM-DZ-59-SC/SC-S-W	TGM-DZ-59-SC/SC-S-S

True Glass Merchandiser:
Curved Glass, Solid Colored End Dual Zone

STANDARD FEATURES

DESIGN
- True's combination "refrigerated" and "dry" display case glass merchandiser combines efficient, high volume merchandising and exceptional refrigeration with an elegant curved glass front for sophisticated presentation of high end end deli, desserts and pastries.
- Please note: If units are banked together, because of side panel, a 1/2" (13mm) gap will remain between units.

REFRIGERATION SYSTEM
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydrocarbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- Exclusive reversing condenser fan motors. Fan motors reverse during defrost off cycles to help keep condenser coil free from dirt, dust and debris. Keeping coils clean optimizes the unit's performance providing colder holding temperatures and increased energy efficiency. Regularly scheduled thorough cleaning of coils still recommended.
- High capacity, factory balanced refrigeration system that has two (2) temperature range options. Standard temperature range maintains cabinet temperatures of 33°F to 41°F (.5°C to 5°C), ideally suited for refrigerated bakery and cold deli products. Optional temperature range maintains cabinet temperatures of 42°F to 65°F (5.5°C to 18.3°C), ideally suited for chocolate & wine options.
- Pull Out Condensing unit slides out for easy cleaning and maintenance.

CABINET CONSTRUCTION
- Exterior - powder coated FDA black rounded front and back, solid wood sides with aluminum cover and front panels. Color options available (upcharge may apply) - white or stainless.
- Curved glass front and side glass panels.
- Interior - powder coated FDA white over CRS material. Color options available (upcharge may apply) - black or stainless.
- Insulation - entire cabinet structure is foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- Welded, heavy duty steel frame rail, black powder coated for corrosion protection.
- Frame rail fitted with leg levelers.

CURVED FRONT DISPLAY GLASS
- Curved glass front is single pane tempered glass with extra large viewing area to maximize product presentation.

REAR DOORS
- Two (2) rear sliding glass doors for back access.
- Each door fitted with 12" (305 mm) long aluminum handle.
- Sliding doors ride on stainless steel V-channel with stainless steel bearings. Doors fit within plastic channel frame.

SHELVING
- Six (6) adjustable heavy duty PVC coated wire shelves standard.
- Each shelf supports a maximum weight of 150 lbs. (69 kg).

PAN CAPACITY
- Cabinet holds six (6) 18"L x 26"D (458 mm x 661 mm) display pans and eight (8) 12"L x 18"D (305 mm x 458 mm) display pans. Pans supplied by others.

LIGHTING
- LED interior lighting, two (2) clips underneath shelf to keep wires in place. Safety shielded.

MODEL FEATURES
- Evaporator is epoxy coated to eliminate the potential of corrosion.
- Pull out condensing unit slides out for easy cleaning and maintenance.
- Electronic temperature control.
- NSF/ANSI Standard 7 compliant for open food product. Tested and certified for performance at NSF Type II: 80°F (27°C) and 55% relative humidity.

ELECTRICAL
- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

115/60/1
NEMA-5-15R

STANDARD OPTIONS

Upcharge and lead times may apply.
- ❑ Black exterior
- ❑ White exterior
- ❑ Stainless steel exterior
- ❑ White interior
- ❑ Black interior
- ❑ Stainless steel interior
- ❑ Solid Colored Exterior Sides with color matching interior (SC)
- ❑ Solid Colored Exterior Sides with Mirrored interior ends (SM)
- ❑ White wire shelves
- ❑ Black wire shelves
- ❑ Chrome plated wire shelves
- ❑ Stainless steel mezzanine shelves

OPTIONAL FEATURES/ACCESSORIES

Upcharge and lead times may apply.
- ❑ Custom exterior colors (contact factory for details)
- ❑ Chocolate/Wine model available
- ❑ Glass shelves
- ❑ Frosted glass shelves
- ❑ Ratchet lock
- ❑ Electrical Receptacle
- ❑ Exterior top scale shelf
- ❑ Exterior small top service shelf
- ❑ Exterior medium top service shelf
- ❑ Exterior large top service shelf
- ❑ External front shelf kit (only available in black)
- ❑ External rear service shelf shelf kit (only available in black)
- ❑ 4" (102mm) Castors
- ❑ 2 1/2" (64mm) castors
- ❑ 6" (153mm) legs

TGM MODEL NUMBER NOMENCLATURE SYSTEM

True Glass Merchandiser → TGM - R - 59 - SC / SC - B - W

Size: (36, 48, 59, 77)

END TYPE: Left Position / Right Position

COLOR: Exterior / Interior

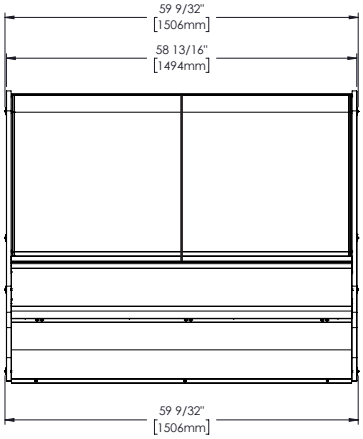
Type:
R - Refrigerator
DZ - Dual Zone
DC - Dry Case
CW - Chocolate/Wine

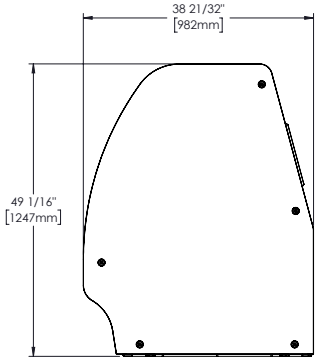
Side Type:
SC - Solid Colored End
SM - Solid Mirrored End

Color:
B - Black
W - White
S - Stainless Steel

Note: Dual Zone models Not Available in 36 size models.

PLAN VIEW





WARRANTY
Three year warranty on all parts and labor and an additional 2 year warranty on compressor. (U.S.A. only)

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

KCL	Elevation	Right	Plan	3D	Back

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EVERSYS

Enigma

Datasheet & Installation

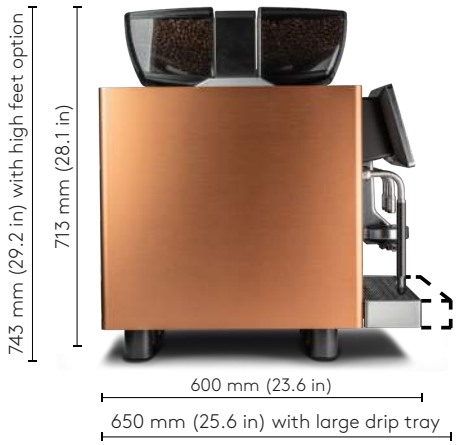
1. Machine configuration and overall dimensions

E'4m x-wide/Classic

Technical data	
Brew chamber	2 x 24 g
Grinder	2 x Ceramic burrs - 64 mm
User Interface	2 x Touch screen 256 mm (10.1")
Bean hopper	2 x 1.5 kg
Coffee outlet height*	190 mm max.
Hot water outlet height*	160 mm max. or 215 mm max. (option)
Interface	2 x USB, 1 x Ethernet, 1 x CCI/CSI/API
Cup heater surface	Up to 128 espresso cups
Coffee boiler size	2 x 1.5 L
Steam boiler size	5.4 L
Grounds drawer	1 x 700 g
Drip tray	Standard or Large with pitcher rinser (option) or Large without pitcher rinser (option)
Water Connection	
Water hose	Inox braided pipe G3/8" female x 2 m
Drain hose	Ø 22 mm x Ø 16 mm x 2 m

*measured from the drip tray

Classic	E'4s x-wide	E'4m x-wide
Weight	115 kg	119 kg
Performance (up to)		
Espresso/h (23 s)	350	
Hot water/h (200 ml)	170	
Cappuccino/h (23 s)	-	350
Adjustable hot water temperature (Manual)	Yes	
Adjustable hot water temperature (Automatic)	Option	
e'Foam Micro Air Dosing (MAD) system (controlled electronically)	Yes	
Milk system with EMT (Electronic Milk Texturing)	-	Yes
Voltage/Power		
North America		
2/PE, 208 V~, 60 Hz, 30A - US/CA	4600 W	
NEMA L6-30 (30Amp) Circuit Required		
Frequency	50/60 Hz	
Power consumption (machine on)	Up to 10200 W	
Power consumption (standby mode)	Less than 2 W	
Water pressure and flow		
2.5 - 4 bars (36.3 - 58 psi) If the pressure exceeds 4.5 bars (65.3 psi), it is necessary to install a pressure valve reducer.		
If the main flow rate is under 200 L/h, there is a risk of damaging the water pump.		



EVERSYS

Enigma

Datasheet & Installation

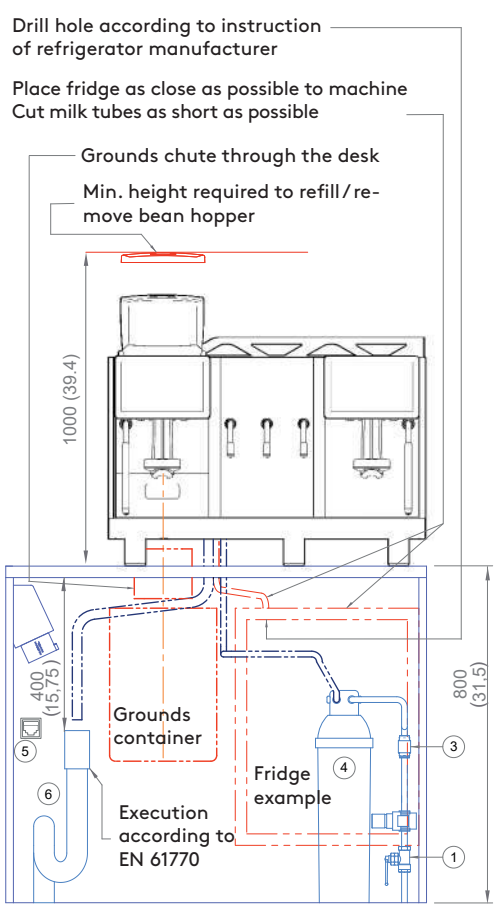
2. Prior to the installation READ SAFETY INSTRUCTIONS

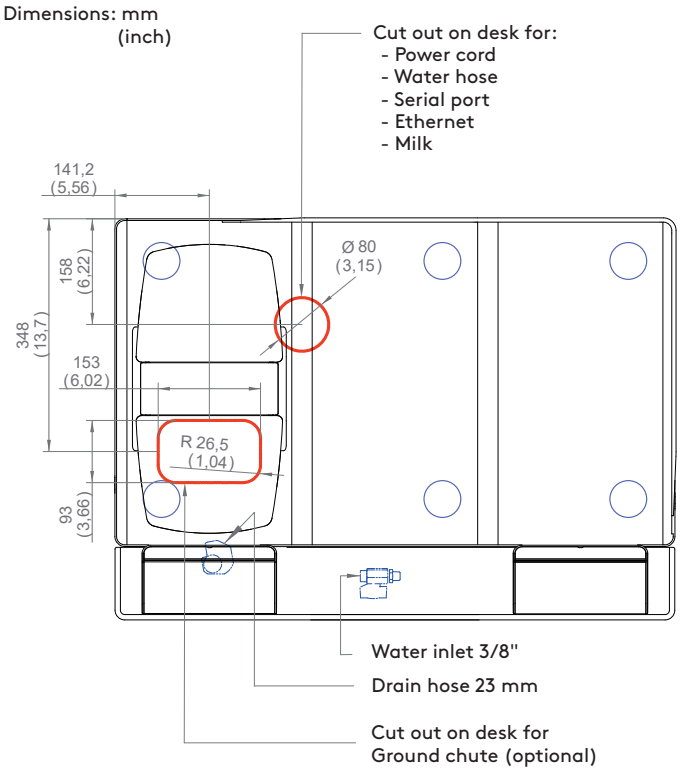
- Check water quality and pressure
- Define filter type and size and check space inside counter
- If no descaling cartridge is used, install carbon filter as minimum
- Check that the machine is on flat and stable surface
- Check counter cut out
- Check water supply installation
- Check that power supply conforms to local standards
- Check that power supply conforms to the machine settings
- Check that the machine is the only device on this power line
- Check all with customer on site
- Make sure original coffee is available
- Make sure cold milk is available (option)
- Check drink recipes and cup sizes
- Check that a milk pitcher is available.

3. After installation

- Explain cleaning and instruct staff using Quick Reference Card
- Fill in and sign the installation form and send it back to Eversys -> orders@eversys.com

4. Desk preparation and countertop cut out dimensions





1. Main water inlet
2. Pressure reducer output 3 bar (43,5 psi)
3. Check valve
4. Descaling cartridge or carbon filter as minimum
5. Electrical socket according to local regulation and RJ-45 connection (e'Connect)
6. Drain with syphon, top end min. 56 mm diameter

Water quality recommendation

Total hardness: 5 - 8° dGH (89-142 ppm)

Carbonate hardness: Max. 6° dKH (107 ppm)

pH value: ideal 7.0 - 7.2

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Parts Dept. (800)424-TRUE • Parts Dept. Fax# (636)272-9471 • www.truemfg.com

Project Name: _____ AIA #

Location: _____ SIS #

Item #: _____ Qty: _____

Model #: _____

Model: **TSSU-36-12M-B-HC**

Food Prep Table:
Mega-Top Solid Door Sandwich/Salad Unit with Hydrocarbon Refrigerant

TSSU-36-12M-B-HC

- True's salad/sandwich units are designed with enduring quality that protects your long term investment.
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- Patented forced-air design holds 33°F to 41°F (.5°C to 5°C) product temperature in food pans and cabinet interior.
- Complies with and listed under ANSI/NSF-7.
- Exterior - stainless steel front, top and ends. Corrosion resistant GalFan coated steel back.
- Stainless steel, patented, foam insulated lid and hood keep pan temperatures colder, lock in freshness and minimize condensation. Removable for easy cleaning.
- Interior - attractive, NSF approved, clear coated aluminum liner. Stainless steel floor with coved corners.
- 8⅞" (226 mm) deep, ½" (13 mm) thick, full length removable cutting board included. Sanitary, high density, NSF approved white polyethylene provides tough preparation surface.
- Heavy duty PVC coated wire shelves.
- Foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest ⅛" (millimeters rounded up to next whole number).

Model	Doors	Shelves	Pans (top)	Cabinet Dimensions (inches) (mm) W	D†	H*	HP	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
TSSU-36-12M-B-HC	2	4	12	36⅜ 924	34⅛ 867	40⅜ 1026	¼ N/A	115/60/1	4.5 N/A	5-15P	7 2.13	255 116

† Depth does not include 1" (26 mm) for rear bumpers.
* Height does not include 6¼" (159 mm) for castors or 6" (153 mm) for optional legs.

MADE WITH INNOVATION IN THE USA · 5 YEAR COMPRESSOR WARRANTY USA · c UL us · CLASSIFIED UL EPA · natural refrigerant.

9/18 Printed in U.S.A.

APPROVALS:

AVAILABLE AT:

Model:
TSSU-36-12M-B-HC

Food Prep Table:
Mega-Top Solid Door Sandwich/Salad Unit with Hydrocarbon Refrigerant

STANDARD FEATURES

DESIGN
- True's commitment to using the highest quality materials and oversized refrigeration systems provides the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.

REFRIGERATION SYSTEM
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydrocarbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- Energy efficient, factory balanced refrigeration system with guided airflow to provide uniform temperature in food pans and cabinet interior.
- Patented forced-air design holds 33°F to 41°F (.5°C to 5°C) product temperature in food pans and cabinet interior. Complies with ANSI/NSF-7.
- Sealed, self-lubricating evaporator fan motor and larger fan blades give True sandwich/salad units a more efficient, low velocity, high volume airflow design.
- Condensing unit access in back of cabinet, slides out for easy maintenance.

CABINET CONSTRUCTION
- Exterior - stainless steel front, top and ends. Corrosion resistant GalFan coated steel back.
- Interior - attractive, NSF approved, clear coated aluminum liner. Stainless steel floor with coved corners.
- Insulation - entire cabinet structure and solid doors are foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- 5" (127 mm) diameter stem castors - locks provided on front set. 36" (915 mm) work surface height.

DOORS
- Stainless steel exterior with clear aluminum liner to match cabinet interior.
- Each door fitted with 12" (305 mm) long recessed handle that is foamed-in-place with a sheet metal interlock to ensure permanent attachment.
- Positive seal self-closing doors with 90° stay open feature. Doors swing within cabinet dimensions.
- Magnetic door gaskets of one piece construction, removable without tools for ease of cleaning.

SHELVING
- Four (4) adjustable, heavy duty PVC coated wire shelves 15 9/16"L x 16"D (396 mm x 407 mm). Four (4) chrome plated shelf clips included per shelf.
- Shelf support pilasters made of same material as cabinet interior; shelves are adjustable on ½" (13 mm) increments.

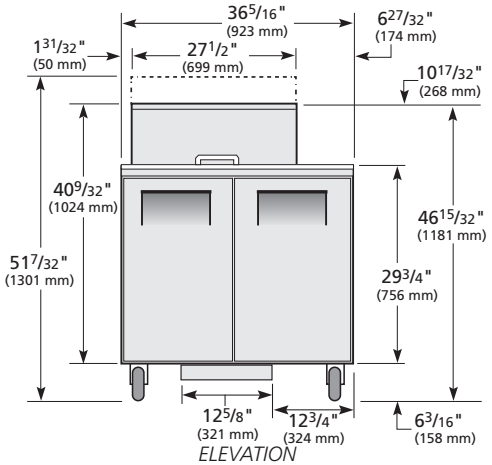
MODEL FEATURES
- Evaporator is epoxy coated to eliminate the potential of corrosion.
- 8 7/8" (226 mm) deep, ½" (13 mm) thick, full length removable cutting board. Sanitary, high-density, NSF approved white polyethylene provides tough preparation surface.
- Stainless steel, patented, foam insulated lid and hood keep pan temperatures colder, lock in freshness and minimize condensation. Removable for easy cleaning.
- Comes standard with 12 (1/6 size) 6 7/8"L x 6 1/4"W x 4"D (175 mm x 159 mm x 102 mm) clear polycarbonate, NSF approved, food pans in countertop prep area. Also accommodates 6" (153 mm) deep food pans (supplied by others).
- Countertop pan opening designed to fit varying size pan configurations with available pan divider bars. Varying size pans supplied by others.
- NSF/ANSI Standard 7 compliant for open food product.

ELECTRICAL
- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

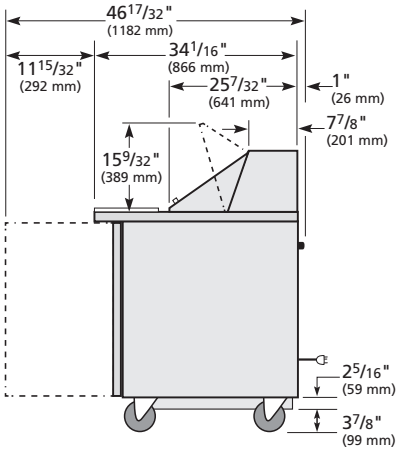
115/60/1
NEMA-5-15R

OPTIONAL FEATURES/ACCESSORIES
Upcharge and lead times may apply.
- ❑ 6" (153 mm) standard legs.
- ❑ 6" (153 mm) seismic/flanged legs.
- ❑ 2 ½" (64 mm) diameter castors.
- ❑ Barrel locks (factory installed). Requires one per door.
- ❑ Additional shelves.
- ❑ Single overshelf.
- ❑ Double overshelf.
- ❑ Flat lid.
- ❑ Sneezeguard.
- ❑ 8 7/8" (226 mm) deep, ½" (13 mm) thick, composite cutting board.
- ❑ Crumb catcher. Requires crumb catcher cutting board for proper installation.
- ❑ Pan dividers.
- ❑ Exterior rectangular digital temperature display (factory installed).
- ❑ ADA compliant model with 34" (864 mm) work surface height.

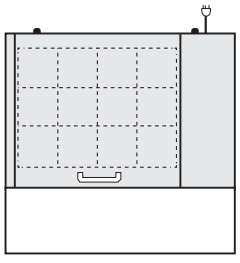
PLAN VIEW



ELEVATION



RIGHT VIEW


PAN LAYOUT

WARRANTY
Three year warranty on all parts and labor and an additional 2 year warranty on compressor. (U.S.A. only)

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Model	Elevation	Right	Plan	3D	Back
TSSU-36-12M-B-HC					

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PRÁTICA

Project _____
Item No. _____
Quantity _____

Rocket Express
Speed Oven

PERFORMANCE

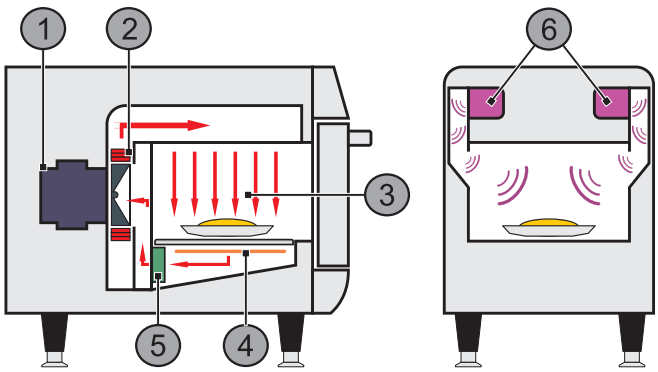
- The Rocket Express rapid cook oven utilizes a combination of convection heat, high speed impinged air, bottom infrared, and precision microwave to reduce cook times by more than 80% with chef-quality results. Rocket Express ovens are equipped with a removable catalytic converter, which break down grease-laden vapors allowing for ventless operation.

FEATURES

- Up to 80 recipes with 6 steps each
- USB port to upload/download recipes
- Easy to clean
- Adjustable temperature from 86F (30C) to 530F (276C)
- User Friendly Interface
- Cool to the touch exterior
- Certified ventless with easy removable catalytic converter
- Variable-speed impingement airflow
- Independently controlled top and bottom heaters
- Ventless side panels allow for zero side clearance installation
- Allows the use of metal pans
- Constructed from AISI430 (exterior) and AISI304 (interior) Stainless Steel
- Manual mode for on-the-fly cooking
- Warranty – 1 year parts and labor

STANDARD ACCESSORIES

- Panini Style Grill Plate
- Ceramic Baking Stone
- Solid PTFE Basket
- Perforated PTFE Basket
- Prática Oven Cleaner
- Prática Oven Protector
- Nylon Scrub Pad
- Aluminum Paddle
- Cleaning Towels
- USB Drive



1. Blower Motor
2. Impingement Heater
3. Impinged Air
4. IR heater
5. Catalytic Converter
6. Magnetrons

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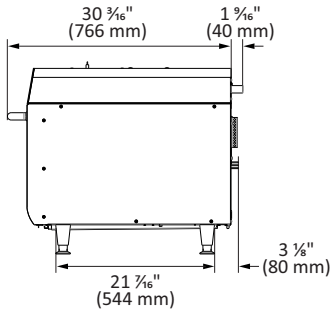
pratica@praticabr.com

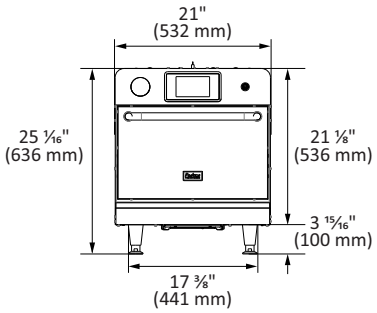
Prática Products, Inc - USA
424 E. Church Street
Lewisville, TX 75057
Phone: +1.214.584.6269
info@praticausa.com

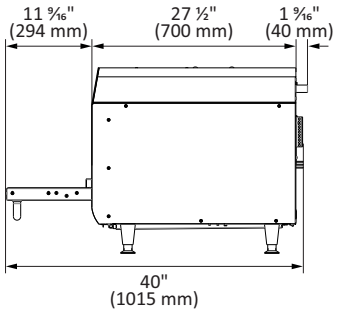
PRÁTICA

Rocket Express
Speed Oven

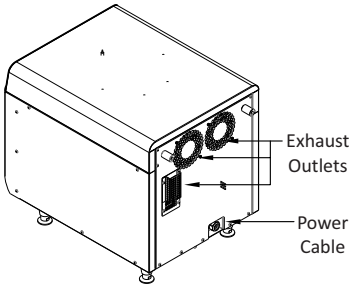
PRODUCT DIMENSIONS

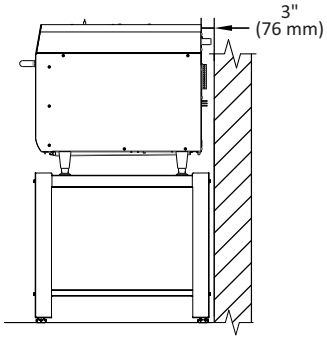


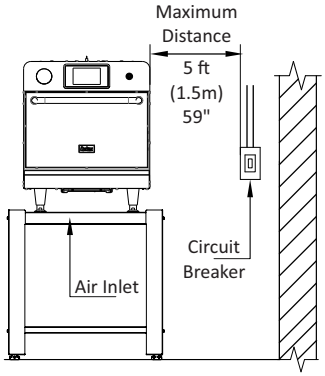




INSTALLATION







ELECTRICAL SPECIFICATIONS

Ensure that the electrical characteristics of the building network are in accordance with the technical specifications located on the data badge located on rear panel of the unit. The outlet should be located no more than 5ft / 1.5m away from the unit.

This plug must be connected to a properly installed and grounded outlet. In the event of an electrical short, properly grounding the unit reduces the risk of electrical shock by grounding the electrical current.

The building electrical is the customer's responsibility.

Region	Voltage (V)	Phases	Freq. (Hz)	Power (kW)	Circuit Breaker (A)	Cable	Socket	
USA	208	Single	60	6.2	30	3x10AWG	NEMA 6-30	
	240			7.2				
Europe	230	Single	50	6.9	32	3x4mm²	32A (2P+T)	
	230	Multi	50	6.9	32	3x4mm²	32A (2P+T)	

GENERAL INSTRUCTIONS

The oven must be installed on a base or counter that supports the weight of the unit (approximately 194 lbs. / 88 kg)

For proper ventilation, a minimum space of 3" (76mm) between the rear of the oven and the wall is required.

Do not block the air inlets and exhaust outlets located on the bottom and rear of the oven.

It is not recommended for the unit to be positioned near stoves, deep fryers, hot plates and other equipment that releases fat, fumes and heat.

The oven must be installed at a leveled and ventilated location.

Improper installation may void the equipment warranty.

DIMENSIONS

	Product Dimensions				Boxed Product Dimensions			
Rocket Express	Height	Width	Depth	Weight	Height	Width	Depth	Weight
	25 1/16" 636mm	21" 532mm	31 3/4" 806mm	194lbs 88kg	31 1/2" 800mm	22" 560mm	33 7/8" 860mm	242lb 110kg

Chamber Dimensions	Capacity	Height	Width	Depth
	0.74 cu.ft 21L	5 3/4" 146mm	15 1/2" 394mm	14 1/4" 362mm

Wall Clearance	Left Side	Back	Right Side
	0" 0mm	3" 76mm	0" 0mm

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Project Name: _____
Location: _____
Item #: _____ Qty: _____
Model #: _____

AIA #
SIS #

Model:
TUC-24-HC

Undercounter:
Solid Door Refrigerator with Hydrocarbon Refrigerant

TUC-24-HC

- True's undercounter units are designed with enduring quality that protects your long term investment.
- Designed using the highest quality materials and components to provide the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- All stainless steel front, top and ends. Corrosion resistant GalFan coated steel back.
- Interior - attractive, NSF approved, clear coated aluminum liner. Stainless steel floor with coved corners.
- Heavy duty PVC coated wire shelves.
- Foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest ⅛" (millimeters rounded up to next whole number).

Model	Doors	Shelves	Cabinet Dimensions (inches) (mm) W	D†	H	HP	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
TUC-24-HC	1	2	24 610	24¾ 627	31⅝ 802	⅙ ⅙	115/60/1 230-240/50/1	2.0 1.03	5-15P ▲	7 2.13	155 71

† Depth does not include 1" (26 mm) for rear bumpers.

▲Plug type varies by country.

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APPROVALS:

AVAILABLE AT:

Model:
TUC-24-HC

Undercounter:
Solid Door Refrigerator with Hydrocarbon Refrigerant

STANDARD FEATURES

DESIGN
- True's commitment to using the highest quality materials and oversized refrigeration systems provides the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.

REFRIGERATION SYSTEM
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- State of the art, electronically commutated evaporator and condenser fan motors. ECM motors operate at higher peak efficiencies and move a more consistent volume of air which produces less heat, reduces energy consumption and provides greater motor reliability.
- Condensing unit access in back of cabinet, slides out for easy maintenance.

CABINET CONSTRUCTION
- Exterior - stainless steel front, top and ends. Corrosion resistant GalFan coated steel back.
- Interior - attractive, NSF approved, clear coated aluminum liner. Stainless steel floor with coved corners.
- Insulation - entire cabinet structure and solid door are foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- Four (4) stationary castors. 31 5/8" (804 mm) work surface height. Two (2) front leg levelers included with unit for alternate use.

DOOR
- Stainless steel exterior with clear coated aluminum liner to match cabinet interior.
- Door fitted with 12" (305 mm) long recessed handle that is foamed-in-place with a sheet metal interlock to ensure permanent attachment.
- Positive seal self-closing door with 90° stay open feature. Door swings within cabinet dimensions.
- Magnetic door gasket of one piece construction, removable without tools for ease of cleaning.

SHELVING
- Two (2) adjustable, heavy duty PVC coated gray wire shelves 20"L x 13 7/8"D (508 mm x 353 mm). Four (4) chrome plated shelf clips included per shelf.
- Shelf support pilasters made of same material as cabinet interior; shelves are adjustable on ½" (13 mm) increments.

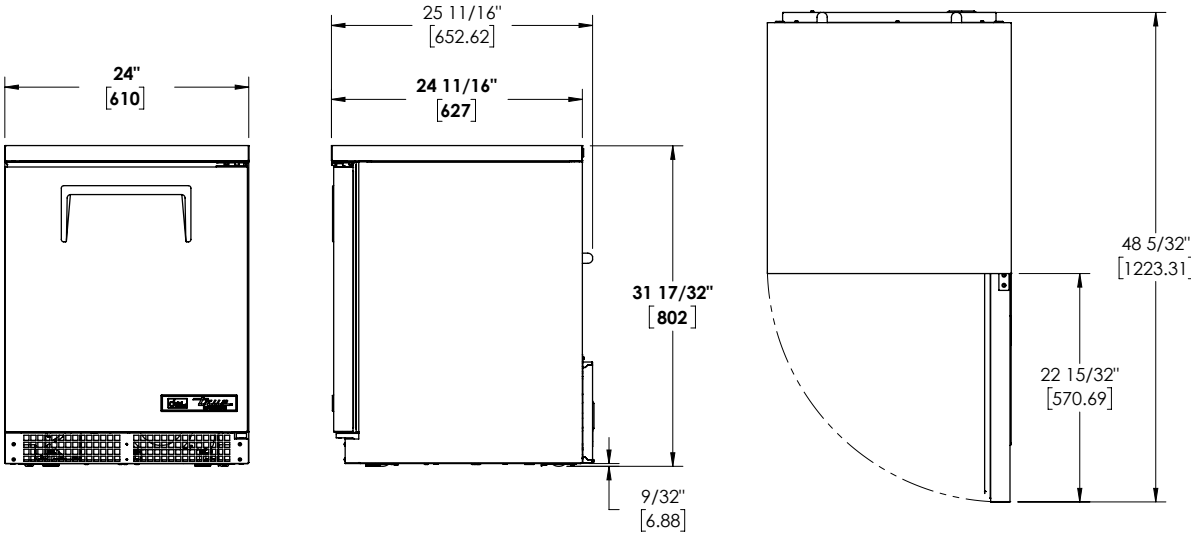
MODEL FEATURES
- Evaporator is epoxy coated to eliminate the potential of corrosion.
- Self-contained condensate pan. No need for external drain.
- NSF/ANSI Standard 7 compliant for open food product.

ELECTRICAL
- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

115/60/1
NEMA-5-15R

OPTIONAL FEATURES/ACCESSORIES
Upcharge and lead times may apply.
- ❑ 230 - 240V / 50 Hz.
- ❑ Digital temperature display (mounted in front edge of countertop)
- ❑ Left hinge available
- ❑ Door lock
- ❑ SPEC3 package

PLAN VIEW



FRONT VIEW *SIDE VIEW* *TOP VIEW*

3 YEAR PARTS + LABOR 7 YEAR COMPRESSOR
WARRANTY
(U.S.A. only)

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Model	Elevation	Right	Plan	3D	Back
TUC-24-HC	TFPY142E	TFPY142S	TFPY142P	TFPY1423	

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Project Name: _____ AIA #

Location: _____ SIS #

Item #: _____ Qty: _____

Model #: _____

Model:
TDD-1-S-HC

Underbar Refrigeration:

Solid Swing Door Stainless Steel Direct Draw Beer Dispenser with Hydrocarbon Refrigerant

TDD-1-S-HC

- True's direct draw beer dispensers are designed with enduring quality and value. Our commitment to using the highest quality materials and oversized refrigeration assures colder product temperatures and years of trouble free service.
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C).
- Exterior - stainless steel doors, front and sides. Matching aluminum back. All stainless steel counter top.
- Interior - Stainless steel floor with ½" (13 mm) reinforced lip and heavy gauge galvanized steel walls. NSF/ANSI Standard 7 compliant for packaged or bottled product.
- One (1) 3" (77 mm) diameter stainless steel insulated beer column. Cold air is directed into beer column to reduce foaming and maximize draft beer profits.
- Anodized aluminum glass rail provides convenient storage for glasses on top.
- Entire cabinet structure and solid door are foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest ⅛" (millimeters rounded up to next whole number).

Model	Doors	Capacity ½ Barrels	Cabinet Dimensions (inches) (mm) W	D	H*	HP	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
TDD-1-S-HC	1	1	23½ 597	31¼ 794	39¾ 1010	⅒ N/A	115/60/1	1.4 N/A	5-15P	7 2.13	210 96

* Height does not include 14¾" (375 mm) for draft arm.

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8/19 Printed in U.S.A.

APPROVALS:

AVAILABLE AT:

Model:
TDD-1-S-HC

Underbar Refrigeration:
Solid Swing Door Stainless Steel Direct Draw Beer Dispenser with Hydrocarbon Refrigerant

STANDARD FEATURES

DESIGN
- True's direct draw beer dispensers are designed with enduring quality and value. Our commitment to using the highest quality materials and oversized refrigeration assures colder product temperatures and years of trouble free service.

REFRIGERATION SYSTEM
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydrocarbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C).
- State of the art, electronically commutated evaporator and condenser fan motors. ECM motors operate at higher peak efficiencies and move a more consistent volume of air which produces less heat, reduces energy consumption and provides greater motor reliability.
- Condensing unit accessed from rear of unit for easy cleaning and maintenance.

CABINET CONSTRUCTION
- Exterior - stainless steel doors, front and sides. Matching aluminum back. All stainless steel counter top.
- Interior - Stainless steel floor with ½" (13 mm) reinforced lip and heavy gauge galvanized steel walls.
- Door threshold protector prevents damage to cabinet from routine loading of product.
- Insulation - entire cabinet structure and solid door are foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- Cabinet fitted with 4" (102 mm) diameter castors (legs not available).
- One (1) 3" (77 mm) diameter stainless steel insulated beer column. Cold air is directed into beer column(s) to reduce foaming and maximize draft beer profits.
- Anodized aluminum glass rail.

DOOR
- Stainless steel exterior with heavy gauge galvanized steel liner.
- Each door fitted with 12" (305 mm) long recessed handle that is foamed-in-place with a sheet metal interlock to ensure permanent attachment.
- Positive seal doors.
- Magnetic door gasket of one piece construction, removable without tools for ease of cleaning.
- Door lock standard.

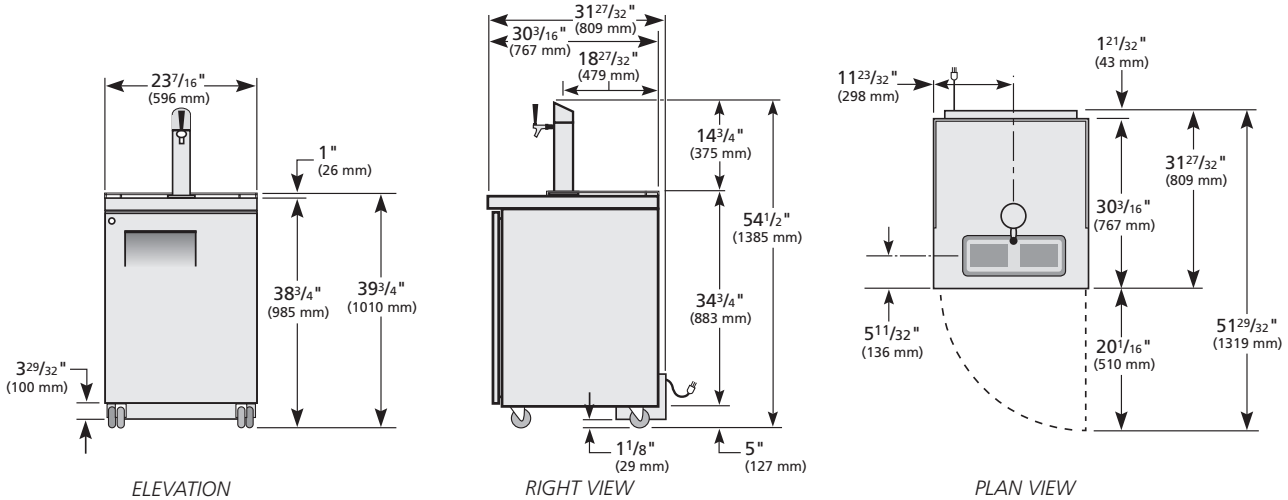
MODEL FEATURES
- Evaporator is epoxy coated to eliminate the potential of corrosion.
- Designed to accommodate all types of beer kegs.
- Listed under NSF/ANSI Standard 7 for the storage and/or display of packaged or bottled product.

ELECTRICAL
- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

115/60/1
NEMA-5-15R

OPTIONAL FEATURES/ACCESSORIES
Upcharge and lead times may apply.
- ❑ Double headed draft column.
- ❑ Triple headed draft column.
- ❑ Two-way tapper manifold.
- ❑ Draft cap.

PLAN VIEW



ELEVATION RIGHT VIEW PLAN VIEW

WARRANTY
Three year warranty on all parts and labor and an additional 2 year warranty on compressor. (U.S.A. only)

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Model	Elevation	Right	Plan	3D	Back
TDD-1-S-HC	TFHY04E	TFHY04S	TFHY04P	TFHY043	

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2001 East Terra Lane • O'Fallon, Missouri 63366-4434 • (636)240-2400 • Fax (636)272-2408 • Toll Free (800)325-6152 • Intl. Fax# (001)636-272-7546 • www.truemfg.com

BK RESOURCES

Mobile Ice Bins

Stainless Steel Ice Bins

Use your smart phone to scan the above QR code to visit our website: www.bk-resources.com

BK-MIB-2422

BK-MIB-2411

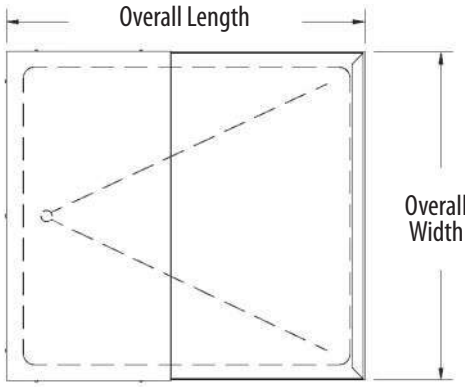
Features:

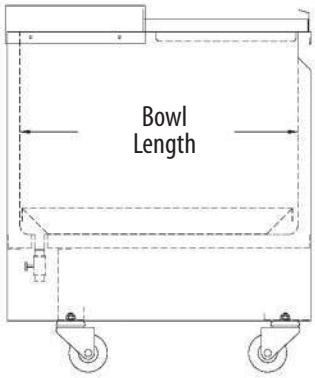
- 3″ Casters With Toe Activated Brake
- Removable Bottom Tray
- Ball Valve Drain In Rear of Unit

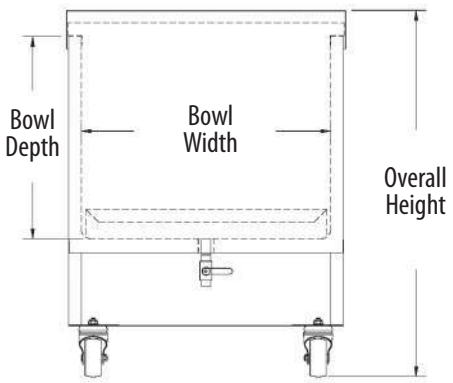
Material:

- T-304 18 ga Stainless Steel

Part Number	Unit Size (l x w x h)	Ice Bin Dim. (l x w x d)	Ice Bin Capacity
BK-MIB-2422	24" x 22" x 29″	$21^{7/8}$″ x $19^{11/16}$″ x $15^{15/16}$″	117 lbs.
BK-MIB-2411	24" x 11" x 29″	$21^{7/8}$″ x $8^{11/16}$″ x $15^{15/16}$″	53 lbs.







PRODUCT DATA SHEET

BK RESOURCES

SILVERKING®

Undercounters

27” Undercounter Freezer

SKF27A-EDUS1

Specification Sheet

Features

Eco-Friendly Refrigerant

R290 refrigerant with a global warming potential (GWP) of 3

High-Strength, Full-Extension Drawers

Premium slide and framework construction promotes lateral stability while offering high dynamic load capacities and a stay-shut feature

Stainless Steel Exterior

Galvanized back and bottom to reduce the risk of corrosion

Easy to Clean

Aluminum interior, coved corners, finished edges, plus full-extension and easy lift out drawers

Heavy-Duty Soft Casters

Secured to a 12 gauge steel base to ensure years of worry-free operation

High-Efficiency Refrigeration System

Forced air circulation provides uniform temperature throughout the cabinet while automatic defrost self-manages ice buildup and evaporates moisture

Drawer Capacity

Each drawer accommodates one (1) full-size 12” W x 20” H x 6” D hotel pan — additional adapters are available for fractional pans

Long-Lasting, Removable Gaskets

Santoprene™ gaskets last four times longer than standard gaskets

High-Density Insulation

Foamed-in-place, CFC-free polyurethane insulation for maximum strength, rigidity, and insulation

MARMON Foodservice Technologies
A BERKSHIRE HATHAWAY COMPANY

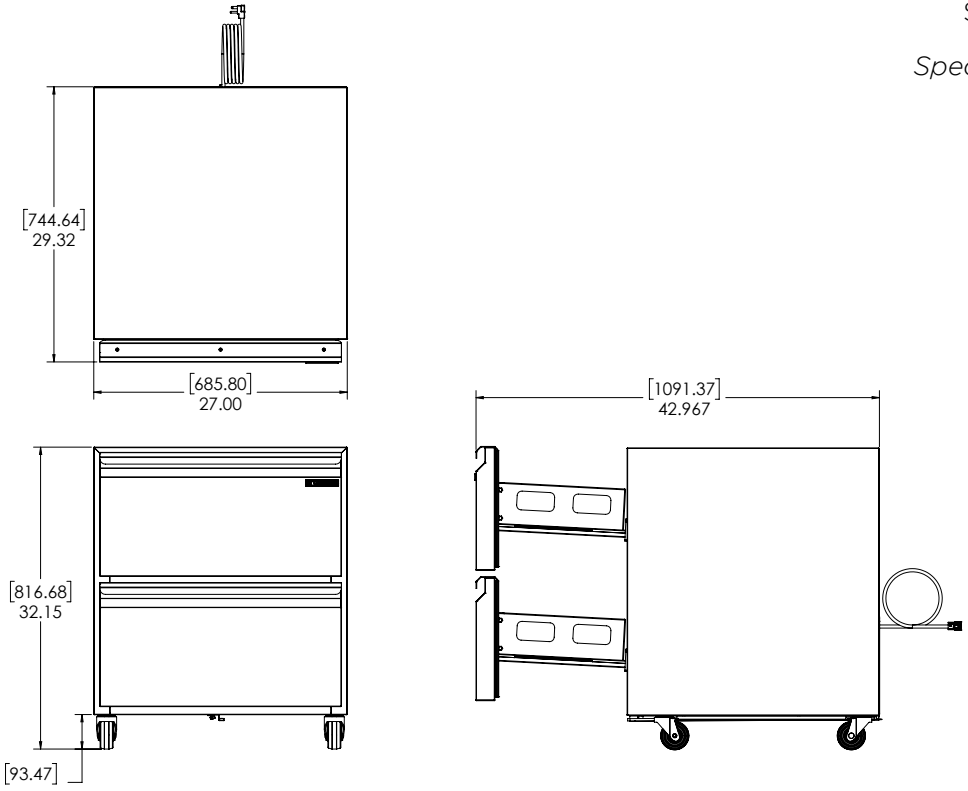
SILVERKING®

Undercounters

27” Undercounter Freezer

SKF27A-EDUS1

Specification Sheet



Technical Specifications

Electrical Requirements	115v/60hz/1ph/2A/NEMA 5-15P Plug
Product Dimensions	27”W x 32.15”H x 29.32”D (68.58cm x 81.66cm x 74.47cm)
Product Weight	190lbs (86.18kg)
Shipping Dimensions	32”W x 40”H x 37”D (81.28cm x 101.60cm x 93.98cm)
Shipping Weight	205lbs (92.99kg)
Shipping Cubic Dimensions	27.41ft^3 (0.78m^3)
Temperature Range	-5 to 5 (-20.6 to -15°C)
Refrigerant	R290

Insulation	Foamed-in-place, CFC-free polyurethane
Exterior Construction	Stainless steel exterior with galvanized back and bottom
Interior Construction	Aluminum interior with coved corners and finished edges
Drawers	Two (2) high-strength, full-extension drawers
Drawer Capacity	Accommodates two (2) full-size 12” W x 20” H x 6” D hotel pans
Door/Drawer Gasket	Santoprene™ gasket
Casters	Four (4) 3” heavy-duty soft casters (two locking)
Certifications	ETL Safety, ETL Sanitation
Warranty	1-year parts and labor, 5-year compressor (part only)

Model Number	Description
SKF27-EDUS1	Undercounter Freezer 27”, 115v/60hz/1ph, 2 drawer, 3” heavy-duty soft casters (two locking), NEMA 5-15P

Accessories	Description
25567	Adapter Bars for Fractional Pans
43581	Pan 1/6 Size, 4” Deep Plastic
43643	Pan 1/6 Size, 6” Deep Plastic
27066	Pan 1/3 Size, 4” Deep Plastic
26415	Pan 1/3 Size, 6” Deep Plastic

To learn more about **Silver King Undercounter Freezer**, visit silverking.com

MARMON Foodservice Technologies
A BERKSHIRE HATHAWAY COMPANY

SPEC SHEET

"PB-DISINK0911-TD" PRO-BOWL HAND SINKS

Drop-In, (1) 11½"x9¼"x6" Deep Bowl w/Optional Soap Dispenser

FEATURES:

- Fabricated Bowl
- Includes Drain With Basket (PBDR-2)
- Suffix "-STD" Includes Deck Mount Soap Dispenser (PB-SD-DM)
- Integrated Towel Dispenser

SPECIFICATIONS:

- Top: Stainless Steel Tops Are TIG Welded, Exposed Welds Polished To Match Adjacent Surface
- 16GA 300 Series Stainless Steel Deck
- 18GA 300 Series Stainless Steel Base
- Drain: 2" Drain Opening, With 1-1/2" NPS Outlet Connection

PB-DISINK091106-TD

PB-DISINK091106-STD

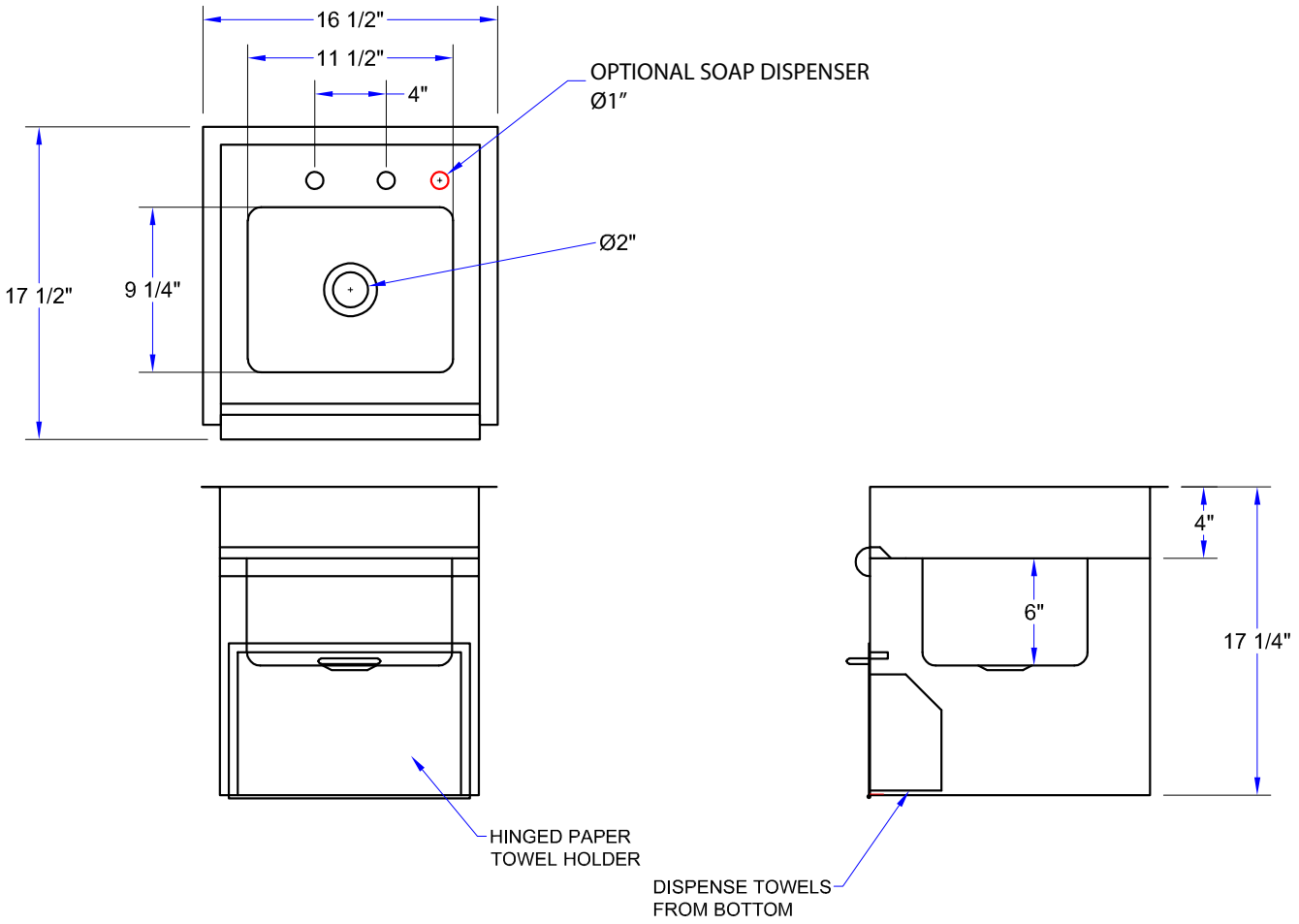
PB-SD-DM

"PB-DISINK0911-TD" PRO-BOWL HAND SINKS

MODEL	BOWL SIZE (L X W X H)	OVERALL SINK SIZE (L X W X H)	SOAP DISPENSER	WEIGHT (LBS)
PB-DISINK091106-TD	11-1/2"x9-1/4"x6"	16-1/2"x17-1/2"x17-1/4"	N/A	27
PB-DISINK091106-STD	11-1/2"x9-1/4"x6"	16-1/2"x17-1/2"x17-1/4"	PB-SD-DM	30

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

DETAILED SPECIFICATIONS



"PB-DISINK0911-TD" PRO-BOWL HAND SINKS

MODEL	BOWL SIZE (L X W X H)	OVERALL SINK SIZE (L X W X H)	SOAP DISPENSER	WEIGHT (LBS)
PB-DISINK091106-TD	11-1/2"x9-1/4"x6"	16-1/2"x17-1/2"x17-1/4"	N/A	27
PB-DISINK091106-STD	11-1/2"x9-1/4"x6"	16-1/2"x17-1/2"x17-1/4"	PB-SD-DM	30

ALL DIMENSIONS ARE TYPICAL. TOLERANCE +/- .500". JOHN BOOS & CO. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

ADVANCE TABCO
SMART FABRICATION™

STAINLESS STEEL

DROP-IN SINKS

Smart Series™ Single & Double Bowl Drop-Ins

Item #: _____ Qty #: _____

Model #: _____

Project #: _____

NOTE: Multi-Compartment Drop-In Sinks ARE NSF Approved when used in Mobile Food Carts and Kiosks only.

FEATURES:

One piece seamless **Deep Drawn** stainless steel bowls.
Self rimming design.
Flat deck allowing for more faucet options.
All bowls are sound deadened.
Units feature Advance Tabco's **Smart Finish™**.
Stainless Steel 1-1/2 IPS basket drain.

MATERIALS:

Stainless Steel Type 304 18 Gauge

DESIGN:

Self-Rim Design. Mounting clips provided accommodates all thicknesses of counter. (Quantity supplied varies based on drop in sink ordered).

8" O.C. Faucet Holes: Unit punched with 1-1/2" Diameter for the hot & cold water supply lines. Center hole punched with 1" Diameter.

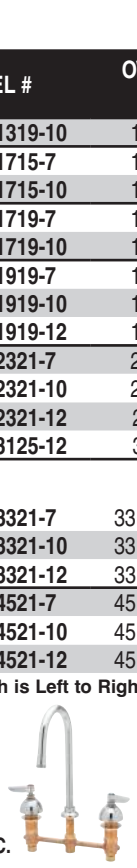
SINGLE BOWL DROP-IN SINKS

MODEL #	OVERALL VIEW	BOWL SIZE L X W	BOWL DEPTH* (D)	CUTOUT (1 1/4" RADIUS CORNERS)	APPROX. WT.
SS-1-1319-10	13" x 19"	10" x 14"	10"	12 1/4" x 18 1/4"	14 lbs.
SS-1-1715-7	17" x 15"	14" x 10"	7-1/2"	16 1/4" x 14 1/4"	12 lbs.
SS-1-1715-10	17" x 15"	14" x 10"	10"	16 1/4" x 14 1/4"	14 lbs.
SS-1-1719-7	17" x 19"	14" x 14"	7-1/2"	16 1/4" x 18 1/4"	16 lbs.
SS-1-1719-10	17" x 19"	14" x 14"	10"	16 1/4" x 18 1/4"	18 lbs.
SS-1-1919-7	19" x 19"	16" x 14"	7-1/2"	18 1/4" x 18 1/4"	16 lbs.
SS-1-1919-10	19" x 19"	16" x 14"	10"	18 1/4" x 18 1/4"	18 lbs.
SS-1-1919-12	19" x 19"	16" x 14"	12"	18 1/4" x 18 1/4"	20 lbs.
SS-1-2321-7	23" x 21"	20" x 16"	7-1/2"	22 1/4" x 20 1/4"	20 lbs.
SS-1-2321-10	23" x 21"	20" x 16"	10"	22 1/4" x 20 1/4"	22 lbs.
SS-1-2321-12	23"x 21"	20" x 16"	12"	22 1/4" x 20 1/4"	24 lbs.
SS-1-3125-12	31"x 25"	28" x 20"	12"	30 1/4" x 24 1/4"	39 lbs.

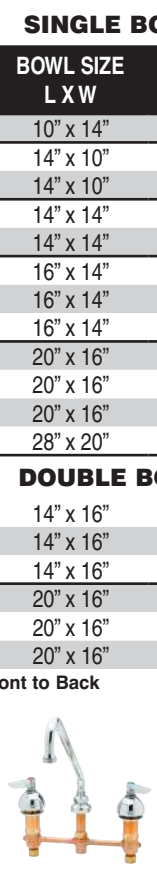
DOUBLE BOWL DROP-IN SINKS

SS-2-3321-7	33 1/2" x 21"	14" x 16"	7-1/2"	32 3/4" x 20 1/4"	33 lbs.
SS-2-3321-10	33 1/2" x 21"	14" x 16"	10"	32 3/4" x 20 1/4"	35 lbs.
SS-2-3321-12	33 1/2" x 21"	14" x 16"	12"	32 3/4" x 20 1/4"	37 lbs.
SS-2-4521-7	45 1/2" x 21"	20" x 16"	7-1/2"	44 3/4" x 20 1/4"	38 lbs.
SS-2-4521-10	45 1/2" x 21"	20" x 16"	10"	44 3/4" x 20 1/4"	39 lbs.
SS-2-4521-12	45 1/2" x 21"	20" x 16"	12"	44 3/4" x 20 1/4"	40 lbs.

Length is Left to Right. Width is Front to Back



K-132
8" O.C.



K-133
8" O.C.

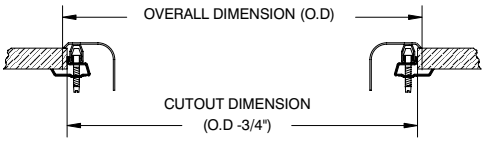
Available Faucets & Accessories	Model #	Qty.
Deck Mounted Swing w/Spray. 8" O.C.	K-58	
Deck Mounted 5 1/2" Gooseneck. 8" O.C.	K-132	
Deck Mounted 9" Swing Spout. 8" O.C.	K-133	
Mounting Clips (Bag of 4)	K-28	

Standard Faucets conform to NSF 61 Standard 9.
Faucets Are AB1953 Lead Free Compliant.

K-58
8" O.C.

INCLUDES STANDARD MOUNTING CLIPS
For countertops over 7/8" and up to 2" thick.
Replacement # K-28 (Per Sink)

TYPICAL INSTALLATION



Cut-Out Size = L to R x F to B

⚠ **WARNING:** Faucets on this page may expose you to chemicals, including lead, that are known to the State of California to cause cancer or birth defects or other reproductive harm. For more Info.,visit www.p65warnings.ca.gov.

ADVANCE TABCO
SMART FABRICATION™
www.advancetabco.com

Customer Service Available To Assist You 1-800-645-3166 8:30 am - 8:00 pm E.S.T.

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Email: customer@advancetabco.com or **Fax:** 631-242-6900

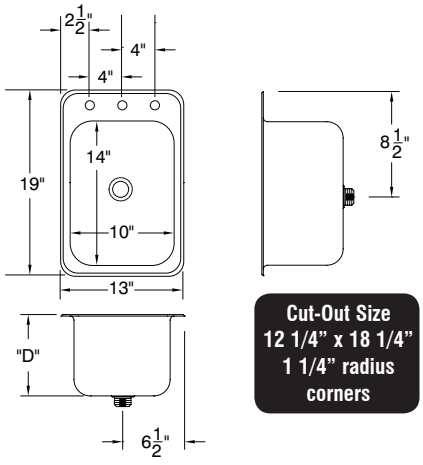
For Smart Fabrication™ Quotes:
Email: smartfab@advancetabco.com or **Fax:** 631-586-2933

DIMENSIONS and SPECIFICATIONS

TOL ± .125”

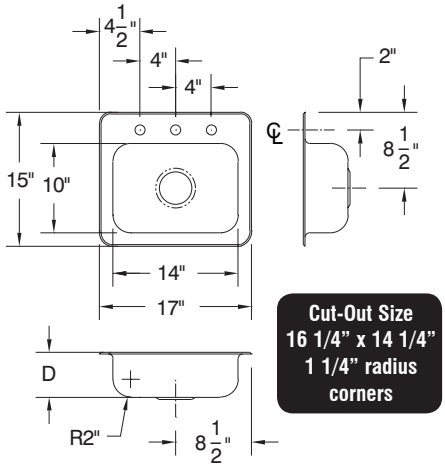
ALL DIMENSIONS ARE TYPICAL

SS-1-1319 Series



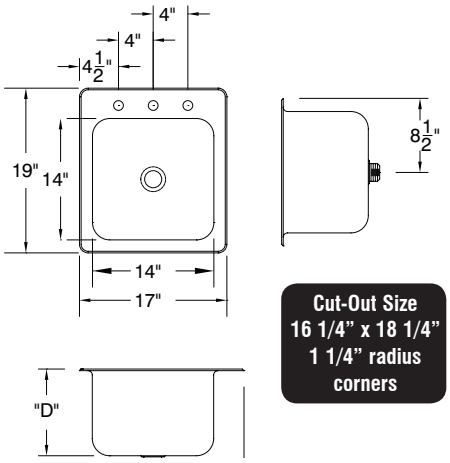
Cut-Out Size
12 1/4” x 18 1/4”
1 1/4” radius corners

SS-1-1715 Series



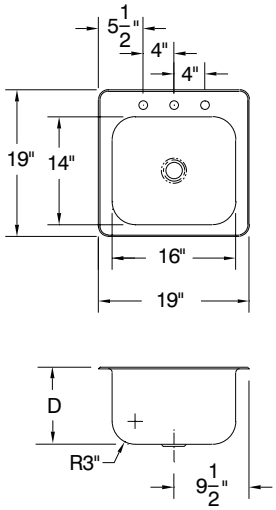
Cut-Out Size
16 1/4” x 14 1/4”
1 1/4” radius corners

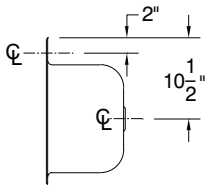
SS-1-1719 Series



Cut-Out Size
16 1/4” x 18 1/4”
1 1/4” radius corners

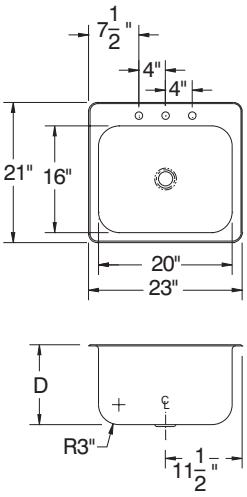
SS-1-1919 Series

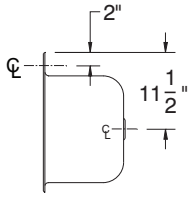




Cut-Out Size
18 1/4” x 18 1/4”
1 1/4” radius corners

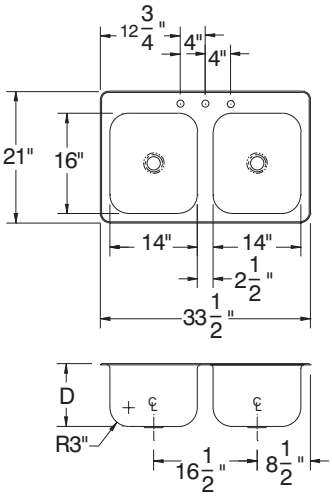
SS-1-2321 Series

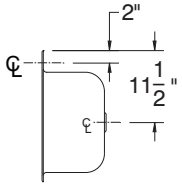




Cut-Out Size
22 1/4” x 20 1/4”
1 1/4” radius corners

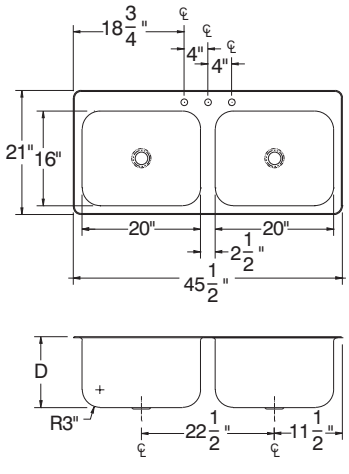
SS-2-3321 Series

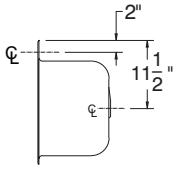




Cut-Out Size
32 3/4” x 20 1/4”
1 1/4” radius corners

SS-2-4521 Series





Cut-Out Size
44 3/4” x 20 1/4”
1 1/4” radius corners

ADVANCE TABCO
SMART FABRICATION™

ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.

TRUE MANUFACTURING CO., INC.
U.S.A. FOODSERVICE DIVISION
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Fax (636)272-2408 • Toll Free (800)325-6152 • Intl Fax# (001)636-272-7546
Parts Dept. (800)424-TRUE • Parts Dept. Fax# (636)272-9471 • www.truemfg.com

Project Name: _____
Location: _____
Item #: _____ Qty: _____
Model #: _____

AIA #
SIS #

Model:
TUC-36-HC

Undercounter:
Solid Door Refrigerator with Hydrocarbon Refrigerant

TUC-36-HC

- True's undercounter units are designed with enduring quality that protects your long term investment.
- Designed using the highest quality materials and components to provide the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- All stainless steel front, top and ends. Corrosion resistant GalFan coated steel back.
- Interior - attractive, NSF approved, clear coated aluminum liner with stainless steel floor.
- Front breathing.
- Heavy duty PVC coated wire shelves.
- Foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).

ROUGH-IN DATA

Specifications subject to change without notice.
Chart dimensions rounded up to the nearest ⅛" (millimeters rounded up to next whole number).

Model	Doors	Shelves	Cabinet Dimensions (inches) (mm) L	D†	H*	HP	Voltage	Amps	NEMA Config.	Cord Length (total ft.) (total m)	Crated Weight (lbs.) (kg)
TUC-36-HC	2	4	36⅜ 924	30⅛ 766	29¾ 756	⅙ N/A	115/60/1	2.0 N/A	5-15P	11 3.35	235 107

† Depth does not include 1" (26 mm) for rear bumpers.
* Height does not include 6¼" (159 mm) for castors or 6" (153 mm) for optional legs.

MADE WITH INNOVATION IN THE USA · 5 YEAR COMPRESSOR WARRANTY USA · c UL us · CLASSIFIED UL EPH · natural refrigerant.

6/18-A Printed in U.S.A.

APPROVALS:

AVAILABLE AT:

Model:
TUC-36-HC

Undercounter:
Solid Door Refrigerator with Hydrocarbon Refrigerant

STANDARD FEATURES

DESIGN
- True's commitment to using the highest quality materials and oversized refrigeration systems provides the user with colder product temperatures, lower utility costs, exceptional food safety and the best value in today's food service marketplace.

REFRIGERATION SYSTEM
- Factory engineered, self-contained, capillary tube system using environmentally friendly R290 hydro carbon refrigerant that has zero (0) ozone depletion potential (ODP), & three (3) global warming potential (GWP).
- Energy efficient, factory balanced refrigeration system with guided airflow to provide uniform product temperatures.
- High capacity, factory balanced refrigeration system that maintains cabinet temperatures of 33°F to 38°F (.5°C to 3.3°C) for the best in food preservation.
- State of the art, electronically commutated evaporator and condenser fan motors. ECM motors operate at higher peak efficiencies and move a more consistent volume of air which produces less heat, reduces energy consumption and provides greater motor reliability.
- Condensing unit access in back of cabinet, slides out for easy maintenance.

CABINET CONSTRUCTION
- Exterior - stainless steel front, top and ends. Corrosion resistant GalFan coated steel back.
- Interior - attractive, NSF approved, clear coated aluminum liner. Stainless steel floor with coved corners.
- Insulation - entire cabinet structure and solid doors are foamed-in-place using a high density, polyurethane insulation that has zero ozone depletion potential (ODP) and zero global warming potential (GWP).
- 5" (127 mm) diameter stem castors - locks provided on front set. 36" (915 mm) work surface height.

DOORS
- Stainless steel exterior with clear aluminum liner to match cabinet interior.
- Each door fitted with 12" (305 mm) long recessed handle that is foamed-in-place with a sheet metal interlock to ensure permanent attachment.
- Positive seal self-closing doors with 90° stay open feature. Doors swing within cabinet dimensions.
- Magnetic door gaskets of one piece construction, removable without tools for ease of cleaning.

SHELVING
- Four (4) adjustable, heavy duty PVC coated wire shelves. Two (2) top shelves are 15 9⁄16"L x 20 1⁄4"D (396 mm x 515 mm), Two (2) bottom shelves are 15 9⁄16"L x 13 3⁄4"D (396 mm x 350 mm). Four (4) chrome plated shelf clips included per shelf.
- Shelf support pilasters made of same material as cabinet interior; shelves are adjustable on 1⁄2" (13 mm) increments.

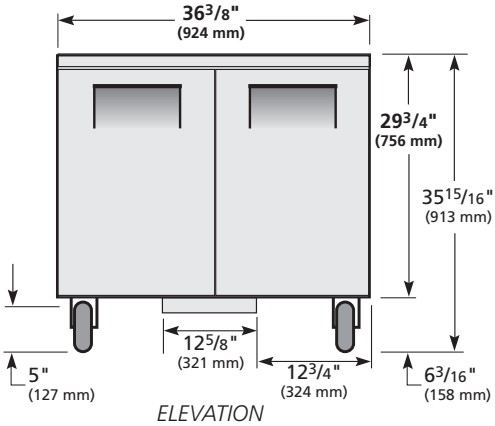
MODEL FEATURES
- Evaporator is epoxy coated to eliminate the potential of corrosion.
- NSF/ANSI Standard 7 compliant for open food product.

ELECTRICAL
- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase, 15 amp dedicated outlet. Cord and plug set included.

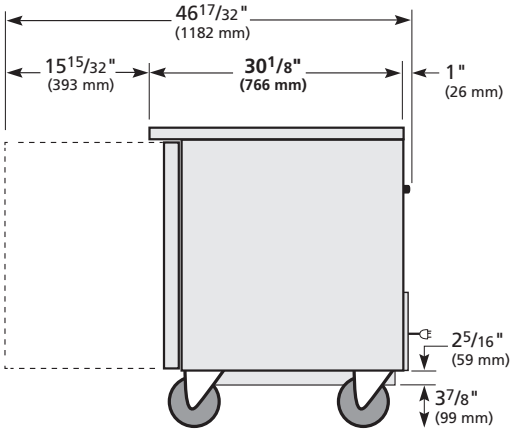
115/60/1
NEMA-5-15R

OPTIONAL FEATURES/ACCESSORIES
Upcharge and lead times may apply.
- ❑ 6" (153 mm) standard legs.
- ❑ 6" (153 mm) seismic/flanged legs.
- ❑ 2 1⁄2" (64 mm) diameter castors.
- ❑ Barrel locks (factory installed). Requires one per door.
- ❑ Single overshelf.
- ❑ Double overshelf.
- ❑ 30" (762 mm) deep, 1⁄2" (13 mm) thick, white polyethylene cutting board. Requires "L" brackets.
- ❑ 30" (762 mm) deep, 1⁄2" (13 mm) thick, composite cutting board. Requires "L" brackets.
- ❑ Exterior rectangular digital temperature display (factory installed).
- ❑ ADA compliant models with 34" (864 mm) work surface height.
- ❑ Low profile models with 31 7⁄8" (810 mm) work surface height.
- ❑ SPEC1 package

PLAN VIEW



ELEVATION



RIGHT VIEW

WARRANTY
Three year warranty on all parts and labor and an additional 2 year warranty on compressor. (U.S.A. only)

METRIC DIMENSIONS ROUNDED UP TO THE NEAREST WHOLE MILLIMETER

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Model	Elevation	Right	Plan	3D	Back
TUC-36-HC	TFPY25E	TFPY25S	TFPY25P	TFPY253	

TRUE MANUFACTURING CO., INC.
2001 East Terra Lane • O'Fallon, Missouri 63366-4434 • (636)240-2400 • Fax (636)272-2408 • Toll Free (800)325-6152 • Intl. Fax# (001)636-272-7546 • www.truemfg.com

DUAL TF DBC BLK 120/240V w/Fnl Locks

35.7" x 20.2" x 21.8"
(90.7cm x 51.3cm x 55.4cm)

Servers and airpots sold separately

- Brews 16.3 to 18.9gal (61.7 to 71.5L) of perfect coffee per hour
- Coffee extraction controlled with pre-infusion and pulse brew, digital temperature control, and large sprayhead; coffee strength controlled with variable by-pass.
- Create coffee recipe cards with custom recipes, ad cards with messages that display on the brewer LCD, and dedicated funnels for special coffees with the BrewWISE Recipe Writer using your PC (Windows® compatible).
- Easy pulse interface allows automatic programming of pulse routine
- Preventive maintenance kit: 39641.0000
- Stores individual coffee recipes so operator can easily brew many varieties
- ThermoFresh® servers are vacuum insulated to keep coffee hot for hours.
- SplashGard® funnels deflect hot liquids away from the hand
- Energy saver mode reduces tank temperature during idle periods
- Operate any combination of BrewWISE equipment error-free with wireless brewer-grinder interface through Smart Funnel with SplashGard®
- Funnel locks help improve safety

Agency:

UL LISTED NSF

Specifications

Product #: 34600.0001
Water Access: Plumbed
Interface: Wireless
Finish: Black
Funnel: Smart Funnel
Faucet: Lower

Additional Features

BUNNLINK Compatible
BrewWISE

Electrical & Capacity

Volts	Amps	Watts	Cord Attached	Plug Type	8oz cups/hr 236ml cups/hr	Input H²O Temp.	Phase	# Wires plus Ground	Hertz
120/240	27.5	6600	No	-	309	60°F (15.5°C)	1	3	60

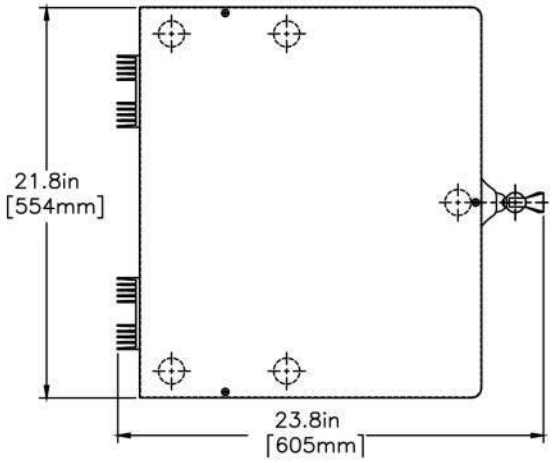
Plumbing Requirements

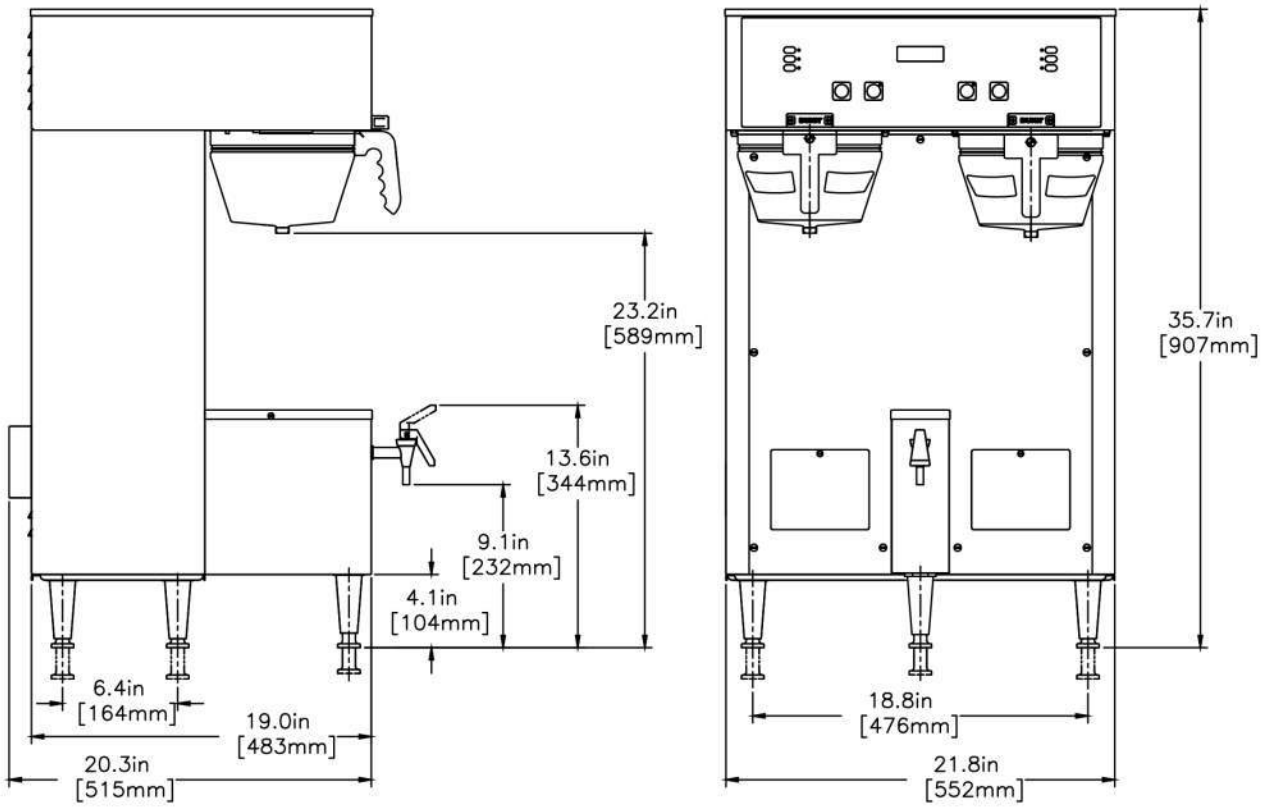
PSI	kPa	Fitting Supplied	Water Flow Required (GPM)
20-90	138-621	3/8" Male Flare Fitting	-

CAD Drawings

2D	Revit	KLC
●		

Created on: 09/13/2017





Unit				Shipping				
	Width	**Height**	**Depth**	**Width**	**Height**	**Depth**	**Weight**	**Volume**
English	21.8 in.	35.7 in.	20.2 in.	-	-	-	92.500 lbs	13.180 ft³
Metric	55.4 cm	90.7 cm	51.3 cm	-	-	-	41.958 kgs	0.373 m³

Created on: 09/13/2017

Related Products & Accessories: DUAL TF DBC BLK 120/240V w/Fnl Locks(34600.0001)

FILTERS,GOURMET 504 252/2 36/CL

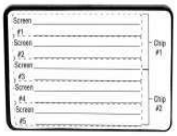
Product #: 20138.0000

BREWWISE RECIPE WRITER

Product #: 34444.0000

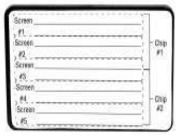
CARD ASSY,RECIPE TRANSFER(BRW)

Product #: 34447.0000



CARD ASSY, TRANSFER-AD (BRW)

Product #: 34448.0000



TARJETA

Product #: 34448.0000

MHG, 120V BLK

Product #: 35600.0022

WATER FILTER, EQHP-25L

Product #: 39000.0002

WATER FILTER, EQHP-25

Product #: 39000.0005

KIT, PM-DUAL TF

Product #: 39641.0000

Created on: 09/13/2017

Serving & Holding Options: DUAL TF DBC BLK 120/240V w/Fnl Locks(34600.0001)

TF SERVER, DSG2 1G/3.8L

Product #:42700.0000

TERMO

Product #:42700.0000

TF SERVER, DSG2 1G/3.8L BLK

Product #:42700.0001

TF SERVER, DSG2 1G CD

Product #:42700.0003

TF SERVER, DSG2 1G BLK CD

Product #:42700.0004

TF SERVER, DSG2 1.5G SST

Product #:42750.0000

TF SERVER, DSG2 1.5G BLK

Product #:42750.0001

TERMO

Product #:42750.0001

TF SERVER, DSG2 1.5G CD

Product #:42750.0003

TF SERVER, DSG2 1.5G BLK CD

Product #:42750.0010

TF SERVER, 1G/3.8L MECH

Product #:44000.0000

TERMO

Product #:44000.0000

TF SERVER, 1G/3.8L MECH BLK

Product #:44000.0001

TERMO

Product #:44000.0001

TF SERVER, 1.5G/5.7L MECH

Product #:44050.0000

TERMO

Product #:44050.0000

TF SERVER, 1.5G/5.7L MECH BLK

Product #:44050.0001

TERMO

Product #:44050.0001

Created on: 09/13/2017

1.5Gal(5.7L) TF Srvr w/ Base, MSG GEN3

22.7" x 12.9" x 9.1"
(57.7cm x 32.8cm x 23.1cm)

- Vacuum insulated to keep coffee hot for hours
- Ideal for use with Twin or Single Infusion Series Brewers
- Brew-through design with flip lid cover
- Soft-grip bail handle for easy transportation
- Self-locking stand allows for multiple brewing and serving options
- Large cup clearance allows for dispensing into cups, decanters and thermal carafes
- Integrated sight gauge assembly allows for easy cleaning
- Sturdy aluminum faucet guard keeps faucet area clean and protected
- Drip tray is easily removed for cleaning or to provide extra clearance for dispensing into pitchers
- Fast flow faucet

Agency:

NSF

Specifications

Product #: 44050.0200

Handle: Bail Handle

Liner: Stainless Steel

Dispense: Lever Action

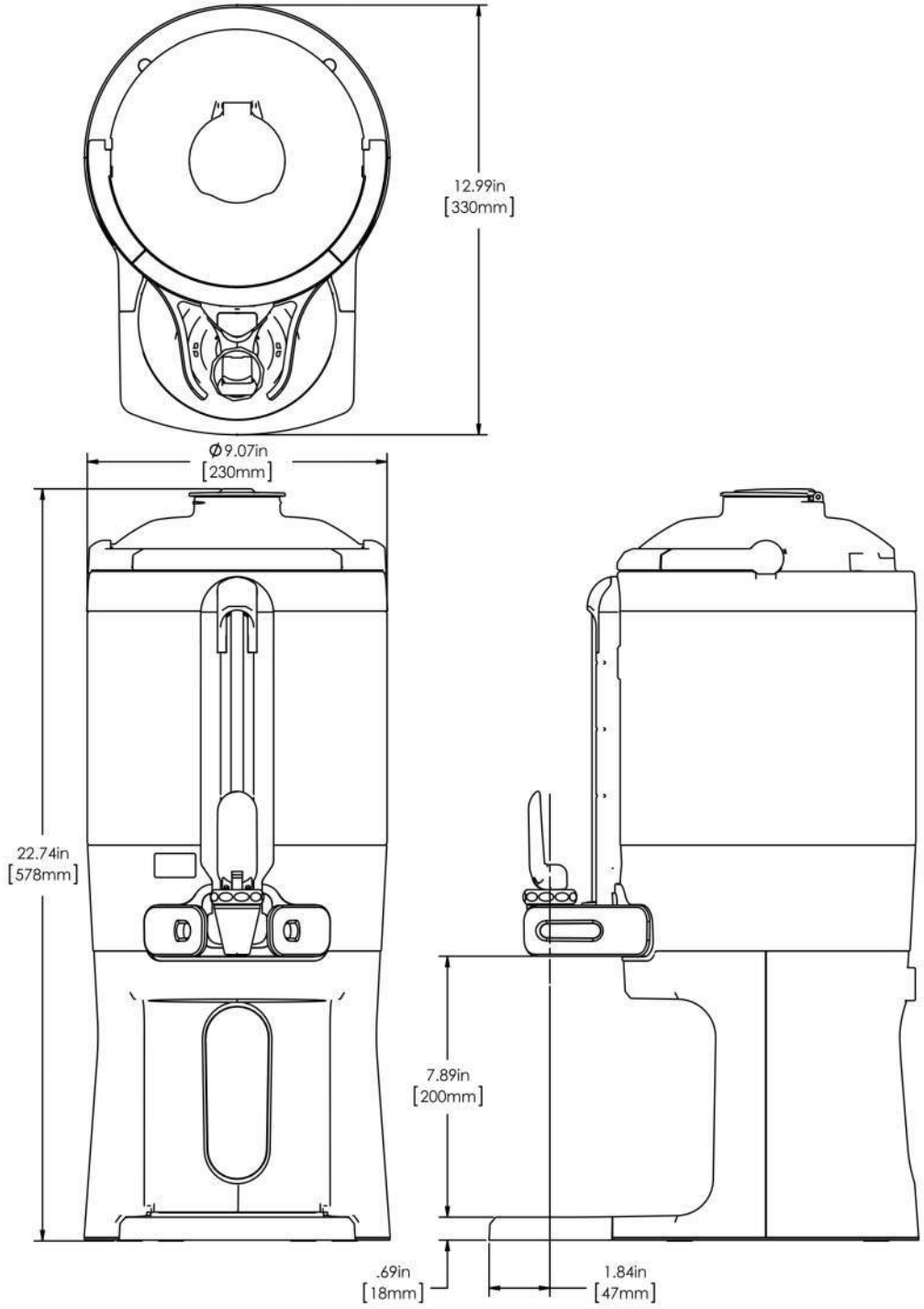
Lid Color: Black

Additional Features

Holding Capacity

English	Metric
192 oz.	5.7 L

Created on: 01/25/2019



Unit				Shipping				
	Width	**Height**	**Depth**	**Width**	**Height**	**Depth**	**Weight**	**Volume**
English	9.1 in.	22.7 in.	12.9 in.	12.3 in.	26.5 in.	15.3 in.	14.300 lbs	2.865 ft³
Metric	23.1 cm	57.7 cm	32.8 cm	31.1 cm	67.3 cm	38.7 cm	6.486 kgs	0.081 m³

Created on: 01/25/2019

Related Products & Accessories: 1.5Gal(5.7L) TF Srvr w/Base, MSG GEN3(44050.0200)

STAND ASSY, TF SERVER GEN3

Product #: 39795.0200

STAND ASSY, TF SERVER

Product #: 54473.0000

Created on: 01/25/2019

Model Compatibility: 1.5Gal(5.7L) TF Srvr w/Base, MSG GEN3(44050.0200)

Serving and Holding selections are currently unavailable. Please contact your sales representative to find out more information.

Created on: 01/25/2019

By Owner

SECTION 11 4000
FOODSERVICE EQUIPMENT
END OF SECTION

SECTION 12 2400
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior motorized roller shades.

B. Motor controls.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

1.09 WARRANTY

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Motorized Roller Shades, Motors and Motor Controls:
   1. MechoShade Systems LLC; UrbanShade Single Roller - Motorized: www.mechoshade.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.
   3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
      a. Comply with NFPA 70.
      b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
      c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.

B. Roller Shades Type _____:
   1. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   2. Roller Tubes: As required for type of shade operation.
   3. Hembars: Designed to maintain bottom of shade straight and flat.

C. Roller Shades Type _____ - Basis of Design: MechoShade Systems LLC; ElectroShade with iQ2-AC EDU, line voltage, 120 VAC: www.mechoshade.com/#sle.

1. Description: Single roller, motor-operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: Regular roll.
   b. Mounting: Ceiling mounted.
   c. Size: As indicated on drawings.
   d. Fabric: As indicated under Shade Fabric article.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
      1) Light-Filtering Fabric: Room-side of opening.
3. Roller Tubes:
   a. Material: Extruded aluminum.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Intelligent Encoded Electronic Drive System:
   a. Line-Voltage EDU, 120 VAC:
      1) Audible Noise: 46 dBA or less measured 3 feet from motor unit, depending on motor torque.
   b. Modes of Operation:
      1) Uniform Mode: Shades move only to defined intermediate stop positions to maintain aesthetic uniformity.
      2) Normal Mode: Shades move to defined intermediate stop positions plus any position between defined upper and lower limits.
      3) Maintenance Mode: Prevent shade from moving to newly commanded positions via dry contact or network control commands until EDU has been serviced or Maintenance Mode has been cleared or disabled.
   c. Control Methods:
      1) Local isolated dry contact inputs support local switch control and third-party system integration without separate interface.
      2) Bidirectional network communication enables commanding operation of large groups of shades over common backbone.
      3) Provide minimum of three customizable preset positions accessible over network connection and local dry contact control inputs.
      4) Provide minimum of 32 customizable preset positions, including three local switch presets, accessible via network commands.
6. Accessories:
   a. Ceiling Pockets with Prewired Raceway: UL 325 listed, extruded aluminum shade pocket with removable closure panel and ceiling tile support, for recess mounting in acoustical tile or drywall ceilings; size and configuration as indicated on drawings.
      1) Designed to accommodate installation of motor control and wiring accessories within pocket.
      2) Product: MechoShade Systems LLC; ElectroPocket; Model _____; www.mechoshade.com/#sle.

2.03 SHADE FABRIC

A. Fabric - Type _____: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch (19.05 mm) total.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.05 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

D. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.07 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.08 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 12 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Countertops for manufactured casework.

C. Wall-hung counters and vanity tops.

D. Sinks molded into countertops.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework.

B. Section 22 4000 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

A. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

E. IAPMO Z124 - Plastic Plumbing Fixtures; 2022.

F. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

G. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.

H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

I. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 0.79 inch (2 mm), minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; up to 93 percent quartz aggregare polyester resin, unfilled,and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Wilsonart; _____: www.wilsonart.com/#sle.
            (a) As indicated on Finish Legend..
         2) Substitutions: Not permitted.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. NSF approved for food contact.
      d. Sinks and Bowls: Integral castings; minimum 3/4 inch (19 mm) wall thickness; comply with IAPMO Z124.
      e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      f. Color and Pattern: As indicated on Finish Legend.
   3. Other Components Thickness: As indicated on drawings. 1/2 inch (12 mm), minimum.
   4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
   5. Skirts: As indicated on drawings.
   6. Fabricate in accordance with manufacturer's standard requirements.

B. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
   1. Flat Sheet Thickness: 1-1/4 inch (32 mm), minimum.
   2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Corian.
            (a) As indicated on Finish Legend.
         2) Substitutions: Not permitted.
      b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
      c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      d. NSF approved for food contact.
      e. Finish on Exposed Surfaces: Polished.
   3. Other Components Thickness: As indicated on drawings. 3/4 inch (19 mm), minimum.
   4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
   5. Skirts: As indicated on drawings.
   6. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

A. Extruded Aluminum: ASTM B211/B211M, 6463 alloy, T5 temper.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 ACCESSORIES

A. Support Brackets as indicated on drawings.

2.04 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3,657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).

C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

3.07 SCHEDULES

A. As indicated on Finish Legend and drawings.

END OF SECTION

SECTION 12 4813
ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. 03 3000 Cast-in-Place Concrete: Instalation coordination.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.

C. Shop Drawings: Indicate dimensions and details for recessed frame.
   1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Entrance Floor Grilles and Gratings:

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

A. Entrance Floor Gratings: Recessed stainless steel bar grating with longitudinal bars running perpendicular to traffic flow and perimeter frame forming sides of recess; grating hinged for access to recess.
   1. Basis-Of-Design: Construction Specialties: GridLine G6, 5/8" Hidden Lockdowns: www.c-sgroup.com.
   2. Grating: Longitudinal bars 0.09 inch (2.3 mm), nominal, in width, spaced at less than twice the bar width apart; cross bars set below for pronounced linear appearance.
   3. Grating Depth: 5/8 inches (____ mm), nominal.
   4. Recess Depth Below Bottom of Grating: 1 inches (25 mm).
   5. Length in Direction of Traffic Flow: 72 inches (1830 mm).
   6. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
   7. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.

B. Mounting: Top of non-resilient members level with adjacent floor.

C. Structural Capacity: Capable of supporting a rolling load of 1000 pounds (453.6 kg) without permanent deformation or noticeable deflection.

D. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

2.03 FABRICATION

A. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Vacuum clean floor recess.

3.03 INSTALLATION

A. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

END OF SECTION

SECTION 21 00 00

FIRE-SUPPRESSION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this Section as shown on the drawings, as specified herein, and/or as required by job conditions.

B. Submit and secure approval for all shop drawings (including coordination drawings), calculations, system components, from the local AHJ and the Owner's insurance company, prior to the start of installation.

1.02 REFERENCES

A. The installation and equipment shall conform to: latest International Building Code amended to the latest North Carolina State Building code; Unified Facilities Criteria UFC-1-200-01, General Building Requirements); UFC-3-600-01, Fire Protection Engineering for Facilities and applicable reference standards cited therein, including NFPA 13,20,24, & 72 and any other local standards .

B. Perform the work in accordance with the requirements of the Contract General Conditions, Section 230000 General Provisions, and with the provisions of all applicable codes and laws.

C. In the event of an overlap or conflict between the requirements of the codes (NFPA & UFC), laws and ordinances, and this standard, then negotiations involving UFC, the AHJ and owner shall bring resolution to the dispute.

1.03 RELATED SECTIONS

A. Division 01 Sections “Construction Waste Management And Disposal”.

B. Division 01 Sections “Construction Indoor Air Quality (IAQ) Management.

1.04 INTENT

A. It is the intention of the specifications and drawings to provide for finished work, tested and ready for operation, subject to the requirements of the contract documents, including but not limited to Paragraphs 1.2 B, C and D below.

B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, necessary to render the work complete and ready for operation, shall be provided without additional cost to the Owner.

C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher

cost shall prevail and be included in the contract price.

D. The drawings show, among other things, the intent of the system components and routing. Fittings and accessories are shown, but it is not the intent to show all piping, fittings and accessories that will be required in order to install the systems in a coordinated way, as finished work. The contractor shall include all piping, fittings and accessories as may be required in order to accomplish the coordination of the various building systems, to ensure the systems fit within the spaces provided, regardless of whether these fittings and/or accessories are shown on the drawings. Some additional sprinkler heads will be required provide complete spray coverage under all obstructions especially in exposed areas without finished ceilings. These additional sprinkler heads shall be provided in the Shop Drawing design and installation and shall be included in the contract price. Refer to notation on FP001 for additional information.

1.05 DESCRIPTION

A. General Description.

1. Fire protection for the new building shall consist of a new fire pump assembly and new automatic sprinkler system.

2. The fire pump assembly shall be rated for 500 gpm and sized to supply the hydraulically most demanding sprinkler system plus hose allowance. The water supply for the fire pump shall be from connect to the street water main.

B. Major Components

1. One (1) fire pump assembly including power transfer switch and controller.
2. One (1) pressure maintenance pump assembly including controller.
3. One (1) riser check valve assembly
4. One (1) 4” sprinkler zone control assembly
5. One (1) 3” Preaction Pac N2 integrated preaction valve cabinet assembly.
6. One (1) wall mounted Fire Department Connection

C. Work Starts at.

1. Flanged 6" fire service line located in the Fire Pump Room, downstream of the 6" backflow preventer.

2. Prior to connecting to the fire service lead-in underground piping, obtain a copy of the Contractor's Material and Test Certificate for Underground Piping, documenting the satisfactory completion of a pressure test and flushing of the lead-in.

D. Additional Components and Work.

1. Complete galvanized test and drain system piped to discharge to the building exterior (or other location as approved by the Engineer and Architect).

2. Complete hanger and earthquake bracing assemblies(if applicable). All hanger and bracing components shall be galvanized.

3. Two (2) electric bells. An interior bell to be located near riser check valve and an exterior electric bell located at the exterior of the Fire Service Room.

4. Alarm actuating devices including tamper switches and flow switches.

5. Required accessories, drains and test connections.

6. Rough cutting and patching.

7. Coordination of all fire protection wiring requirements with Division 26.

E. General Design:

1. The Contract Drawings shall be considered diagrammatic/schematic indicating the essential features of system but not necessarily all sprinkler heads, piping, piping offsets, hanger assemblies, etc. Provide any piping, equipment and/or sprinkler heads, etc. required for a complete code compliant design and installation.

2. All piping and sprinklers shall be of the concealed type in areas where ceilings exist. Exposed piping and sprinklers will be installed in areas without ceilings.

3. All fire protection work shall be coordinated with other trades, the building's architectural features and with the ceilings, soffits, and partitions. Special care should be taken in areas where sprinklers are centered in ceiling tiles or with other ceiling features.

4. Do not run exposed piping in front of windows and skylights. Keep all exposed piping as high as possible and as tight to walls and ceilings/decking as possible. Exposed piping and sprinklers shall be installed in coordination with the buildings structural and architectural features. Concealed piping should be elevated +/- 6" above the ceiling. Coordinate all piping with lights, diffusers, and all other equipment above the ceilings. Provide any additional piping, offsets, and hanger assemblies required to meet the aesthetic considerations of this project. Do not locate piping in areas where it would interfere with door swings or required head clearances or egress paths.

5. Provide all required drain and control valves. All valves shall be a maximum of 7'-0" above the finished floor unless noted otherwise.

6. Do not attach any hanger assemblies directly to the underside of any roof assemblies. When supporting fire protection piping and equipment at the underside of roof construction, use "unistrut" type supplemental steel to span adjacent roof structure and attach equipment hangers to the "unistrut".

F. Related work specified elsewhere.

1. Finished patching
2. Electrical wiring
3. Fire extinguishers
4. Painting of exposed fire protection piping located in public spaces

1.06 SITE INVESTIGATION

A. Examine the drawings and specifications of all trades, and the site, and from these investigations be responsible for the nature and location of work, general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, etc.

1.07 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the Drawings. Consult the architectural drawings and details, and the drawings of other trades, for exact location of equipment.

B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which the work will be installed. Maintain maximum headroom and space conditions. Where headroom or space conditions appear inadequate, the Architect and Construction Manager shall be notified before proceeding with installation.

C. If directed by the Architect, Engineer or CM, make modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

D. The drawings are schematic and diagrammatic.
1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but not necessarily have dimensional significance; neither do they necessarily delineate all related and subsidiary parts and equipment.
2. The work shall be installed complete and ready for operation in conformity with the intent expressed on the drawings and in the specifications.

E. Coordinate the work with the requirements of the architectural and structural drawings for dimensions, locations and clearances.
1. Locations of items exposed to view shall be taken from the architectural drawings or located as directed.

1.08 COORDINATION WITH OTHER TRADES

A. Closely schedule with the Construction Manager your work so that all work will be installed at the proper time without delaying the completion of the project.

B. Where the work will be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, arrange space conditions to make a satisfactory adjustment. If work is installed before coordinating with other trades, make necessary changes to the work to correct the condition without additional cost to the owner.

C. Prepare complete set of drawings showing all necessary existing/new slab penetrations and existing/new structural penetrations along with supports that require structural framing. Drawings shall clearly indicate sizes and location relative to established column lines. Drawings shall be completed in sufficient time to allow for structural steel fabrication so as not to delay project schedule.

D. Shop drawing submissions shall demonstrate knowledge of the work of other trades, and shall show the locations of the work of other trades which affects the work of this contract.

1.09 SUBMITTALS

A. Procedure.

1. Prepare and make the submissions listed below and in Section 230000.

B. Materials.

1. Pipe and fittings
2. Wall plates
3. Sleeves
4. Control valves
5. Check valves
6. Drain and auxiliary valves
7. Riser check valve assembly
8. Sprinkler zone control assemblies
9. Pre-action valve integrated cabinet assembly with nitrogen assembly
10. 2-Way Fire Department Connection
11. Electric bells
12. Supervisory tamper switches
13. Alarm Pressure and Flow Switches
14. Hanger and earthquake bracing assemblies(if applicable)
15. Valve tags, charts, pipe makers, and equipment signage including hydraulic summary placards for sprinklers systems
16. Fire stopping assemblies
17. Pressure gauges
18. Sprinklers, escutcheons, and head guards
19. Spare sprinkler cabinet
20. Fire Pump assembly including pump controller and power transfer switch
21. Pressure maintenance pump assembly including pump controller
22. 2-way fire pump test connection
23. Fire pump test connection valve storage cabinet
24. Air venting
25. Corrosion monitoring

C. Shop Drawings.

1. Provide dimensional installation piping layout(s) coordinated with all trades. Include all sprinklers, piping, pipe sizes, fittings, drains and auxiliary drain, hangers and locations, valves with identification numbers, alarm equipment, and all other necessary information required for a complete shop drawing. Each drawing shall accurately list the size, type and schedule of all pipe and fittings used on the project.

2. Determine any deviations from the contract documents (drawings and specifications) and clearly indicate them on in writing at the time of Bid.

3. Submitted shop drawings shall be clear and legible. Minimum text size shall be 1/8”. All sprinkler information must standout on the shop drawings (i.e., bold piping, etc. or lighter background). Reverse reading drawings are not acceptable. Do not draw piping intersecting with other piping that does not actually connect. Poor quality printings, reverse reading drawings and drawings with excessive unnecessary information (i.e., field fabrication notes, etc.) will not be reviewed

and will be returned for resubmission. Shop drawing submittal shall include a minimum ¼" scale including sections views to provide a reasonable representation of the piping and component layout.

4. With initial drawing submittal, include a complete, schematic type, riser diagram indicating all system components, hydraulic reference points, and elevations at each floor. Diagram shall include all information from the water main connection up to and including each sprinkler control assembly, and pre-action valve assembly. Also include volume of pre-action system and the fill rate and pressure (start and stop) settings of the air compressors.

5. With initial drawing submittal, provide a full height building cross-section indicating floor elevations, types of construction, and locations of ceilings, walls/partitions, and sprinkler piping. Include a complete drawing index with each submittal and on the first drawing in the fire protection shop drawing set.

6. Provide a complete drawing index with each submittal and on the first drawing in the fire protection shop drawing set.

7. On projects where there are multiple drawings per floor, include a key plan for each drawing.

8. Include a site plan indicating the water main, test hydrants (i.e., gauged and flowing hydrants), and fire department connection.

9. Shop drawings must include a NICET Level III or Level IV certification number (or a PE stamp) as proof of design and/or review by said NICET/PE certified/registered person.

D. Hydraulic Calculations.

1. Each calculation shall contain a water summary sheet indicating all of the information required per NFPA 13 along with stating the pressure and flow required at the municipal water connection along with the pressure available at the required flow. Each cover sheet shall also clearly indicate the shop drawing number, floor/level and area associated with the remote area. This information shall be included on associated shop drawing(s).

2. Each hydraulic calculation shall have its own unique identification name and number.

3. Calculations are to be brought back to the water main. Calculations must print out results in a consecutive format representing actual flow direction. Calculations, which do not conform to this requirement will be returned not reviewed.

4. Calculations shall include a 10 psig design margin between the required pressure and the available water supply pressure (at the required flow).

5. Hydraulic reference points shall be clearly indicated on drawings. Do not use "pipe numbers"; provide consecutively numbered reference points at all areas indicated on hydraulic calculations starting at the connection to the water main.

6. All sprinklers in the remote area must be flowed in the calculations (i.e., do not exclude sprinklers in small rooms, closets, etc). Do not include any unsprinklered spaces in the determining the square footage of the remote area.

7. The remote area must be the minimum square footage indicated in the Contract Drawings. A reduction in the remote area square footage is not permitted with the use of quick response sprinklers.

8. Grid calculations shall include "Peaking" process (per NFPA requirements) to ensure calculation of most remote area.

9. HYDRAULIC SUMMARY DATA MUST BE INCLUDED ON SHOP DRAWINGS. Summary data shall include: location, file number, density, remote area square footage, number of sprinkler heads flowing, flow & pressure required at municipal water main along South Street.

10. Friction loss shall be limited to a maximum of .30 PSI per foot per this specification.

11. Provide a calculation indicating the required pressure at the FDC required to supply the greatest sprinkler and hose stream demand.

12. For every submittal, hydraulic calculations must include a NICET Level III or Level IV certification number (or a PE stamp) as proof of design and/or review by said NICET/PE certified/registered person.

E. Procedures.

1. Field acceptance testing of fire pump assembly including controller and power transfer switch.

F. Samples.

1. Submit three (3) samples on each of the following items:
   a. Sprinklers including escutcheons and cover plates
   b. Sprinkler head guards

G. Closeout Documentation.

1. At completion of installation work, provide complete "As-Built" documentation including revised shop drawings and hydraulic calculations that have been updated to reflect any changes to the design to accommodate field conditions, and the Operations and Maintenance Manual.

H. Operating and Maintenance Manual.

1. Before requesting acceptance of work, furnish five (5) printed and bound sets of the Operations and Maintenance Manual.

2. Each Manual shall include:

   a. Title Page identifying the project name & location, and contractor’s emergency contact information.

b. Table of Contents with tabbed sections
c. A section providing a brief description of systems and components, and basic operating features
d. A section providing the Manufacturer's name, (include address and telephone number) model number, service manual, spare parts lists, wiring diagrams and descriptive literature for all components including the fire pump pressure maintenance pump, controllers and automatic transfer switch
e. A section providing maintenance instructions, listing of possible breakdowns and repairs of major components
f. A section providing instructions for start-up and operation of major components including a detailed and simplified one line color-coded flow and wiring diagrams, and copy of fire protection systems' valve tag chart
g. A section that includes all as-built shop drawing and hydraulic calculations
h. A section that includes the following witnessed certificates:
   - Contractor's Material And Test Certificate for Above Ground Piping (NFPA 13, Figure 24.1)
   - Contractor's Material And Test Certificate for Underground Piping (NFPA 13, Figure 10.10.1)
   - Certificates shall include all required signatures along with printed names and titles of all individuals conducting the tests and witnesses.
i. A section that includes factory certified fire pump performance test curve and field acceptance testing of the fire pump assembly in accordance with NFPA 20
j. A section that includes a copies of required procedures and summary of results:
   - Field acceptance testing of fire pump including controller and automatic transfer switch
k. A section that includes a copy of the first year's required inspections, testing and maintenance contract and copy of latest NFPA 25
l. A section that includes a USB Flash Drive with all approved fire protection as-built drawings, both .pdf and .dwg file types, along with all of the other Close-Out documents listed herein (Test& Inspection Certificates, O&M Manual, NFPA 25, Valve Tag Chart, etc).
m. A section that includes factory certified fire pump performance test curve and field acceptance testing of the fire pump assembly in accordance with NFPA 20.
n. A section that includes copies of all required procedures and summary of results: Field acceptance testing of fire pump including controller.

1.10 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping (except for piping directly supplying sprinklers for such room):

1. Prohibited, except as noted, in:

a. Electric Rooms and Closets.
b. Telephone Equipment Rooms and Closets.
c. Elevator Machine Rooms.

2. Prohibited, except as noted, over or within 5 feet of:

a. Transformers.
b. Substations.
c. Switchboards.
d. Motor control centers.
e. Standby power plant.
f. Bus ducts.

3. When over or within 5 feet unavoidable, provide drip pans under piping over electrical equipment.

1.11 QUALITY ASSURANCE

A. Quality of Materials.

1. All equipment and materials to be UL listed. All equipment and materials shall also be and Factory Mutual approved (unless noted otherwise).
2. New, best of their respective kinds and free of defects.
3. Electrical equipment: Listed by Underwriters Laboratories or bearing their label.
4. Secure approval from Architect, Engineer and all authorities having jurisdiction for materials, equipment, and installation prior to installation.
5. Obtain fire pump, pressure maintenance pump, controllers and automatic transfer switch through one source from a single manufacturer for each type of equipment.

B. Warranty.

1. All fire protection work shall be free from defects in workmanship and materials for a period of one (1) year from date of final acceptance shall meet all local and state codes. The Sprinkler Contractor shall repair all defects, which develop or are discovered within this period, to the satisfaction of the Owner, at no additional cost.
2. Provide (as part of the contract) all inspections, testing and maintenance required for the one (1) year period following final acceptance. Required inspections, testing and maintenance shall be those defined in NFPA 25-2008.
3. Provide (as part of the contract) service agreement for fire pump, pressure maintenance pump, controllers and automatic transfer switch for the one (1) year period following final acceptance. As part of the agreement, manufacturer's authorized service representative shall provide complete system inspection twice a year including: check of proper pump sequencing and alarm activation with adjustments, as required; and review of instructions for operating personnel, if requested. Any required service work to be noted in a formal inspection report along with a detailed proposal for the repairs. The service representative shall provide for 24 hour emergency service.

1.12 CONTRACT DOCUMENTS

A. The Contract Documents are generally diagrammatic and are intended to convey the scope of work and indicate general arrangements of pipe routing, sprinkler locations, riser locations, etc. The Contract Documents do not necessarily show all required sprinkler heads and/or piping, hangers, etc. Any work in addition to or different from these Contract Documents will not be considered an extra cost to the Contract. The Contractor shall examine the site of the scope of work to evaluate any existing conditions that may

affect their work.

1.13 SEISMIC RESTRAINT

A. Provide seismic restraint of all mechanical, electrical, plumbing and fire protection systems as required per latest Building Code, including but not limited to Sections 1705, 1070 and 1708 and referenced sections and publications. Building is considered Seismic Design Category B

1. Seismic Design Category B: All mechanical and electrical components are exempt from the seismic requirements of ASCE 7- Chapter 13.

B. This building is considered Seismic Design Category B as per Structural Drawing S1.01. Therefore, seismic bracing can be excluded from the fire protection system.

1.14 BASE BID MANUFACTURERS

A. Base bid on materials or equipment specified by:

1. Name of manufacturer.
2. Brand or trade name.
3. Catalogue reference.

B. Where two or more manufacturers are named, choice optional with bidder.

C. Manufacturers other than specified will only be considered if:

1. Stated at time of bid.
2. Proposed substitutions are named and submission of equipment of manufacturers other than specified shall detail equality and difference, item by item.
3. Difference in base bid is indicated including changes in cost of all work affected thereby.

PART 2 - PRODUCTS

2.01 PIPE

A. Above Ground.

1. Schedule 40 except as noted, seamless or welded mild steel, ASTM A-135, A-795 or A-53 for size 1" and larger.

2. Minimum Wall 0.188” may be used for size 8”

3. Galvanized pipe shall be used for test and drain piping, above ground piping between fire department connection and check valve, piping for auto-ball drip and for any above ground piping subject to alternate wetting and drying (e.g. pre-action system piping), and air supply piping.
   a. Grooved end connections shall have cut grooves

4. Provide chrome-plated pipe for any exposed test and drain piping at the building exterior.

B. Underground.

1. Ductile iron pipe, thickness class 52, AWWA C151, double cement lined in accordance with AWWA C104 and coated on exterior, along with rods and clamps, with coal tar enamel.

2. Provide push-on rubber gaskets and setscrew retaining glands for attachment to mechanical joint fittings

2.02 FITTINGS

A. Above Ground.

1. Cast iron threaded: Standard weight, ANSI B-16.4.

2. Cast iron flanged fittings and flanges: Standard weight, ANSI B-16.1.

3. Malleable iron: Threaded and banded, standard weights, ANSI B-16.3.

4. Steel welding: Standard seamless steel, ANSI B-16.9 and ASTM A-234.

5. Steel flanges: ANSI B-16.5, ASTM A-181 Grade 1 up to 300 PSI.

6. Grooved end ductile iron fittings, and bolted clamp type ductile iron couplings with rubber sealing gaskets for grooved end pipe, 250-PSI WWP. Allowed for size 1¼" and larger. Similar to: VICTAULIC Co.

7. Couplings for pre-action system shall employ “flush seal” type gaskets.

8. Plain end fittings and bushings are NOT PERMITTED.

9. Unions are only permitted on trim and test/drain piping

10. All reducing fittings shall be tapered. Reducing couplings are allowed for one "nominal" pipe size reduction (i.e.: 6" x 4", 3" x 2 ½“, etc).

11. Provide galvanized fittings for all dry system, test and drain piping, above ground piping between fire department connection and check valve, piping for auto-ball drip and for any above ground piping subject to alternate wetting and drying, and air supply piping.

12. Provide chrome-plated fittings for any exposed test and drain fittings at the building exterior.

B. Underground.

1. Ductile iron, pressure class 250, AWWA C110 & C111, mechanical joint type,

cement lined in accordance with AWWA C104 and coated on exterior, along with rods and clamps, with coal tar enamel.

2.03 WALL PLATES

A. Chrome plated, heavy gauge steel, hinged split ring wall plate with spring steel inserts and positive locking tab. For exposed piping through interior floors, walls, and ceilings. Similar to: ARGCO series.

B. Chrome plated, heavy duty, forged brass, one piece, wall plate with setscrew. For exposed piping through exterior walls. Similar to: ARGCO series.

2.04 SLEEVES

A. Install galvanized steel, schedule 40, pipe sleeves for pipes passing through floors, walls, and partitions. Sleeves shall be sized per NFPA requirements. Floor sleeves shall project 1" above finished floor to prevent seepage.

1. 16 gauge galvanized sheet metal sleeves may be used for pipes passing through partitions.

B. All sleeves passing through any rated construction shall be sealed with a UL listed fire and smoke resistive assembly

C. Grout-in all sleeves through concrete walls and floors.

D. All sleeves passing through exterior walls shall be schedule 40 galvanized steel pipe with integral water stop. Seal shall be interlocking expandable synthetic rubber links, assembled with corrosion resistant bolts, nuts, and pressure plates. Similar to: LINK-SEAL

2.05 VALVES

A. General.

1. Above ground valves shall be UL and FM approved. Similar to: KENNEDY, NIBCO, VICTAULIC or MILWAUKEE.

B. Above ground Valves.

1. 2" and smaller:

a. Butterfly type, slow close indicating valve with built-in tamper switch, threaded or grooved, 175 PSI. Similar to MILWAUKEE, Model No. BB-SCS02 OR BB-VSCS02 ("Butterball")

b. Gate type, OS&Y, bronze, threaded, 175 PSI WWP. Similar to: NIBCO, Model T-104-O.

2. 2 ½ " to 6":

a. Butterfly type, Tight closing, epoxy coated ductile iron, elastomer encapsulated disc, grooved, 300 PSI WWP, with stainless steel shaft, lifetime bearings, handwheel gear operator with position indicator, and built-in tamper switch. Similar to: VICTAULIC, Series 705 OR 705 RD ("FireLock")

b. Gate type, OS&Y, resilient wedge, flanged, 250 PSI WWP, pre-grooved stem for tamper switch, tapped and plugged boss. Similar to: NIBCO, Model F-607-RW.

C. Check valves.

1. 2" and smaller:

a. Swing type, bronze, threaded, rubber disc, 200 PSI WWP. Similar to: NIBCO, Model KT-403-W.

2. 2 ½" and larger:

a. Grooved, 250 PSI. Similar to: VICTAULIC, Series 717 ("FireLock").

D. Drain and Auxiliary Drain Valves.

1. Threaded bronze angle or globe type with composition disc, 175 PSI. Similar to: NIBCO KT-65, KT-211, KT-67, and KT-301.

2. Provide valves (not plugs) as required and at indicated locations for complete drainage of systems.

3. Pipe all drain and sprinkler test piping to the building exterior. Drains that drain to a floor drain, sump pit, or mop sink, will only be permitted with approval from the Engineer and Owner. Provide any required pipe, fittings, and labor to terminate drains at approved coordinated locations.

4. At system low points where drain piping does not extend to a drain receptacle, provide a threaded hose and adapter at the valve outlet (where permitted by the Engineer).

E. Automatic Ball Drip Valves.

1. ¾" bronze, threaded, angled. Similar to: POTTER-ROEMER Model 5984.
2. Pipe to an approved drain location.

2.06 SPECIALTY VALVES

A. Riser Check Valve Assembly

1. Grooved check valve including 2" main drain, and two pressure gauges each with a maintenance valve, and waterflow switch.
2. Waterflow switch shall actuate main fire alarm panel.

3. Similar to: VICTAULIC, Model 717R.

B. Sprinkler Control Assemblies.

1. Grooved manifold body, including a grooved control valve with tamper switch, waterflow switch, pressure gauge with maintenance valve, and a test & drain valve assembly.
2. Similar to: VICTAULIC Model UM or UMC

C. Double Interlocked Preaction Valve Assembly

Preaction Valve cabinet Assembly – 3" "Preaction Pac" doublee-interlocked pre-action valve assembly with nitrogen generator assembly.

1. Provide pressure reducing device if pressures exceed 175 PSI.

2. Similar to United Fire Corp.

3. Double interlocked preaction system (which is a type of dry pipe system) actuated by properly spaced smoke detectors (provided by Div. 26) will operate and open the preaction valve when a smoke detector activates. This will “flood” the preaction system piping but will not discharge water unless a sprinkler head also activates at which point water will only flow from sprinkler heads that activate due to high heat conditions. This system is designed to monitor the piping (with pressurized nitrogen) for leaks to avoid accidental water discharge and to provide early warning before water spray occurs. This system shall also prevent water discharge in the event of damage to a head via building fire alarm system and by manual release.

4. The required detection signal (from the main fire alarm panel) and local electric alarm bell in the preaction area shall be wired to the preaction control panel. Operation of this system shall be via this panel and/or the manual release station. The building main fire alarm panel shall monitor the preaction panel (by Division 26).

5. All wiring between building fire alarm panel, preaction supervisory air panel and preaction control panel to be supplied and installed by Div. 26.

2.07 FIRE DEPARTMENT CONNECTIONS

A. 2-Way flush mount.

1. 2-Way, cast brass body with built-in drop clappers and top outlet, two 2½ hose thread inlets x 4" NPT outlet.
2. Hose thread type shall comply with local requirements.
3. Finish shall be polished chrome plated OR as otherwise specified by the Architect.
4. Similar to: POTTER-ROEMER, Model 5023
5. Provide cast brass, polished chrome plated identification base plate with words "AUTO. SPKR."
6. Provide written statement under company letterhead with material submittal that

the submitted hose thread type and lettering has been confirmed with responding Fire Department.

2.08 PUMPING FACILITIES

A. Fire Pump Assembly.

1. Fire Pump

a. Pump shall be an electrical motor driven, horizontal split case single stage type.
b. Design capacity: 500 gpm at approximately 85 psi. Actual pressure rating shall be confirmed by contractor and based on current water flow test results and hydraulic calculations
c. Design attributes: 40 HP, 3525 RPM, 480 volt, 3 phase
d. Similar to: PEERLESS PUMP, Model 4AEF10G
e. Underwriters Listed and Factory Mutual Approved
f. The fire pump assembly shall be arranged to run continuously until shut down manually

2. Pump Accessories.

a. Suction and discharge fittings
b. Liquid filled discharge and suction pressure gauges
c. Automatic air release valve
d. Casing circulation relief valve
e. Pump test valve and flush mounted test header assembly
f. Digital pressure recorder device that includes monitoring of the voltage and amperage of the fire pump controller. Similar to FIRETROL “MARK II”

3. Motor.

a. Delta-wound squirrel cage motor with all leads brought out of the motor terminal box
b. Grease lubricated radial bearings and oil lubricated thrust ball bearings carrying total thrust of entire pump assembly
c. Vertically mounted
d. Drip-proof with drip cover

4. Fire Pump Controller.

a. Soft-start, soft-stop, interrupting transfer switch, and suitable for use as Service Equipment.
b. Isolating disconnect switch / circuit breaker, sized to coordinate with specified motor and controller.
c. Fire pump isolating disconnect switch shall be lockable in the on and off positions with 2 sets of normally open and normally closed Form C contacts rated 4 amperes @ 30 volts DC. Provide connections for

switch, open or tripped, to signal a trouble alarm at the fire alarm control panel, to interrupt the fire pump PTS emergency generator start circuit, and to provide a status signal to the BMS Floor mounted and enclosed, with required accessories including power failure alarm, phase reversal alarm, and pump running alarm.

d. Contacts shall be wired to terminal block for extension to building fire alarm system.

e. Similar to: FIRETROL, Model FTA1930.

5. Power Transfer Switch.

a. A power transfer switch shall be provided in accordance with NFPA 20, Article 7.8. The same manufacturer as the fire pump controller shall construct the PTS, which shall be UL listed/F.M. approved for fire pump service.

b. The ATS shall be housed in a dedicated NEMA 2 enclosure (attached to the fire pump controller) and labeled "Automatic Transfer Switch -Fire Pump".

c. A complete wiring diagram shall be provided for field wiring to the emergency power source and the electric fire pump controller.

d. The PTS shall be rated for 125 amps, 208 volt, 3 phase, withstand current rating (WCR) - 200,000 amps RMS SYM.

e. Engine control contacts, both N.O. and N.C., shall be provided to start the generator set when the normal power source fails. These contacts shall be designed for low voltage start signals.

f. Similar to: FIRETROL model FTA950

B. Pressure Maintenance Pump Assembly.

1. Multi-stage, in-line type
2. Design capacity: 10 GPM, +/-85 PSI head,
3. Design attributes: 3500 RPM, 1.5 HP, 208 volt, 3 phase, 1-1/4" suction, 1-1/4" discharge connections.
4. Similar to GRUNDFOS PUMPS CORP, model CR3-7

C. Pump Accessories.

1. Tamper switches - Provide tamper switches on the pressure maintenance pump suction and discharge control valves.

D. Motor.

1. Squirrel cage induction type, grease lubricated, vertically mounted, drip proof with drip cover.

E. Pressure Maintenance Pump Controller.

1. Wall mounted and enclosed with required accessories.
2. Running period timer.
3. Similar to FIRETROL model FTA500

2.09 FIRE PUMP TEST MANIFOLD

A. 2-Way flush mount.

1. 2-Way, cast brass body with angle inlet, two (2) 2½" connections outlets with hose thread, two (2) caps and chains x 4" NPT inlet.
2. Hose thread type shall comply with local requirements.
3. Finish shall be rough chrome plated body with polished chrome plated trim OR as otherwise specified by the Architect.
4. Similar to: POTTER-ROEMER, Model 5862
5. Provide cast brass, polished chrome plated identification base plate with words "FIRE PUMP TEST"
6. Provide two (2) 2½" gate valves, brass body with brass trim and swivel inlet. Similar to POTTER-ROEMER, Model 4365.
7. Provide written statement under company letterhead with material submittal that the submitted hose thread type and lettering has been confirmed with responding Fire Department.

2.10 ALARM ACTUATING DEVICES (Coordinate with Division 26)

A. Closed circuit OS&Y type valve tamper switches to operate within two revolutions of valve wheel.

1. Built-in models or Similar to: POTTER Electric Signal Co. model OSYSU-2.

B. Closed circuit Ball type valve tamper switches to monitor full open position of ball valve.

1. Built-in models or Similar to: POTTER Electric Signal Co. model RBVS.

C. Closed circuit waterflow indicators with retarding device to prevent false alarms from line surges.1

1. ½" and smaller:

a. Similar to POTTER Electric Signal, Model VSR-S

2. 2" and larger:

a. Similar to: POTTER Electric Signal, Model VSR-FE-2

D. All wiring from devices to main fire alarm panel to be responsibility of Division 26.

2.11 ALARM INDICATING DEVICES (Coordinate with Division 26)

A. Electric Bell.

1. 6" diameter Underwriters listed 24-volt DC type. Include weatherproof box and seal. Provide one electric bell inside the fire protection room and one on the building exterior. Coordinate exterior location with Architect.

2. Similar to: POTTER ELECTRIC SIGNAL CO. Model PBD246.

B. All wiring from devices to main fire alarm panel to be responsibility of Division 26.

2.12 VALVE TAGS, CHARTS, PIPE MARKERS AND EQUIPMENT SIGNAGE

A. Tags.

1. Brass 18 gauge with ½" stamped numbers and ¼" letters filled with black paint. Not less than 1 ½" inches round with 3/16" top hole.

a. Similar to: SETON Style No. 65542.

2. Provide on all valves and controls identifying numbered metal tags, with letter to indicate system (FP) fastened by heavy brass hook and chain.

a. Similar to: SETON Style Nos. 16197 and 16182.

B. Charts.

1. Provide (two) frame mounted and laminated: Valve tag charts along with a diagrammatic/schematic diagram showing essential features of system.
2. All fire protection control, test and drain valves shall be tagged.
3. Valve numbering and lettering shall correspond to designation on the metal valve tags.
4. Valve tag chart shall indicate valve location, function, and area controlled. Minimum size is 11" x 17".

C. Markers.

1. Provide ½" wide self-adhesive pipe markers with flow arrows at reasonable locations (not to exceed 30' intervals) and in accordance with Section 15000, on all concealed and exposed piping.

a. Similar to: SETON brand style Nos. M4268 and M4167.

D. Signage.

1. Provide proper signage on all fire protection valves and devices, describing device and function in accordance with NFPA requirements.

2.13 PIPE HANGERS and EARTHQUAKE BRACING

A. Top Beam Clamps.

1. Carbon steel, galvanized, clamp body with hardened steel cup point setscrew and locknut. Body shall be tapped through to permit extended adjustment of threaded rod. Similar to: TOLCO Figures 65 and 66.
2. Provide retaining straps for all beam clamps.

B. Hanger Rods.

1. Carbon steel, galvanized, continuous thread sized in accordance with NFPA 13 requirements. Similar to: TOLCO Figure 99.
2. Do not bend hanger rods. Use appropriate offsetting brackets/clamps.

C. Swivel Rings.

1. Carbon steel, galvanized. (For sizes 1" and larger). Similar to: TOLCO Figure 2.

D. Expansion Anchors.

1. Maximum loading, including pipe contents, covering and all required loads shall be 75 percent of rated load, SAE 110M, slotted type, plated with dull zinc finish. Similar to: HILTI Drop-In Anchor (HDI).
2. Use only at Owner approved locations.

E. Side Beam Brackets.

1. Carbon steel, galvanized, flush back plate with threaded eye socket, for pipe sizes 1" through 4".
2. Similar to: TOLCO Fig. 57.

F. Split Ring Hangers.

1. Carbon steel, galvanized, split ring hanger.
2. Similar to: ERICO, Model NI 429.

G. Steel Rod Couplings.

1. Carbon steel, galvanized
2. Similar to: TOLCO Fig. 70.

H. Earthquake Bracking.(If required)

1. Carbon steel, galvanized, UL/FM approved. Similar to: TOLCO Figures 906, 907, 908, 909, 910, 975, and 1000.

I. Other Hanger Materials.

1. All other hanger materials, assemblies and methods shall be UL/FM approved for their intended application.
2. All hanger and bracing material must be galvanized.

2.14 PRESSURE GAUGES

A. 3½" diameter, single spring, bronze bourdon tube with brass case and chrome plated brass ring with heavy glass. Include a shutoff/bleeder valve for testing and replacement.

1. Provide a pressure gauge with valve at the top of all risers.

2.15 PRESSURE GAUGES

A. 4” diameter, air/water, 0-300 PSI, accuracy ±3/2/3% of span (ASME B40.1 Grade B. Include a shutoff/bleeder valve for testing and replacement. Connection Material: copper alloy lower mount (LM) - 1/4" NPT limited to wrench flat area. Bourdon Tube: Material shall be copper alloy C-type. Movement: Copper alloy, silicone dampened. Dia: White plastic with stop pin - black & red lettering. Pointer: Black aluminum. Case: Black polycarbonate. Window: Acrylic, ultrasonically welded to case.

B. UL 393 Listed, FM Approved

C. Similar to ARGCO Standard Series, Type 110.10sp

1. Provide a pressure gauge with valve at the top of all standpipe risers.
2. Locate gauge in valve cabinet when riser is concealed at the top.

2.16 AIR VENTING

1. Air vent/s shall be provided on each wet pipe system/zone. The vent shall be located at a high point in the system/zone to allow air to be removed from that portion of the system/zone. Vents shall be of the automatic style, unless noted otherwise. similar to AGF Model 7000 PRV.

2. Air venting valves shall be accessible, unless noted otherwise. The air venting valve assembly should be located at an accessible point.

3. Automatic model, similar to AGF PURGEnVENT Model 7900AAV 1” automatic air venting valve assembly.

4. Manual model, similar to AGF PURGEnVENT Model 7910MAV ½” manual air venting valve.

2.17 PRESSURE RELIEF VALVES

1. Per NFPA 13, provide a listed relief valve assembly on all wet pipe systems/zones. The valve shall not be less than ½” in size and set to operate at 175 PSI, unless noted otherwise. Also provide a listed relief valve assembly downstream of system/zone check valves.
2. Similar to AGF Model 7000 PRV.

2.18 CORROSION MONITOR

1. Provide corrosion monitoring at the locations as recommended by the manufacturer. Typical locations include at the incoming FP water supply, mid-section of the sprinkler system and at remote/ end of a system.
2. Similar to AGF CORRinSITE Corrosion Monitor installed on a welded outlet and/or mechanical tee. Include (in permanent marker) the date of installation on the outer face of the monitor.

2.19 SPRINKLERS

A. General.

1. Cast brass, closed, quick response bulb type, standard spray with ½" discharge orifice.
2. Include complete sprinkler head descriptions on shop drawings. Provide make, model, temperature rating, and Sprinkler Identification Number (SIN) for all sprinklers.
3. Similar to: VIKING Corp. models unless noted otherwise.
4. Utilize ordinary temperature ratings, except as noted. Utilize high temperature ratings where subject to abnormal heating and conditions such as near heaters, heating lines, and in blast of heaters.
5. On exposed piping, use upright heads wherever possible and pendent type where necessary.
6. All sprinkler heads shall be quick response type (unless noted otherwise).

B. Sprinkler Types.

1. Exposed upright or pendent type, ½", brass. Similar to: VIKING Corp., SIN VK300 and VK302. Architect shall select finish.
2. Horizontal sidewall type, ½", brass. Similar to: VIKING Corp., SIN VK305. Architect shall select finish and style.
3. Extended coverage horizontal sidewall type, ¾" brass, 8.0 K-Factor. Similar to VIKING Corp., SIN VK630. Architect shall select finish.
4. Concealed pendent type, ½", brass, adjustable, with cover plate. Similar to: VIKING Corp., SIN 462. Architect shall select finish.
5. Dry horizontal sidewall type, ½", brass, adjustable with escutcheon plate. Similar to: VIKING Corp., SIN VK156. Architect shall select finish.
6. Extended coverage horizontal sidewall type, ¾", brass, 8.0 K-Factor, recessed with thread-on recessed escutcheon. Similar to: VIKING Corp., SIN VK630. Architect shall select finish.

C. Accessories.

1. Escutcheons shall be listed for the specific sprinklers they are used with. Similar to VIKING Corp., Model E-2.
2. Sprinkler head guards shall be listed for specific sprinkler heads they are protecting. Similar to VIKING Corp., Model D-1.

2.20 CABINETS

A. Spare Sprinkler Cabinet.

1. Enameled red steel. Similar to: POTTER-ROEMER, Model 6162.
2. Equipped with a minimum of two (2) sprinklers of each type and temperature rating used on the project, but not less than twelve (12) sprinklers. Concealed covers shall be provided when required by sprinkler type.
3. Equipped with a sprinkler wrench(s) that is needed to remove and install the

types of sprinklers included in the cabinet.

4. Equipped with a list of each type and temperature rating of sprinklers used on the project.

B. Fire Pump Test Connection Valve Storage Cabinet

1. Cabinet shall be sized to accommodate the three (3) fire pump test connection valves. Approximate size will be 20” wide x 20” high x 9.25” deep.
2. Cabinet construction shall be of 20-gauge sheet metal box, with a 20-gauge tubular steel door and 18-gauge frame.
3. Cabinet shall be surface mounted.
4. Door style shall be flush solid metal door with lock.
5. Finish shall be powder-coated with an electrostatically applied, thermally fused, recoatable OSHA red finish.
6. Labeling shall be: "FIRE PUMP TEST CONNECTION VALVES"
7. Similar to POTTER-ROEMER, Model 1815.

2.21 FIRE STOPPING

A. All fire stopping shall be UL listed assemblies.

1. Similar to: HILTI Firestop Systems.

PART 3 - EXECUTION

3.01 PIPING – GENERAL

A. Approximately as indicated, modify to suit building conditions, avoid interferences with other trades and maintain pitch.

B. Provide additional offsets, fittings, valves, drains, etc., where required by construction and work of other trades.

C. Run in chases, recesses, shafts, hung ceilings and beam cuts where applicable. Do not cover before examination and testing.

1. Run parallel with or at right angles to walls, other piping, neatly spaced with plumb risers.
2. Maintain 1” clearance between hubs, coverings and adjoining work.

D. Provide reducing fittings for changes in pipe size.

1. No bushings or street elbows permitted.
2. Grooved reducing couplings are acceptable for decreases of one nominal pipe size. (I.e.: 6" x 4", 3" x 2 ½", etc.).

E. Concealed piping in hung ceilings.

1. Obtain ceiling heights from Architect's Drawings.

F. Use extra heavy pipe for nipples where unthreaded portion of pipe is less than 1 1/2 inches long. No close nipples permitted.

G. Joints.

1. In accordance with manufacturer's instructions.
2. Provide dielectric fittings wherever pipes of dissimilar materials are connected.
3. Screwed piping: Clean-cut of exact length, ream pipe after cutting and threading, apply approved compound on male threads only, apply graphite on drain plugs.
4. Use extra heavy pipe for nipples where unthreaded portion of pipe is less than ½ inches long. Use close nipples only where necessary.
5. Ductile iron bell and spigot piping.

    a. Push-on rubber gasket joints, ANSI A21.11.
    b. Mechanical stuffing box type: Bolted assembly, ANSI A21.11.

6. Underground piping:

    a. Reinforce joints at fittings and valves with galvanized steel clamps and 3/4 in. galvanized steel rods, approved masonry thrust blocks in accordance with manufacturer's recommendations or combination of both in accordance with NFPA 13 and manufacturer's recommendations.
    b. Paint clamps and rods with heavy coat of bitumen solution paint.

H. Mechanical outlet fittings.

1. Must be equal to VICTAULIC #920 for sizes available, and #920N, where a #920 is not available in the required size. No other types or styles will be permitted.

I. Flanged piping with full-faced rubber gaskets.

J. Welded piping: (Shop application only, NO FIELD WELDING)

1. Oxyacetylene or electric arc process in accordance with latest accepted practice and in accordance with Underwriters Laboratories.
2. Performed only by welders meeting qualifying tests for strength welds in pressure piping of ANSI.
3. Provide, have tested, and submit for review, standard sample welds for each welder before he commences work.
4. Remove foreign matter from ends of pipe before tacking and welding, align pipe ends concentric, then tack weld to prevent misalignment during welding.
5. Welding fittings.

    a. Factory made, forged steel.
    b. Fabricated: Not permitted.

6. Connections.

a. One-half size of main or smaller, Weld-o-lets or Thread-o-lets permitted.
b. Larger connections: Regular welding tees.
c. Hammer, clean and flush out piping after welding to remove scale, slag, welding beads, etc.

3.02 CONCRETE BASES

A. Provide reinforced concrete bases of sufficient dimension for fire pumps, pressure-maintenance pumps, and controllers.

3.03 SLEEVES

A. Provide required clearance between piping and sleeves as required by NFPA 13.

B. Provide reduced clearances and flexible couplings wherever possible and increased clearances where necessary, unless noted otherwise.

3.04 AIR VENTING

1. The purpose of the air venting valve is to exhaust as much trapped air as possible from a single location every time the system is filled. The air venting valve should be located where it will be most effective. In order to effectively accomplish venting, it is necessary to choose a location where the greatest volume of trapped air is vented during the first fill and each subsequent drain and fill event. The vent connection to the system should be located off the top of horizontal piping at a high point in the system. Each wet pipe sprinkler system should be vented every time the system is filled.

3.05 PIPING SUPPORT

A. Maximum loading, including pipe contents, covering and all required loads, 75% of rating.

1. Support piping so as to secure in place, maintain required pitch and prevent vibration.
2. Design and installation shall be in accordance with NFPA 13.
3. Provide for expansion and contraction.
4. No piping shall be hung from other piping, ductwork, conduit, ceiling structure, etc.

B. Suspended Horizontal Piping:

1. Chain, strap, perforated bar and wire hangers: NOT PERMITTED.
2. Suspension from inserts, beam clamps, steel fishplates, cantilever brackets, or other approved methods with threaded rods with double nuts tightly made up.
3. Where overhead construction does not permit fastening hanger rods in required locations, provide additional steel framing as required and reviewed.
4. Maximum hanger spacing per NFPA 13 requirements.

C. Vertical Piping.

1. Riser clamps, bolted on each side of pipe and bearing equally on structure.
2. Similar to: TOLCO Riser Clamp Fig. 6.
3. Minimum clamp spacing: At every floor (or at a maximum of 15' on center).
4. At offset from vertical: By hanger on horizontal branch close to riser or base fitting on foundation.

D. If removal of existing fireproofing is required for installation purposes, such removal shall be kept to a minimum. The Fire Proofing Contractor shall replace all removed fireproofing with new, to the satisfaction of the Owner at no additional cost to the owner.

E. The Contractor shall provide all supplementary structural steel required or spanning between, or connecting to, building structural members, for the hanging or support of piping. Welding to or drilling into building structural members will not be permitted without the approval of the Owner and the Structural Engineer.

F. Supports: Hang or support sprinkler piping from overhead construction in accordance with NFPA 13, and maintain maximum headroom as practical.

G. Underground Piping: All underground piping shall be laid on 6" sand and backfilled with clean fine earth compacted to 12" above pipe. Complete backfill with available earth free of large boulders and sharp rocks. Tamp and overfill to allow for settlement.

3.06 CLEANING AND ADJUSTING

A. Brush and clean work, prior to concealing, painting, and acceptance. Perform in stages, if directed.

B. Painted or exposed work that is soiled or damaged must be cleaned and repaired to match adjoining work before final acceptance.

C. Remove debris from the inside and outside of all material and equipment.

D. Flush piping at least twice after installation and before final connections are made in a manner as directed and/or approved by the Owner, and in accordance with NFPA 13 requirements. Make all temporary connections and furnish all appliances required for the purpose of proper flushing at no extra expense to the Owner.

E. Adjust alarm-indicating devices to meet the requirements of the NYC Fire Marshal.

F. Remove and properly dispose of all unused or waste material.

3.07 TESTS

A. Provide required labor, equipment and connections for the following tests of the Combined Standpipe and Sprinkler System.

1. Pressure Test – The entire system shall be subjected to a hydrostatic test pressure of two hundred twenty five (225) psig for two (2) hours in accordance with NFPA 13.
2. Air Test – The pre-action system shall be subjected to an air test pressure of

forty (40) psig for 24 hours in accordance with NFPA 13

3. Trip Test – The pre-action system shall be subjected to a timed trip test in accordance with NFPA 13
4. Fire pump assembly acceptance testing in accordance with NFPA 20
5. Repair or replace defective work as indicated or as directed at no extra cost to the Owner.
6. Submit results of all testing for review within 1 week of completion of the test. Also include the results of all testing in O&M manuals.
7. Pay for cleanup and restoration or replacement of damaged work of others due to testing (which section 210000 may be responsible for)

B. Engage a factory-authorized service representative to review field-assembled fire pump assembly including fire pump, pressure maintenance pump, controllers and automatic transfer switch, all connections, and to observe and assist with acceptance testing. Results of all observations shall be reported in writing. Representative shall also train Owner's maintenance personnel on how to adjust, operate, and maintain fire pump, pressure maintenance pump, controllers, and automatic transfer switch.

3.08 VALVES

A. Provide control valves where indicated in the contract drawings or required. All valves shall be accessible.

B. Seal valves in proper position and provide approved tag and/or signage indicating purpose of valve. Indicate accurate field pressure settings of any pressure-activated valves.

1. Provide control valves with 24 volt closed circuit supervisory tamper switches, (see Alarm Actuating Devices section of this specification), mounted in accordance with manufacturer's requirements.
2. Install all valves at a maximum of 7'-0" above the finished floor unless otherwise indicated on contract drawings.

3.09 SPRINKLERS

A. All sprinklers shall be used in accordance with all conditions, requirements, and limitations of their listing and in accordance with NFPA 13 and all other applicable codes.

B. Install sprinklers, in hung ceiling areas, center of tile OR wood panels and align heads symmetrically with ceiling tile or panel. Install sprinklers in gypsum and plaster ceilings symmetrically and align with adjacent ceiling fixtures.

C. Install all concealed sprinklers on return bends.

D. Provide factory applied custom finishes and colors as selected by the Architect.

E. Refer to Architectural ceiling plans for preferred locations of sprinklers. Refer to architectural sections and details for required pipe routing. Notify Architect and/or Engineer of any conflicts.

3.10 WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess materials are Contractor's property. At completion of work, remove from Project site.

B. Excess Waste: Disposal and recycling of waste shall comply with requirements of Division 01 Section “Construction Waste Management And Disposal”. Provide documentation of compliance.”

END OF SECTION 21 00 00

SECTION 220000
PLUMBING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this Section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of the Contract General Conditions, Section 230000 General Provisions, and with the provisions of all applicable Local, State, and Federal Codes and laws.

1.03 SCOPE OF WORK

A. The work under this Section shall include all incidentals, labor, material, equipment, appliances, services, hoisting, scaffolding, supports, tools, consumable items, fees, licenses, and administrative tasks required to complete and make operable the plumbing work shown on the drawings and specified herein.

B. The Contractor shall furnish and install all equipment as necessary to provide a complete installation including system check out and start up on each item and system. The following equipment shall be provided:

1. Sanitary, waste, and vent systems.
2. Building sanitary drain to 5'-0" outside building.
3. Storm and roof drainage systems.
4. Building storm drain to 5'-0" outside building.
5. Domestic hot and cold-water systems.
6. Domestic water service to 5’-0” outside building.
7. Natural Gas service to 5’-0” outside building.
8. Fuel gas systems.
9. Kitchen equipment plumbing support systems and connections.
10. Pipe materials, hangers and supports.
11. Insulation
12. Valves
13. Pipe sleeves and seals.
14. Drains
15. Cleanouts
16. Plumbing fixtures
17. Water heating equipment
18. Pumps
19. Domestic booster pumping systems.
20. Water detection systems.
21. Hose bibbs and wall hydrants.
22. Drip pans.
23. Access panels.
24. Miscellaneous plumbing specialties.

1.04 WORK BY OTHERS

A. Division 26 shall provide power wiring to electrical devices. Section 220000 shall provide

and install all control wiring required for equipment operation. Section 220000 shall provide motor starters for installation by Division 26.

B. Section 220000 shall provide and install all make- up water distribution to HVAC equipment from outlet valve of backflow preventer. Section 220000 shall provide and install backflow preventer.

C. Section 203523 shall provide and install indirect condensate waste piping and trap to drain receptor from all HVAC equipment.

D. Excavating, backfilling, and compacting shall be provided under other divisions of this specification. Coordinate requirements.

E. Concrete housekeeping pads for floor-mounted equipment and concrete pits shall be provided under other divisions. Coordinate exact locations, dimensions, piping locations, and anchor bolt requirements.

1.05 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to all State, Local, and Federal Codes and Laws.

B. The criteria of design and performance to produce the required operation is based on equipment of the named manufacturers. Equipment of other manufacturers shall be considered, subject to its acceptability in the Engineer's judgment and opinion. The equipment must conform to the operational characteristics and dimensions established by specified item and the drawings for mechanical spaces and other clearances.

C. The following manufacturers, vendors, or materials, when provided in accordance with requirements of this Division, are approved for use. Materials supplied shall comply with specification requirements and be of a product of approved manufacturers. No deviations from this list shall be permitted unless specifically approved, in writing, after submission of satisfactory evidence relative to compliance with specification requirements.

1.06 SUBMITTALS

A. Procedure: Prepare and make the submissions listed below and in Section 230000.

B. Shop Drawings: Submit shop drawings of all items proposed to be furnished and installed under this Section which shall include but not be limited to.

1. Coordination drawings, coordinated with all other trades as outlined in Section 230000.
2. Piping materials, joints, and fittings.
3. Valves, tags and name plates with schedule and location.
4. Pipe hangers and supports.
5. Insulation
6. Valves
7. Pressure regulating valves.
8. Cross connection protection devices.
9. Pipe sleeves and seals.
10. Drains
11. Cleanouts
12. Plumbing fixtures
13. Water heating equipment
14. Pumps
15. Water detection equipment.
16. House tank equipment.
17. Hose bibbs and wall hydrants.

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18. Drip details.
19. Access panels.
20. Trap primers.
21. Miscellaneous plumbing specialties.
22. Welding certifications: submit reports as required for piping work,
23. Brazing certifications: submit reports as required for piping work.
24. Manufacturers' recommended installation procedures which, when approved, will become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

PART 2 - PRODUCTS

2.01 PIPE MATERIALS

A. Sanitary, waste, vent, and storm piping above ground (up to and including 10" size) within building: Hubless cast iron pipe with no hub fittings CISPI 301 and "Clamp-All 125" or 4 band "Huskey" clamps.

B. Sanitary, waste, vent, and storm piping below ground (all sizes and above slab over 10" size) within building: service weight cast iron pipe and fittings with hub and spigot ends, ASTM A74. Seal: one-piece neoprene rubber gaskets matching the internal configuration of the hub.

C. Exterior sanitary sewer pipe and fittings below ground (up to and including 12" size): polyvinyl chloride (PVC) type SDR35 pipe and fittings, ASTM D2665; D2949; D3034; F891. Pipe shall be installed in accordance with ASTM D2321.

D. Exterior storm sewer piping and fittings below ground (l5" and larger): reinforced concrete pipe ASTM C76, C655 and AASHO M-170. Joints; rubber and mortar type ASTM C443, C361. Piping and components shall comply with HS-20-44 loading requirements.

E. Domestic hot water, cold water, hot water recirculating, condensate, and indirect waste piping above ground: hard drawn seamless Type L copper tubing ASTM B88 with wrought copper solder fittings A.N.S.I. B16.22 and "Bridgit" or other no lead content solder joints ASTM B32-83, alloy Grades SN96 or SB5. Solder flux lead content-zero percent.

F. Domestic hot water, cold water, and hot water recirculation piping below ground: pre-insulated prefabricated and factory tested piping system consisting of Type K copper tubing hard temper ASTM B88, and wrought copper solder fittings ANSI B16.22 with lead free solder, non-compressible polyurethane insulation (K- Factor 0.14), 2" thickness and PVC outer jacket. Ricwil Econo-Gard piping systems.

G. Water service piping from well casing shall be Schedule 40 polyethylene 200 PSI water service piping ASTM D-2737, manufactured by Hastings. Fittings shall be Mueller 110 compression type.

H. Gas piping (up to and including 2" size): schedule 40 black steel ASTM A106, threaded end ANSI B1.20.1, with class 150 malleable iron threaded fittings ANSI B16.3.

I. Gas piping (over 2" size): schedule 40 black steel ASTM A106, with schedule 40 butt weld fittings.

J. Underground gas service piping: plastic piping conforming with "standard specifications for thermoplastic gas pressure pipe, tubing, and fittings" ASTM D2513. Pipe shall be marked "GAS" and "ASTM D2513". Piping shall be installed in accordance with NFPA 54, and manufacturer’s requirements.

2.02 PIPE HANGERS, SUPPORTS, SEISMIC RESTRAINT, AND VIBRATION ISOLATION

A. Pipe hangers and supports refer to Section 230523.

B. Seismic restraint: refer to Section 230000 and 230548.

C. Vibration isolation: refer to Section 230548.

2.03 INSULATION

A. Insulation and sound attenuation: refer to Section 230700.

2.04 VALVES

A. General: refer to Section 230523 for general plumbing service valves.

1. Domestic water systems up to 2-1/2"size: Nibco T-595-Y, 3-piece, full port, bronze threaded, 600 psi WOG.
2. Domestic water systems sizes 3" and over: Class 125, IBBM, gate valve.
3. Check valves for domestic water systems up to 2-1/2" size: class 125 all bronze, silent type, threaded.
4. Check valves for domestic water systems sizes 3" and over: class 125 IBBM flanged, silent check valve.
5. Balancing valve (domestic hot water circulation): all bronze, threaded end, calibrated stem, balancing ports, Armstrong CBVT series.

B. Backwater valves (BWV): Cast iron body with manual spade type bronze gate operated by a non-rising stem, integral check valve. Buried backwater valves equipped with cast iron extension collar and stem extending to top of slab or grade with nickel bronze top.

Manufacturer: Zurn model Z 1088.
Jay R Smith model 7150 series

C. Reduced pressure backflow preventers (RPD) - sizes 3/4" through 2": UL listed, AWWA, USC, and SBCCI/IAPMO approved bronze body reduced pressure zone air gap equipped with stainless steel relief and check valves, oversized copper funnel for pressure relief discharge piped to drain, bronze test cocks, integral body unions, bronze strainer and inlet and outlet ball valves.

Manufacturer: Watts 909 series, or HW-909 for hot water service.
Febco 825Y series.
Zurn/Wilkins 975XL series.

D. Reduced pressure backflow preventers (RPD) - sizes 2-1/2" to 4": UL listed, AWWA, USC, and SBCCI/IAPMO approved iron body reduced pressure zone air gap equipped with bronze relief and check valves, oversized copper funnel for pressure relief discharge piped to drain, bronze test cocks, complete with F.D.A. approved epoxy coated strainer and resilient wedge inlet and outlet gate valves.

Manufacturer: Watts 909 series.
Febco 825YD series.
Zurn/Wilkins 975 series.

E. Gas service valves: UL listed, for gas service, lubricated, semi-steel plug type, 100% pipe area, with threaded end ANSI B16.10 for up to 2"size, and 125 lb. ANSI B16.1 flanged for sizes over 2", 200 psi WOG.

Manufacturer: Homestead 6111/612 series.

F. Gas pressure regulating valves: Pilot controlled, and actuated. Sized for capacity and pressures as indicated on drawings.

Manufacturer: Rockwell 243-RPC series.

G. Water pressure regulating valve: the valve type shall be a fluid actuated pilot-controlled pressure regulating valve equipped with a pressure sustaining feature that will cut out flow at a pre-set minimum pressure. The cut-off minimum pressure shall be set in the field, after a documented flow test and water supply curve is performed and plotted. The valve shall incorporate:

1. Bronze body.
2. Sealed FDA approved elastomer diaphragm.
3. Stainless steel spring and stem
4. Quad-ring flow throttling retainer.
5. Brass hydraulic control pilots.
6. Copper control tubing.
7. Full size FDA approved strainer and blow down valve.
8. Inlet and outlet pressure gauges with bleed shut off valves on the gauge stem.

Manufacturer: Watts 115-2 series.
Watts Regulator Co. ACV Div., Houston TX.
Cla-Val 92-01 series.

H. Hose end drain valve NIBCO Fig. No. T-113-HC, all bronze gate (Watts #B-6000-cc, all bronze ball valve) with 3/4" hose thread outlet, threaded cap, rubber gasket and safety chain.

2.05 PIPE SLEEVES AND SEALS

A. Masonry walls and slabs: Schedule 40 galvanized steel pipe with integral water stop.

B. Piping seal (interior walls in contact with earth): interlocking expandable synthetic rubber links, assembled with corrosion resistant bolts, nuts and pressure plates; "Link type seal".

C. Piping seal (interior walls and floors in contact with earth): interlocking expandable synthetic rubber links, assembled with corrosion resistant bolts, nuts and pressure plates; "Link type seal".

D. Piping seal (interior floor slabs in contact with earth): seal between pipe and sleeve with a flexible elastomeric caulk listed specifically as a pipe sealant.

E. Sleeve adapters: coated cast iron, equipped with flashing clamp.

F. Fire and smoke seal: UL listed, approved, and tested fire and/or smoke sealing material installed in all fire and/or smoke rated floor and partitions in accordance with manufacturer's recommendations. Refer to 230000.

2.06 DRAINS

A. General: Provide all poured in place drains with 24" x 24" vinyl flashing.

B. Floor drain toilet rooms (FD1): cast iron body, bottom outlet, 7" diameter nickel bronze top, trap primer connection, seepage pan and combination membrane flashing clamp.

Manufacturer: Smith 2010-A
Wade 1100STD
Zurn ZN-415- type B strainer

C. Floors drain mechanical rooms (FD2): heavy duty floor drain with, cast iron body, bottom outlet, 9" diameter cast iron top, trap primer connection, seepage pan and combination membrane flashing clamp.

Manufacturer: Smith 2120
Wade 1310
Zurn Z-508

D. Floor drain kitchens (FD3): white acid resistant enamel (ARE) coated interior 6" deep cast

iron body, bottom outlet, 8" square nickel bronze top, white ARE interior bucket, seepage pan and combination membrane flashing clamp.
Manufacturer: Smith 3411-C series
Wade 9110 series
Zurn ZN-1910 series

E. Floor sink kitchens (FD4): white acid resistant enamel (ARE) coated interior 8" deep cast iron body, bottom outlet, 12" square nickel bronze top, white ARE interior bucket, seepage pan and combination membrane flashing clamp. Provide drains receiving indirect waste with 1/2 grate options.

Manufacturer: Smith 3151 series
Wade 9140 series
Zurn ZN-1901 series

F. Roof drain (RD): heavy duty drains with, 15" diameter cast iron body, bottom outlet, 12" diameter cast iron dome, roof sump receiver, under-deck clamp, insulation extension collar, and cast-iron combination membrane flashing clamp/gravel guard.
Manufacturer: Smith 1010 series
Wade 3000 series
Zurn Z-100 series

G. Overflow Roof Drain (ORD): heavy duty drains with, 15" diameter cast iron body, bottom outlet, 12" diameter cast iron dome, roof sump receiver, 4” standpipe, under-deck clamp, insulation extension collar, and cast-iron combination membrane flashing clamp/gravel guard.
Manufacturer: Smith 1070 series

2.07 CLEANOUTS

A. General: Provide all poured in place cleanouts with 24" x 24" vinyl flashing.

B. Floor cleanout (DPCO): areas incorporating floor finishes, adjustable round scoriated heavy duty nickel bronze secured top, cast-iron body, flashing flange and clamp, tapered bronze plug.
Manufacturer: Smith 4020 series
Wade 6000Z series
Zurn ZN-1400 series

C. Floor cleanout (DPCO): exposed concrete floor areas, adjustable round scoriated heavy duty cast iron secured top, cast-iron body, flashing flange and clamp, tapered bronze plug.
Manufacturer: Smith 4220 series
Wade 6000Z series
Zurn Z-1400 series

D. Floor cleanout (DPCO): carpeted areas, adjustable round scoriated heavy duty nickel bronze secured top, carpet marker, cast iron body, flashing flange and clamp, tapered bronze plug.
Manufacturer: Smith 4020 series
Wade 6000 series
Zurn ZN-1400 series

E. Floor cleanout (DPCO): exterior areas, adjustable round scoriated heavy-duty cast-iron top, cast ductile iron body, flashing flange and clamp, tapered bronze plug. Install cleanouts with 18" square x 6" deep concrete apron in non-paved areas.
Manufacturer: Smith 4250 series
Wade 8300MF series

F. Wall plate cleanout cover (WPCO): provided at cast iron cleanouts with tapered bronze plug a 6" x 6" chrome plated nickel bronze square frame and plate secured with vandal

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proof screws.
Manufacturer: Smith 4730 series
Wade 8480ST series
Zurn ZANB-1460 series

2.08 PLUMBING FIXTURES

A. General: Fixtures shall be new, complete with trimmings and fittings, including faucets, carriers, supplies, stops, traps, tailpieces, waste plugs, casings, hangers, plates, brackets, anchors, supports, hardware and fastening devices.

B. Stainless steel: type 302, 304, 316, or 317, as noted, sound deadened.

C. Trimmings and fittings: construct of forged, cast, rolled, or extruded brass or bronze with monel and other suitable non-corrosive parts: designed with easily renewable parts that are subject to wear or deterioration. No die castings and stampings other than brass or stainless steel.
Plumbing trim shall consist of:
Exposed surfaces: chrome plated. Pipe: copper type L.
Pipe fittings: threaded bronze.
Supply stops: chrome plated bronze, stuffing box, renewable seat washer.
Waste tailpiece: minimum #17-gauge brass.
Escutcheons: one-piece chrome plated cast brass or stainless steel.
Air Chambers: Nibco #620-L. 12” long

D. Water closets (WC): Wall-mounted, flushometer, standard and handicapped vitreous china, wall hung, 1.28 gpf low flow, elongated, siphon jet, with 1-1/2" top spud. Seat: heavy duty solid plastic elongated open front. Chrome plated electronic flush valve combined concealed carrier and support. Color: white.
Fixture: Toto CT708E(G).
Flushometer: Toto TET1LN32.

E. Urinal (UR): wall hung, flush valve, standard and/or handicapped, vitreous china, 0.125 gpf, ultra-low flow, washout with 3/4” top stud, complete with electric flush valve and combination concealed carrier and support. Color: white.
Fixture: Toto Ultra High-Efficiency Urinal and EcoPower Exposed Flush Valve

F. Under-Counter Lavatories (L1): Standard and Handicap Accessible. Vitreous china, counter mount, 1-1/2" cast brass P-trap with cleanout plug, chrome plated brass angle stops with loose key operator, and grid drain. Faucet: battery powered, infrared sensor activated, 0.5 gpm vandal-proof aerator and thermostatic mixing valve. Color: white.
Fixture: Kohler "Archer" K-2355.
Faucet: Bradley “Verge” “Zen” S53-3700 with 6-3700 soap dispenser.

G. Drinking water fountains (DF): non-refrigerated, “Hi-Lo” wall mounted barrier free drinking fountain with electronic bottle filler and a single drinking fountain unit, shall include 18 gauge Type 304 high polished stainless steel finish basins with integral swirl design, 14 gauge Type 304 high-polished stainless steel wall bracket, push-button operated stainless steel valves with front-accessible cartridge and flow adjustment, polished chrome-plated brass vandal-resistant waste strainers, vandal-resistant bottom plates, high-polished stainless steel finish back panel, 1-1/4” O.D. waste pipes, Flexi-Guard bubbler heads, in-line lead removal filter, support carriers and front access panels.
Manufacturer: Elkay LZWS-EDFPBM117K with ACCESS12X38-5.
and Elkay EDFP114C with AP99.

2.09 WATER HEATING EQUIPMENT

A. General: Water heaters shall conform to all applicable A.S.M.E. Standards and if gas fired Design Certified by the A.G.A. under Volume II "Tests for Commercial Heaters for Delivery of 140 Degrees F. Water", approved by the National Sanitation Foundation, and in compliance with ASHRAE 90.1-2007.

B. Domestic Water Heater (WH1): A gas-fired domestic water heater with submerged combustion chamber, helical heat exchanger coil, powered permanent anodes to protect the tank, glass lining on both sides of the heat exchanger, power-direct or conventional power venting and AMSE tank construction. The unit shall be capable of 95% thermal efficiency.
Manufacturer: A.O. Smith model BTH-199

C. Thermal expansion tank (ET1):

2.10 PUMPS

A. Domestic hot water circulating pumps: UL listed, all bronze, in-line centrifugal pump, close coupled.
Manufacturer: Bell & Gossett series PR.

B. Circulator controllers: UL listed, automatic immersion aquastat, adjustable temperature range, and differential immersion well. Electrical rating 115 VAC.
Manufacturer: Honeywell L4006A.

C. Domestic Pressure Booster Pump: Duplex, packaged system, UL listed, factory assembled, piped, wired, and tested on a common groutable painted steel base frame. Pump packaged equipped with pumps rated at 100 gpm @70' TDH, 5HP, stainless steel manifold piping, pressure (pilot) regulating/check valves, control panel, and 81gallon 125psig ASME hydropneumatic tank.
Manufacturer: Syncroflo #55DC33GAF-VFD with
Amtrol #WX-255PA hydro-tank.

D. Motor starters: UL listed, manual starting switch in NEMA 1 enclosure with "Hands-Off-Auto" selector switch. Refer to Section 230513.

2.11 WATER DETECTION SYSTEM

A. Cable water detection system: specification to follow.

B. Point water detection system: complete with water sensors, remote indicator panel and power supply. Include wiring between sensors and remote indicator.
Manufacturer: Water Alert SS-R(T) sensors, RI-2-(AT) remote indicator and PS-3 power supply.

2.12 MISCELLANEOUS PLUMBING SPECIALTIES

A. Mechanical mixing valves (TMV): bronze body, chrome plated, 3/8" inlet and outlet connections.
Manufacturer: Symmons #4-10 series.

B. Water hammer arrestors (WHA): all stainless steel, mechanical-pneumatic type, hermetically sealed bellows, threaded inlet; 150 psi WWP. Size and placement determination: PDI-WH 201.

Manufacturer: Precision Plumbing Products SC Series.

C. Trap primer valve: Automatic trap primer system including integral backflow preventer, flush or surface mounted cabinet, 120/220Vpower, pre-set 24-hour change, manual override switch, calibrated manifold for equal distribution. Locate manifolds per plumbing plans or as needed in mechanical rooms, janitor's closet's other locations approved by Architect and Engineer.
Manufacturer: Precision Plumbing Products PT series

D. Pressure gauge (PG): direct mounting, liquid filled, constructed with non-corrosive internal mechanism, recalibrator adjustment, assembled on 4-1/2" black phenolic turret type case with blow out plug, gasket sealed glass faced with dial, 0 to 200 psig range. Gauge accurate to 1% of scale range.
Manufacturer: Trerice 450LFB series.

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E. Gauge valve: all bronze needle valve, 150 psi WWP.

F. Water filter: two-piece high impact strength plastic housing, 125 psi WWP, replaceable 5-micron filter cartridge. Equip on cold water supply to all electric water coolers.
Manufacturer: AMF CUNO 1M housing with G78B2 filter series.

G. Water filter Scale Inhibitor: scale inhibitor water conditioner, constructed of high impact strength plastic for 125 psi WWP, equipped with integral by-pass and replaceable cartridge filter element, 1 to 6 gpm flow range. Equip on cold water make-up supply to all HVAC equip.
Manufacturer: Filterite SI-4 series.

H. Vacuum breaker (pressure type): bronze body, silicone vent disc, silicone check valve disc with bronze seat, 1/4 turn bronze ball valve, IAMPO listed, USC tested. Note: do not locate vacuum breaker in concealed space. Provide and install oversized copper drain pan with indirect waste piped to drain receptor.
Manufacturer: Watts 800 series.

I. Vacuum beaker (non-pressure type): brass body, silicone disc.
Manufacturer: Watts 288 series.

J. Freeze proof hose bibb (FPHB): surface mounted wall hydrant with polished bronze face plate and bronze casing with "T" handle key and internal vacuum breaker. Size 3/4".
Manufacturer: Zurn Z-1310 series.
Smith 5609 series.
Wade 8600 series.

K. Hose bibb (HB): unfinished areas, bronze body, removable valve seat and stem assembly, threaded end, and Watts NF8 vacuum breaker.
Manufacturer: Nibco #64 with Watts NF8 series.

L. Hose bibb (HB): finished areas, chrome plated bronze sill cock with "lock shield key", removable hand wheel, and vacuum breaker.
Manufacturer: Nibco 763-LS series.

M. Overflow Storm Water Downspout: Type 304 Stainless Steel Downspout Cover with Hinged Perforated Cover. Size per floor plan(s).
Manufacturer: Smith 1775 series

2.13 ACCESS DOORS IN WALLS AND CEILINGS

A. At each valve, cleanout or plumbing device requiring access, furnish an access door for installation by other sections. Rigid construction with two hinges and a latch. In plenum ceilings, provide felt between the door and frame to make an airtight seal. Access doors shall be flush mounted, prime coated with rust inhibitive paint, concealed frame, flush screwdriver operated locks with metal cams and anchors as required. Refer to division 8 for additional requirements.
Access door sizes shall be:
12" x 12" at easily accessible items.
16" x 16" where partial body access is required.
24" x 24" where full body access is required.
Manufacturer: Milcor type M series.
Cesco series.

2.14 DRIP PANS

A. Provide and install drip pans for piping as indicated on drawings and as required by actual field conditions where piping passes over including area within 3'-0" of electrical equipment. Refer to Section 233000 for materials.

PART 3 - EXECUTION

3.01 GENERAL

A. Drawings are diagrammatic and indicate a general arrangement of work. General design

concepts indicated must be followed or bettered. Do not scale drawings. Consult Architectural and Structural drawings for space conditions. Develop and submit coordination drawings as outlined in Section 230000.

B. Manufacturer's qualifications: firms regularly engaged in the manufacturer of fixtures, appliances, pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. Material qualifications: shall conform to all local, state, and national/federal codes and regulations which may apply and nothing in these specifications shall be interpreted as an infringement of such codes or regulations.

D. Welding: qualify welding procedures, welders, and operators in accordance with ASME B31.1, or ASME B31.9, as applicable. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).

E. Brazing: certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Except for concrete, corrugated metal, hub-and-spigot, clay, and similar units of pipe, provide factory-applied plastic endcaps on each length of pipe and tube. Maintain endcaps through shipping, storage, and handling, as required to prevent pipe-end damage, and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

3.03 ELECTRICAL CONNECTIONS AND WIRING

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A. Power wiring to electrical devices shall be installed by Division 26. The Plumbing Contractor shall be responsible to furnish all motor starters for installation by Division 26 and provide and install miscellaneous control and power wiring required by the equipment for proper and safe operation not specifically outlined in Division 26.

3.04 EQUIPMENT IN OTHER DIVISIONS AND/OR BY THE OTHERS

A. Kitchen, Laboratory, Laundry, and Darkroom equipment - Equipment shall be provided, set, assembled, and installed by Kitchen, Laboratory, Laundry, and Darkroom Contractor, except as noted below or on drawing.

B. Faucets and tailpieces and laboratory fittings shall be provided and set by other divisions. Piping connections shall be provided by Section 220000.

C. Section 220000 shall provide and/or install traps, stops, faucets, fittings, tailpieces, etc. including any miscellaneous trim and/or components not furnished by others but required for safe and proper operation and connect the service.

D. Obtain certified and approved prints of roughing drawings of equipment before starting work.

E. Coordinate and verify all equipment locations, connections, and equipment requirements with the appropriate Contractors (i.e., Kitchen, Laboratory, Laundry, Darkroom, etc.). Provide and install all piping and equipment necessary to operate all equipment properly and safely whether specifically shown or not.

F. All exposed piping, stops, cocks, and wastes which are visible to occupants shall be chrome plated.

G. Install gas piping, and gas piping specialties in accordance with NFPA 54, NFPA 58, and authorities having jurisdiction.

3.05 COORDINATION OF WORK

A. Carefully coordinate space requirements with other trades to insure that all materials can be installed in spaces allotted thereto, including finished suspended ceilings.

B. Prepare and submit coordination drawings as outlined in Section 230000.

C. Provide and install concrete housekeeping pads for all floor mounted plumbing equipment.

3.06 PIPING GENERAL

A. The word "piping" in this Specification shall mean pipe, fitting, flanges, nipples, and valves. Install underground piping as soon as possible so that trenches may be closed as quickly as possible.

B. No piping shall be covered until tested approved by the Authorities having jurisdiction.

C. Install all piping in correct relation thereto and the finished grades indicated on the drawings, and as required for coordination.

D. All piping shall be run perpendicular and/or parallel to floors, interior walls, etc. Piping and valves shall be grouped neatly and shall be run as to maximize headroom or passage clearance. All valves, controls and accessories concealed in furred spaces and requiring access for operation and maintenance shall be arranged to assure the use of a minimum number of access doors.

E. All pipelines made with screwed fittings must be provided with enough flanges and/or unions to allow for easy and convenient dismantling of the system without breaking fittings.

F. Check the drawings for space limitations permitted for the installation of piping such as shafts, chases, and furred ceilings.

G. All piping shall run concealed in furred spaces of occupied areas or chases wherever construction permits. Contractor shall obtain permission from the Contracting Officer to run any exposed pipes.

H. All pipes shall be reamed to full area before installation and blown clear of chips and dirt. With threaded pipes apply compound to the male thread only.

I. Cap all pipe and equipment outlets during construction and keep lines and inside of equipment free of foreign materials. Provide for expansion without warping or dislocating lines or straining connected equipment. Install piping to clear building construction and to avoid interference with other work.

J. Provide and erect in a workmanlike manner, according to the best practices of the trade, all piping shown on the drawings or required to complete the installation intended by these specifications.

K. The drawings indicate schematically the size and location of piping. Piping shall be set up and down and offset as required to meet field conditions.

L. This Contractor shall inform himself from the general construction specifications and plans, of the exact dimension of finished work and of the height of finished ceilings in all rooms where equipment or pipes are to be placed and arrange his work in accordance with the schedule of interior finishes, as indicated on the architectural drawings.

M. All piping below grade or building slab shall be coated with coal tar enamel.

N. Provide and install identification of piping and valves. Refer to other Division 23 Sections for installation requirements.

O. Provide and install additional pipe protection (i.e., concrete encasement, and /or laying condition, bedding type and methods.) for underground piping subject to excessive loading by depth of bury, traffic or other sources.

P. Underground piping shall be coordinated with concrete piers, footings, and grade beams. Piping shall not be located adjacent to the concrete structure’s bed closer than a 45-degree angle from the bottom of the concrete structure. Piping running below a wall footing or grade beam shall have a minimum non-bearing clearance of 6” above the pipe to the bottom of the concrete structure.

3.07 PRESSURIZED PIPING

A. Exterior water piping shall be installed at least 5'-0" below grade to top of pipe.

B. Water piping shall be run free of traps and unnecessary bends. Any traps formed shall be provided with hose end drain valves with threaded cap and chain to completely drain the system.

C. Install water hammer arrestors on water systems in accordance with manufacturer's recommendations.

D. Provide section cut-off valves on all main branches or as shown. Pitch and valve all water piping for convenient drainage.

E. Wherever dissimilar metals are joined together an approved dielectric fitting shall be used.

F. Each sectional shut-off shall have a brass tag and copper wire with a number. A chart shall be made up for each system setting forth the number of valves and what fixture it controls. Chart to be placed in glass frame and hung in Mechanical Equipment Room. Refer to Section 230000 for piping and valve identification requirements.

G. Balance domestic hot water recirculation systems to maintain temperature throughout entire system.

3.08 DRAINAGE PIPE INSTALLATION

A. Run all soil, waste and vent piping shown or required by local codes. Piping shown is minimum and in accordance with State and Federal codes. If local codes require additional venting or larger sizes, same shall take precedence.

B. Make all connections through traps. Each trap to be vented, either by circuit, loop, or individual vent, as required, but not less than shown, or as required by local code.

C. Install exterior underground sanitary and storm drainage piping at least 36 inches below grade to top of pipe unless otherwise specifically indicated.

D. Vent pipes shall be graded to free themselves of any water or condensation. Pitch vents not less than l/8" per foot up toward stack.

E. Install exterior cleanouts with a 18" square x 6" thick concrete apron.

F. Pitch horizontal storm water and drains within or buried under the building not less than

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l/8" per foot unless otherwise indicated on drawings.

G. Pitch horizontal sanitary and waste piping at 1/2" per ft. slope for piping 1-1/2" or less; 1/4" per ft. slope for piping 2" and 3" diameter; and 1/8" per ft. slope for piping 4" to 6" diameter.

H. Piping shall be laid true to line and grade as shown on the drawings, and in such a manner that a true and even surface at the invert is made over joints and throughout the entire length of the line. Piping shall be graded by the tripod level and measuring rod method assuring a uniform slope of the pipe.

I. All underground piping shall be laid on 6" sand and backfilled with clean fine earth compacted to 12" above pipe. Complete backfill with available earth free of large boulders and sharp rocks. Tamp backfill in 6" elevations and overfill to allow for settlement.

3.09 PIPING SUPPORT

A. General
1. Refer to Sections 230000, 230523, and 232000 for general requirements.
2. Protection shields shall be provided under all horizontally insulated piping at each hanger.
3. Provide necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations.

B. Horizontal piping support
1. Cast iron soil pipe shall be supported at not more than 5-foot intervals. Supports shall be of ferrous material.
2. Copper tubing shall be supported at approximately 6-foot intervals for piping l-l/2" and smaller and 10-foot intervals for piping 2" and larger. Supports shall be of copper material.

C. Vertical piping support
1. Cast iron soil pipe shall be supported at not less than every story height and at its base. Supports shall be of ferrous material.
2. Bases of cast iron soil stacks shall be supported on concrete, or metal brackets attached to the building structure, or any other methods designed to eliminate stress at the base of stacks and leaders approved by the local administrative authority.
3. Copper tubing shall be supported at each story for piping l-l/2" and over and not more than 4-foot intervals for piping l-l/4" and smaller. Supports shall be of copper material.

3.10 INSULATION

A. Refer to Section 230700 for installation requirements.

3.11 VALVES INSTALLATION

A. Refer to Section 203523 for general requirements.

B. Do not install air gap backflow preventers in concealed spaces or in areas where splashing water will damage finishes. Provide and install an oversized copper funnel with air gap directly below RPD pressure relief port. Pipe funnel to spill as an indirect waste to an approved drain location.

C. Install all trap primer valves in an accessible location. Provide and install access panels and doors where required to gain access in concealed construction.

3.12 SLEEVE INSTALLATION

A. Refer to Section 230000and 230523 for general requirements.

B. All piping through walls, floors or ceilings shall have sleeves and escutcheons.

C. All piping penetrating a slab on grade or foundation wall below grade and in contact with earth shall be provided with a poured in place schedule 80 galvanized steel watertight sleeve with integral water stop and seal equal to "link seal".

D. Furnish and set steel pipe sleeves of schedule 40 black steel for all locations of interior partitions, walls and floors providing at least 1/2" clearance between pipe insulation and sleeve or pipe and sleeve. Wall sleeves shall be smooth cut and set flush with finished walls. Floor sleeves shall extend 2" above the finished floor. Provide a two-piece chrome escutcheon where piping passes through walls or floors of finished spaces.

E. Fill void spaces between piping and pipe sleeves penetrating fire/smoke walls and floors with an approved UL listed and fire tested sealing material.

3.13 DRAIN AND CLEANOUT INSTALLATION

A. General: Provide and install all drains and cleanouts with 6# 24" x 24" vinyl flashing.

B. Make all connections through traps. Each trap to be vented, either by circuit, loop, or individual vent, as required, but not less than shown, or as required by local code.

C. Cleanouts shall be installed at the base of all stacks, at all changes of directions greater than 45 degrees and in runs to provide means of cleaning lines at maximum 50' intervals.

D. Coordinate floor drain locations with respect to equipment housekeeping pads. Place drains such that edge of the floor grate extends no further than 2 inches from the side of the pad.

3.14 PLUMBING FIXTURES

A. The fixtures shall be furnished complete with chrome plating on exposed piping or trim. Provide anchor bolts, hangers, strainers, faucets, and other incidental items furnished as standard. Provide loose key stops at every fixture. All supply fittings and exposed fixture trim shall be all brass, chrome plated.

B. All fixtures are to be new, free of cracks, blemishes, or other imperfections and to be "acid-resisting" quality.

C. Set and properly connect all fixtures with hot and cold water, vent, and drainage piping, as required and protect fixtures until acceptance and test. Clean all flush valves after two weeks of operation.

D. All piping through walls, floors or ceilings shall have sleeves and escutcheons.

E. Provide all fixture mounting supports and carriers as required to suit field conditions. Carriers and supports shall be floor mounted type except as noted.

F. Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Correct any incorrect location of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the engineer. All rough-in to plumbing fixtures shall conform to fixture manufacturer published rough-in dimensions, and requirements.

G. Adjust all plumbing fixtures, faucets, and flush valves to meet the maximum water consumption requirements listed herein.

Water closets:	1.6 gallons per flush
Urinals:	1.0 gallons per flush
Lavatory:	0.5 gpm flow restrictor

H. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

I. Inspect each installed unit for damage to finish. If damaged, restore and match finish to original at site to the satisfaction of the Architect/Engineer; otherwise, remove fixture and replace with new unit. Remove cracked or dented units and replace with new units.

J. Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation.

K. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream and specified gpm.

L. Exercise care in handling of fixtures, trim, pipe, and fittings. Use tools designed to prevent damage to surface finishes.

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M. Set fixtures level and uniformly, with connections at right angles to wall and properly centered. Lay out roughing accurately and in coordination with space and finish requirements. If field cut-outs and holes are required use proper cutting and drilling tools to maintain integrity of finished surface. Provide cut-out templates for countertop insert or undermount items.

N. Locate waste outlets and water supplies at constant horizontal levels, with waste outlet centered on fixture drain connection and water supplies spaced equally to right and left.

O. Support wall hung fixtures rigidly from building construction, not from piping, by means of concealed metal supporting members designed to carry weight of fixture under conditions of unusual loading, with no stress placed on waste connection or any other part of system.

P. Secure floor mount supports to slab. Secure wall mount supports to 1/4-inch-thick metal backup plate secured to wall construction. Do not use wire, nails, or other makeshift devices to secure supporting members. Secure recessed and inserted items to supporting surface.

Q. Use vandal-proof devices to secure fixtures, trimmings, and fittings to deter unauthorized removal. Provide chrome plated brass washers and cap nuts for exposed bolt ends.

R. Provide escutcheons, threaded, or held in place with threaded part or set screw, on piping and fixture supports protruding from wall or floor, and on visible connections to fixtures.

S. Make connection between integral trapped fixtures and drainage piping with an approved prepared gasket that shall be a germicide, absolutely gas and fume-proof, watertight, stainproof, containing neither oil or asphaltum, and which will not rot, harden, or dry under any extreme of climatic change, and must adhere on wet surfaces.

T. Use non-ferrous spacing devices to support and stabilize water piping.

U. Paint non-coated ferrous metal surfaces of fixtures, including brackets, hangers, and plates with prime coat of paint.

V. Upon completion of work, remove protective covers and thoroughly clean surfaces, traps, and strainers. Check all items for proper operation. Tighten packings and retaining devices.

W. Adjust flush valves to provide minimum flow consistent with cleaning requirements of fixtures. Adjust supplies to provide adequate flow without splashing, and with flow rate of hot and cold water equal in velocity, except as otherwise required.

3.15 INDIVIDUAL SIZES OF BRANCHES TO FIXTURES

	COLD	HOT	WASTE	VENT
Water closets(tank)	1/2"	---	4"	2"
Water closets (flush val)	1-1/4"	---	4"	2"
Urinals (flush valve)	1"	---	2"	1-1/2"
Lavatories	1/2"	1/2"	1-1/2"	1-1/2"
Electric water coolers and drinking fountains	1/2"	---	1-1/2"	1-1/2"
Hose bibbs	3/4"	--	---	---
Clothes washer	1/2"	1/2"	2"	1-1/2"
Service sink or mop receptor	3/4"	3/4"	3"	1-1/2"
Sinks	1/2"	1/2"	2"	1-1/2"
Showers	1/2"	1/2"	2"	1-1/2"
Tubs	1/2"	1/2"	1-1/2"	1-1/2"

3.16 ROUGHING HEIGHTS

A. Above Finished Floor

Lavatories 31" to top of rim.

Urinals	24" to top of rim.
Water closets	l5" to top of rim.
Electric water coolers and drinking fountains	33" to top of rim.
Hose bibbs	24" to bottom of spout

B. Handicap fixtures shall be set in accordance with ADA and local requirements.

3.17 EQUIPMENT IN OTHER DIVISIONS AND/OR BY OWNER

A. Plumber shall provide and install traps and stops and install faucets and tailpieces and connect the service as required.

B. Plumber shall obtain certified prints of roughing drawings of equipment before starting work.

3.18 GAS SYSTEMS

A. General: Conform to the requirements of NFPA 54.

B. Provide dirt trap, gas cock, and union at each connection to each piece of equipment.

C. Locate gas piping with adequate separation between electrical cables, equipment, and conduit.

D. Slope gas piping to low points without traps. Provide drips (pipe tee, nipple, and cap) at bottom of all vertical risers and drops.

E. Make branch connections to mains from top or side, not from bottom of main.

F. Extend unthreaded portions of piping at least 2 inches through finished wall surfaces, floors, ceilings, and sleeves.

G. Provide and install gas shut-off valves for the proper and safe control of the system.

H. DO NOT locate gas valves in spaces used as air plenums.

I. Verification: before making a gas connection, verify that equipment is compatible with the type and pressure of gas being supplied.

J. Purging: purge gas to safe location.

3.19 THRUST BLOCKS AND BRACING

A. General: Conform to the requirements of NFPA 24.

B. Thrust blocks for water piping shall be provided at all changes in direction both horizontally and vertically. Thrust blocks shall bear against undisturbed earth or earth installed in accordance with NFPA 24.

C. Use rough forms along ends of concrete. Place concrete directly against fittings to be braced, and directly against undisturbed surface of trench wall. Do not encase fittings in concrete.

3.20 PENETRATIONS THROUGH FIRE SEPARATIONS

A. Fire and smoke seal: UL listed, approved, and tested fire and/or smoke sealing material installed in all fire and/or smoke rated floor and partitions in accordance with manufacturer’s recommendations.

3.21 DISINFECTION OF POTABLE WATER SYSTEM

A. Potable water systems shall be disinfected in accordance with State and Local codes but by not less than one of the following methods before it is placed in operation.

B. The system, or part thereof, shall be filled with a solution containing 50 parts per million of available chlorine and allowed to stand 24 hours before flushing and returning to service.

C. The system, or part thereof, shall be filled with a solution containing 200 parts per million of available chlorine and allowed to stand 3 hours before flushing and returning to service.

3.22 TESTS

A. General: Test plumbing systems to satisfaction of Building Official. Do not close in, conceal, or cover up any plumbing work until it has been tested, inspected, and approved.

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B. Flush piping, prior to testing, to remove foreign materials which may have entered during course of installation. Clean filters and strainers after flushing.

C. Test all piping except drainage and vent piping, including valves, fittings, and joints hydrostatically at a pressure equal to at least l-l/2 times the normal working pressure of the system under which it is to be used, but no less than 100 psig for a minimum of four hours. Blank off or remove all elements or equipment which may be damaged by the pressure. Open but do not back-seat valves. Inspect all joints and connections.

D. Test rough plumbing drainage and vent system with water or air at least as follows:

1. Water test: apply water test to drainage system either in its entirety or in sections. If applied to entire system, tightly close all openings in piping, except highest, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, and fill section with water. In testing successive sections at least upper 10 feet of next preceding section shall be tested, so that no joint or pipe in building (except uppermost 10 feet of system) shall have been submitted to a test of less than a 10-foot head of water. Keep water in system or in portion under test, for at least 15 minutes before inspection starts; system shall then be tight at all points.

E. Final test for gas and water tightness to be as follows:

1. Smoke test: fill all traps with water, and then introduce into the system a pungent thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, they shall be closed, and a pressure equivalent to one inch water column shall be held for the test and inspection period.

F. Test all gas piping in accordance with NFPA 54 Section 4 with no leakage noted. Coordinate test procedure and requirements with local utility company.

G. Repair all leaks, defects or damage revealed by the results of the testing and re-test the system.

H. Do not insulate or conceal piping until the system has been tested and the results approved.

I. Perform tests in the presence of the Authority Having Jurisdiction. Notify Architect and/or Engineer.

3.23 TRAINING

A. Provide field training course for Owner's designated personnel.

B. Training shall be provided for a total period of at least (8) hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests.

C. Field training shall cover all the items contained in the operation and maintenance manuals.

END OF SECTION

SECTION 23 0000
GENERAL PROVISIONS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Work of this Division shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this Division as shown on the drawings, as specified herein, and/or as required by job conditions.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

C. Perform the work in accordance with the above requirements and the provisions of all applicable codes and laws.

D. Standard Specifications and Abbreviations

E. The following abbreviations used in the Specifications refer to organizations publishing specifications and standards. These shall be construed to mean the latest standard adopted and published at the date of advertisement for bids and such specifications are made part of the Contract Documents to the same extent as if written out in full.

ADA	Americans with Disabilities Act
ADC	Air Diffusion Council
AHDGA	American Hot Dip Galvanizing Association
AISC	American Institute of Steel Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	American Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
FIA	Factory Insurance Association
FM	Factory Mutual
FS	Federal Specifications
IGSPHA	International Ground Source Heat Pump Association
MCAA	Mechanical Contractors Association of America
MSS	Manufacturers Standardization Society of Valve and Fittings Industry
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety Health Act
PDI	Plumbing and Drainage Institute
PPI	Plastics Pipe Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
SSPC	Steel Structures Painting Council

STI Steel Tank Institute
UL Underwriters Laboratories, Inc.
USDC United States Department of Commerce
USPHS United States Public Health Service

a. Conform to ANSI - 31.1.0 and addenda for basic materials and methods of installation for closed piping systems with pressures in excess of 30 PSI, and for pipe welding regardless of system pressures.

b. Conform to ASME Boiler and Pressure Vessel Code Section VIII and FM requirements for construction of unfired pressure vessels.

1.02 INTENT

A. It is the intention of the specifications and drawings to provide for finished work, tested and ready for operation, subject to the requirements of the contract documents, including but not limited to Paragraphs 1.02 B, C and D below.

B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, necessary to render the work complete and ready for operation, shall be provided without additional cost to the Owner.

C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

D. The drawings show, among other things, the intent of the system components and routing. Some fittings and accessories are shown, but it is not the intent to show all similar or other fittings and accessories that will be required to install the systems in a coordinated way, as finished work. The contractor shall include all fittings and accessories as may be required to accomplish the coordination of the various building systems, to ensure the systems fit within the spaces provided, regardless of whether these fittings and/or accessories are shown on the drawings.

1.03 WORK INCLUDED

A. The work under this Division shall include all labor, material, equipment plant, services and administrative tasks required to complete and make operable the mechanical work shown on the Drawings and specified herein, including but not limited to, the following:

1. Preparation and submission of shop drawings, diagrams, and illustrations.

2. Procuring all necessary permits and approvals, and paying all required fees and charges in connection with the work of this Division.

3. Protection, testing, cleaning, adjustment and guarantee of the work of this Division to safely, properly and continuously operate.

4. As-built drawings, operating and maintenance instructions and manuals.

5. Identification labels, tags, charts and diagrams.

6. Excavation and backfill.

7. Independent commissioning of new and modified systems and all associated components as described herein.

1.04 RELATED WORK

A. Section 01015 – Volatile Organic Compound (VOC) Limits for Adhesives, Sealants and Architectural Coatings

B. Section 01300 – Submittals

C. Section 01515 – Construction IAQ Management

D. Section 01570 – Construction Waste Management

1.05 WORK NOT INCLUDED

A. Finish patching of all construction cut under this Division.

B. Waterproofing of roof penetrations for the work of this Division.

C. Concrete and masonry work except as specified.

D. Painting, except as noted.

1.06 SITE INVESTIGATION

A. Examine the drawings and specifications of all trades, and the site, and from these investigations be responsible for the nature and location of work, general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, etc.

1.07 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the Drawings. Consult the architectural drawings and details, and the drawings of other trades, for exact location of equipment.

B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which the work will be installed. Maintain maximum headroom and space conditions. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.

C. If directed by the Architect, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

D. The drawings are schematic and diagrammatic.

1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but not necessarily have dimensional significance; neither do they necessarily delineate all related and subsidiary parts and equipment.

2. The work shall be installed complete and ready for operation in conformity with the intent expressed on the drawings and in the specifications.

3. Coordinate the work with the requirements of the architectural and structural drawings for dimensions, locations and clearances.

4. Locations of items exposed to view shall be taken from the architectural drawings or located as directed.

1.08 COORDINATION WITH OTHER TRADES

A. Closely schedule the work so that work will be installed at the proper time without delaying the completion of the entire project.

B. Where the work will be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, arrange space conditions to make a satisfactory adjustment. If work is installed before coordinating with other trades, make necessary changes to the work to correct the condition without additional cost to the owner.

C. Prepare complete set of drawings showing all necessary slab openings and structural supports that require structural framing. Drawings shall clearly indicate sizes and location relative to established column lines. Drawings shall be completed in sufficient time to allow for structural steel fabrication so as not to delay project schedule.

D. Shop drawing submissions shall demonstrate a knowledge of the work of other trades, and shall show the locations of the work of other trades which affects the work of this contract.

1.09 EQUIPMENT DEVIATIONS

A. Where an item of equipment is proposed, other than that detailed or specified on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical or electrical layouts, such redesign, and new drawings required therefore, with approval of the Architect, shall be prepared without cost to the Owner.

B. Where such approved deviation requires a different quantity and arrangement of equipment from that specified or indicated on the drawings, provide required equipment, wiring, piping, connections, valves, and structural supports, and any other additional equipment required by the deviation, at no additional cost to the Owner.

C. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, the substituted item must conform in all essential respects to the specified item including operating efficiency, noise generated, and method of operation. Consideration will not be given claims that the substituted item meets performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.

1.10 EQUIPMENT AND SYSTEMS CRITERIA

A. The criteria of design and performance to produce the required operation are based on equipment shown or scheduled.

B. The equipment must conform to the structural design provisions for loads applied to the structure, to the dimensions established by drawings for machine spaces and other clearances, and for inlet and outlet locations and proper relationship to associated equipment, piping and ducts.

C. The descriptions cover basic equipment and operation but not all the details of design and construction.

D. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish all equipment required to produce specified performance under installed conditions.

E. Factory wiring, interconnections, piping and connections shall conform to these specifications for the field work.

F. Provide all trim, enclosures and accessories required to make a complete installation.

G. Finish mechanical equipment, motors, controls and similar apparatus with machinery enamel, prime coat, and finish coat. Provide prime coat suitable for field painting and other protective treatments and coatings as specified.

H. Acoustical performance of equipment and systems.

1. Noise levels from operation of motor driven equipment, whether air-borne or structure-borne, and noise levels created by or within air-handling equipment and air distribution and control media shall not exceed sound pressure levels determined by the noise criterion curves in the ASHRAE Guide as follows:

Location	Noise Criterion
Great Hall	NC-35
Changing Gallery	NC-35
Meeting Room	NC-30
Offices	NC-35
Classroom	NC-35
Galleries	NC-35
Remaining Spaces	NC-40

2. Testing for conformance to the above requirements will be provided by an acoustical consultant retained by the Owner.

a. Octave band sound pressure levels will be obtained for ambient room conditions with equipment not operating and with the installed equipment operating per plans and specifications.

b. For testing purposes, sound pressure levels will be measured 3'-0" above the floor.

1.11 APPROVALS

A. Obtain all approvals in accordance with Division 1 - General Requirements.

B. Submit to the Architect for approval a list of manufacturers of equipment proposed for the work.

C. Intent to use exact make specified does not relieve the Contractor of responsibility for submitting the required list.

D. Where any specific materials, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. In all cases, verify the duty specified with the specific characteristics of the equipment offered for approval.

E. Equipment of one type shall be products of one manufacturer.

1.12 SUBMITTALS

A. Procedure

1. Prepare and make the submissions listed below in accordance with the procedure specified in this Section.

B. Shop drawings

1. Equipment and system components.
2. Coordination Drawings.
3. Guarantees and Warrantees.
4. Operating and Maintenance Manual.
5. Record As-Built Drawings.
6. Identification Markings.
7. Fire rated penetration safing.

1.13 SUBMITTALS PROCEDURE

A. Refer to Division 1 - General Requirements for number of copies and routing procedure of submittals.

B. Shop drawings shall be submitted for each item listed in each specification section of this division or specified on plans. Required submittals shall be grouped by Paragraph number of the relevant Section of this Division and shall be provided with separate shop drawing submittal numbers. Common submissions including different equipment and/or components are not acceptable and will be summarily rejected.

C. Submittals shall include the following information on a cover sheet:

1. Job Name
2. Contractor's Name
3. Manufacturer's Name
4. Specification Section
5. Paragraph Number
6. Contractor Submission Number
7. List drawings and/or sheets included.
8. List variations from specifications and drawings
9. Space for Engineer's and Architect's Review Stamp

D. Submittals shall consist of following applicable items:

1. Manufacturer's Drawings.

a. Equipment listed in each section, include material specifications, operating characteristics, and finishes.

2. Installation Drawings.

a. Coordinated scale drawings of equipment including interconnecting piping and ductwork.

b. Coordinate space requirements for equipment and services.

c. Include connections, anchorages, and fastenings.

d. Make allowance for clearances for access to and maintenance equipment.

3. Wiring and Control Diagrams.

a. Electric wiring diagrams and automatic control diagrams and sequences of operation. The wiring diagrams must be complete and coordinated with the equipment installed.

4. Provide composite shop drawings showing work of all related construction, when required to ensure full coordination and proper fitting of the work, and when directed by the Architect.

5. Provide drawings showing dimensions and locations of concrete work required for the mechanical work.

6. Samples: Color samples for prefinished items.

7. Reports:

a. Manufacturer's certified pressure tests on vessels.

b. Manufacturer's certified performance tests on operating equipment.

c. Field pipe testing reports and certificates of approval.

d. Welder's certificates and field test report.

e. Field operating test results for operating equipment.

f. Performance report on the balancing of air and water systems.

g. Performance report and calculations for vibration isolation equipment.

h. Manufacturer's certified reports on motorized equipment alignment and installation.

E. If submissions of catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features proposed shall be clearly identified.

1. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.

2. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.

3. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that units may be checked individually and as an assembly.

4. Keep on the site, in good order, a complete up-to-date set of approved shop drawings. All shop drawings shall be available for inspection by the Architect.

5. The approval of shop drawings will be general and shall not be construed as permitting any departure from the contract requirements other than those specifically brought to the Architect's attention and so approved.

    a. If the shop drawings show any variations from contract requirements because of standard shop practices or other reasons, such variations shall be clearly identified on the drawings in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby.

    b. Failure to identify such variations will not relieve the Contractor of responsibility for executing the work in accordance with the Contract even though such shop drawings have been reviewed and the work installed.

    c. Review of submittal shall not relieve the Contractor of responsibility for any error in details, dimensions, etc., that may exist on shop drawings nor for the furnishing of materials or work required by the Contract and not indicated on the shop drawings.

    d. Review of submittal shall not be construed as approved departure from details or instructions previously furnished by the Architect.

    e. Review of submittal with a requirement for resubmission is an approval contingent upon satisfactory resubmission within 30 days. Failure to comply shall result in a revocation of the contingent approval.

F. Shop Drawing Schedule

1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions.

2. The schedule shall include the following information.

    a. Item to be submitted.
    b. Date of submission
    c. Latest date for approval
    d. Manufacturers of the specified item.

3. Items not specifically listed as "approved equal" should be listed for consideration at this time.

G. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:

1. NO EXCEPTION - Submittal appears to comply with the contract drawings and specifications. Contractor is not relieved of responsibility to meet the requirements of the contract drawings and specifications due to errors, omissions, or conflicts with other equipment or trades.

2. EXCEPTIONS AS NOTED - Submittal appears to comply with the contract drawings and specifications except for the items noted by the engineer. Contractor is not relieved of responsibility to meet the requirements of the contract drawings and specifications due to errors, omissions, or conflicts with other equipment or trades.

3. REVISE AND RESUBMIT - In the opinion of the engineer the nature and/or quantity of exceptions is sufficient to require resubmission to demonstrate compliance. Submittals must be returned within 30 days for contingent acceptance to remain valid. Submittals will become rejected if not returned within 30 days.

4. REJECTED - Submittal does not comply with contract drawings and specifications.

5. REVIEWED – Submittal was reviewed for impact on mechanical, electrical, plumbing and/or fire protection work.

1.14 PERMITS AND CERTIFICATES

A. Prior to proceeding with any installation, prepare and submit to the proper authorities, for their approval, all required working drawings. Provide all necessary notices, obtain all permits, and pay all local, state, and federal taxes, fees, and other costs in connection with the work.

B. The contractor shall be responsible for performing all controlled inspections required by applicable administrative building Code.

1.15 COORDINATION DRAWINGS

A. Sheet metal shop drawings that have been coordinated with architectural and structural drawings shall be submitted to Engineer for approval. Drawings must be returned from Engineer either "No Exception" or "Exceptions as Noted" prior to being used as basis for coordination drawings. Refer to Section 233000 for sheet metal shop drawing requirements.

B. After sheet metal drawings have been revised per Engineers comments, reproducible copies shall be sent to the others trades in the following sequence for the inclusion of their work:

1. plumbing contractor
2. electrical work
3. mechanical piping
4. sprinkler piping

C. Prior to inclusion of sprinkler piping and equipment, contractor shall have submitted sprinkler plans and calculations to engineer for approval and to Rating Bureau for review.

D. After all trades have included their work on the coordination drawing and noted conflicts, all trades shall meet to resolve conflicts and agree to acceptable solutions. Each trade shall sign coordination drawings. Items not shown on coordination drawing are responsibility of omitting contractor and contractor is subject to additional costs incurred by other trades.

E. The Architect and Engineer are not part of the coordination drawing process. The Engineer will aid relative to acceptability of installations.

F. Submit final signed coordination drawing to engineer. Only submit items that are different from previously approved shop drawings. Revisions shall be clearly indicated.

G. Any work fabricated or installed prior to sign off by all trades shall be removed and re-installed in conformance with coordination drawings.

H. Each contractor (mentioned above) is responsible for the coordination of his sub-contractors.

I. The overall coordination of the coordination process is the responsibility of the construction manager.

PART 2 DOCUMENTATION

2.01 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Furnish manufacturers operating and maintenance instructions, parts lists, and sources of supply for replacements in accordance with Division 1 - General Requirements.

B. Provide the following:

1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.

2. Bind each set within a common binder. Index and organize with a table of contents, to permit quick and convenient reference.

C. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force. Design a 2-week period, convenient to Owner, during which qualified personnel, including manufacturers' technicians and engineers will be available for Owner's instruction. Owner shall have the right to record the instruction sessions in video and/or audio format.

D. Master Operating Manual - submit hard copy and PDF (with bookmarks)

1. Manufacturer's mechanical and electrical equipment parts lists of all components of the systems listed on the equipment schedules, control diagrams and wiring diagrams of controllers. List shall give system number, unit number, manufacturer's model number, and manufacturer's drawing numbers.

2. Step by step operating instructions for each system including preparation for starting, summer operation, winter operation, shutdown and draining.

3. Maintenance instructions for each type of equipment.

4. Possible breakdowns and repairs for each type of equipment.

5. List of nearest local suppliers for all equipment.

6. Manufacturer's literature describing each piece of equipment listed on the equipment schedules, control diagrams and wiring diagrams of controllers and a copy of the air balance report.

7. As-installed control diagrams by the control manufacturer.

8. Description of sequence operation by the control manufacturer.

9. Recommended trouble shooting procedures in the event of foreseeable mechanical system failure.

10. Complete "As-Installed" color coded wiring diagrams of all systems and all electrical motor controller connections and interlock connections of all other mechanical equipment.

11. Chart of the tag numbers, location, and function of each valve.

12. Copies of the following test reports:

    a. Air Balance.
    b. Water Balance.
    c. System Performance.
    d. Required Pressure Tests.
    e. FM Water Flow Tests.

2.02 RECORD DRAWINGS

A. Provide "Record Drawings" in accordance with Article 4 of the General Conditions Governing all Contracts, indicating in a neat and accurate manner a complete record of all revisions of the original design of the work. Include all changes and accurately record, on reproductions of the contract drawings or appropriate shop drawings and in digital format (on flash drive in Adobe Acrobat PDF and either AutoCAD (2015 or later) or Revit (2015 or later), depending on the format under which the design team produced the contract documents. All deviations between the work shown on the contract documents and the work installed.

B. Record drawings shall include valve numbers, cross-referenced to the valve chart (for isolation and throttling valves) and to the automatic temperature control contractor's shop drawings (for control valves), for each valve.

C. Submit for approval bound sets of the required drawings, manuals, and operating instructions.

2.03 IDENTIFICATION MARKINGS

A. General - apply after insulation and field painting are completed.

B. Valve Identification

1. Furnish and attach to each valve a 2" diameter tag of solid brass with number and service abbreviated as noted on contract drawings. Numbers to correspond to consecutive numbers on valve chart identifying each individual valve.

2. Securely attach tags to the stem of valves with brass "S" hooks.

3. Provide valve charts mounted on 1/4" Masonite and covered with heat, bonded plastic laminate. They shall identify each valve by a number, service, its functions and list any remarks concerning special features of the valve; its location and the contract drawings which reference the valve.

4. Provide one such mounted valve chart in each Mechanical Equipment Room.

5. In addition, furnish one unmounted folded copy of the valve charts for each instruction manual.

C. Piping Identification

1. Provide identification for all bare or covered piping for all services, in spaces with or without ceilings, to be readable from the floor (even in the case of spaces with removable and/or hard ceilings – for identification if the ceilings are later removed). Piping shall be identified by prefabricated acrylic plastic markers. Markers shall be snap on or secured with bands (6" and over). Colors and lettering shall conform to ANSI Standard 13.1-1981. Seton Name Plate Company or the approved equal. Generally, they shall be located at changes of direction, take-offs, valves, where pipes pass through walls and at intervals not greater

than 30'-0" on straight runs, and shall indicate direction of flow at each marker.

D. Underground piping shall be provided with underground warning tapes, buried above piping run to identify by color and text, the utility below. Non-metallic piping shall be provided with warning tape having metallic core bonded between two polyethylene films. Seton Name Plate Company or the approved equal. The tape shall be installed 12"-36" below finished grade, directly above the buried pipe. Burial depth of the tape shall not exceed manufacturer's installation guidelines.

E. Ductwork Identification: Provide identification for all bare or insulated ductwork for all services, to be readable from the floor (even in the case of spaces with removable and/or hard ceilings – for identification if the ceilings are later removed). Ductwork shall be identified by service and associated unit tag number, and direction of airflow, using prefabricated acrylic plastic markers. Markers shall be self adhesive vinyl. Seton Name Plate Company 76470 or 76471, or the approved equal. Generally, they shall be located at changes of direction, take-offs, where ducts pass through walls and at intervals not greater than 30'-0" on straight runs.

F. Underground piping shall be provided with underground warning tapes, buried above piping run to identify by color and text, the utility below. Non-metallic piping shall be provided with warning tape having metallic core bonded between two polyethylene films. Seton Name Plate Company or the approved equal.

G. Equipment Identification

1. Identify all equipment listed in equipment schedules that are in mechanical rooms, on roof, outside adjacent to building, above ceilings, and other locations that are not exposed in finished areas. Identification shall be by unit tag (per drawings), or other approved unique identifier, on a permanently attached minimum 1-1/2" x 4" x 1/16" thick nameplate of white core laminated phenolic plastic with black surface and incised letters, located where it is legible and accessible. Where possible, mount plates in the same location on all similar pieces of equipment. Seton or approved equal.

    a. Identify wall mounted temperature, humidity and/or CO_2 sensors with the zone they serve on the inside of the cover or on the sensor backplate.

2. Each unit shall bear a manufacturer's nameplate with the following information:

    a. Manufacturer's name and address.
    b. Serial and model number.
    c. Rated capacity.
    d. Temperature pressure or other limitations.

3. Attach or mount adjacent to all controls and starters, a nameplate indicating which equipment it controls.

H. WARNING LABELS

1. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.

    a. Labels shall use white lettering (12-point type or larger) on a red background.

b. Warning labels shall read as follows.

C A U T I O N
This equipment is operating under automatic control and may start or stop at any time without warning. Switches disconnect to "Off" position before servicing.

2. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.

   a. Labels shall use white lettering (12-point type or larger) on a red background.

   b. Warning labels shall read as follows.

C A U T I O N
This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

PART 3 EXECUTION

3.01 COORDINATION AND LAYOUT

A. Study Drawings and Specifications to ensure completeness of work required. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete work, though not specifically indicated or specified.

B. Verify measurements and conditions in field before starting work.

C. Examine materials to which work is to be applied and notify the Architect, in writing, of any conditions existing which are detrimental to proper and expeditious installation of work. Starting of work shall be construed as acceptance of conditions.

D. Confer with other trades; install work to avoid interference with other trades and provide all necessary adjustments to conform to structural conditions and work of other trades.

E. Coordinate and set inserts and locate openings in floors and walls in new construction.

   1. Locate pipes and ducts to avoid interference with other work shown on the drawings and as directed by the Architect.

   2. Keep all concealed pipes and ducts within the enclosing construction provided.

   3. Arrange exposed work neatly in parallel runs and parallel with walls or structure, with uniformly spaced hangers and supports, and within the spaces assigned for each kind of work.

F. Make coordinated layouts showing concrete work required for housekeeping pads, equipment bases and inertia masses which are cast in place, including the location of anchors and dowels.

   1. Coordinate the scheduling and placing of the concrete to suit the mechanical work schedules.

   2. Concrete housekeeping pads are to cover the full area of each piece of equipment and extend 4” all around. Edges of housekeeping pads shall be chamfered.

3. Concrete bases are to be of dimension and heights to suit the equipment but shall not be less than 4” high unless specifically approved.

4. The forming and placing of concrete will be provided under this specification section.

3.02 USE OF PREMISES AND CLEANING

A. Remove and dispose of all waste materials and rubbish due to all construction operations under the contract, except as otherwise noted, and keep the building free from rubbish and dirt caused by his and/or his subcontractors' employees. During the entire progress of the work, rubbish removal shall be made frequently to prevent any potential safety or health hazard.

B. Upon completion of the work, remove all protection, paint, putty, and other stains from all fixtures and glass and leave the premises thoroughly broom cleaned.

3.03 EQUIPMENT INSTALLATION

A. Locate and set equipment anchor bolts, dowels and aligning devices for all equipment requiring them. Refer to concrete work coordination. Level the equipment and grout solid between the equipment and the surface below. Grout to be premixed Embeco or Five Star Grout mixed in accordance with manufacturer's specifications.

B. The field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspections, adjustments, and approval by the manufacturer.

C. Equipment startup: Each manufacturer of equipment shall provide qualified personnel to inspect and approve equipment and to supervise the operating tests of the equipment.

D. Equipment and system test operation.

1. Notify the Architect in advance of beginning the equipment and system test operation.

2. Each piece of equipment shall be operated in its system if required to provide proper functioning.

3. Perform an operating test of each complete system for twenty-four hours continuous operation as a minimum, or if required to provide coordination and proper functioning of all related systems and controls.

4. The operating criteria for each test shall be determined in advance with the Architect's approval whenever seasonal conditions will not produce a full design load on any equipment or system.

5. Certify to the Owner that all equipment is functioning properly.

6. Should the apparatus fail to meet the contract requirements, adjust, repair, or replace all defective or inoperative parts and conduct the complete performance tests again.

3.04 WORKMANSHIP

A. Perform all work in a practical, neat, and workmanlike manner with mechanics skilled in work, and using the best practices of the trade involved.

B. No work shall be concealed until it has been inspected and approved by the Architect.

C. Workmanship or materials not meeting with requirements of the specifications and drawings and satisfaction of the Architect shall be rejected and immediately replaced in an acceptable manner, without additional cost to the Owner.

3.05 EXCAVATION AND BACKFILLING

A. Excavation under the lump sum bid shall mean and intend the removal of all materials of every nature and description which are encountered in obtaining the lines and grades indicated or required for the work and which, in the opinion of the Architect, can be loosened and removed by hand, by means of hand tools or by means of power shovels. The Contractor shall assume that all excavations to the lines and grades required can be executed by the means.

B. Additional payment will be made by the Owner for the removal of all materials of every nature and description which are encountered in the work to obtain the required lines and grades and which, in the opinion of the Architect, require for removal the use of air operated hammers, barring and wedging or drilling and blasting. Vertical payment lines for such work shall be two feet (2') greater than the external diameter of the pipe installed in the trenches. No additional payment will be made for the removal of sidewalks, curbs, driveways, or pavements regardless of the methods used in removals. Such work shall be included in the work under the lump sum bid.

C. Protection - Provide all necessary and required sheet piling, bracing, and shoring to maintain the work safe to life, limb and property and all decking, guard rails and planking for the safety of pedestrians and vehicular traffic and all other precautionary measures as directed.

D. Trimming - The bottom of all excavations shall be trimmed to the lines and grades required for the work.

E. Surface and Subsurface Water - Provide and operate necessary equipment for pumping surface and subsurface water to keep excavations and foundations for the work under this contract always dry. The water shall be disposed of into sewers or other carry-off agencies in a manner approved by the Architect.

F. Surface and Subsurface Utilities

1. Active Services - When encountered in the work and where indicated on the drawings, all existing active sewer, gas, water, electric and other utility services and structures shall be protected at all times and where required for the proper execution of the work shall be relocated as directed by the Architect. If existing active services are not indicated but are encountered and require protection or relocation the Contractor shall request the Architect in writing for determination and decision in the matter and the work shall not proceed until written directions as to procedure are obtained.

2. Inactive Services - When encountered in the work, whether or not indicated on the drawings, all existing inactive sewer, water, gas, electric and other utility services and structures which interfere with the execution of the work shall be removed, capped, plugged or otherwise discontinued.

3. The cost of all work connected with protecting and maintaining all utilities shall be borne by the Contractor. The cost of relocating all utilities not indicated to be relocated, but directed to be, shall be borne by the Owner.

G. Blasting - Where blasting is required it shall be done by persons skilled in such work. All blasts shall be properly covered, and every precaution shall be taken to insure the safety of person and property. Blasting powder, caps and other explosives shall be stored in accordance with regulations of agencies or bureaus having jurisdiction thereof.

H. Restoration

1. Backfilling - After inspection and approval of the work, all sheeting and shoring shall be removed and the excavations shall be refilled with clean earth, thoroughly tamped. Excess material shall be removed as directed. Backfill shall be placed in horizontal layers not exceeding 12" in depth.

2. Surface Restoration - Surface of sidewalks, pavements, sodding, shrubs, etc., shall be restored to their original condition except as otherwise specified.

3. Removal of Temporary Work - Temporary decking, guard rails, planking and other protective work shall be removed when, in the opinion of the Commissioner, the need for same ceases to exist.

4. Repairs - All work removed or damaged through the installation or removal of the temporary protective work or through improper protection shall be replaced at no additional expense to the Owner.

3.06 CUTTING, ALTERING AND PATCHING

A. Provide all cutting, chasing, drilling, altering and rough patching required for the work of this division.

1. Including the restoring of existing work cut for or damaged by installation of new work, and where present work is removed.

2. All materials and workmanship required in connection with cutting, altering and rough patching shall match the existing work in every respect.

B. Do all shoring, bracing, cutting, patching, piecing out, filling in, repairing, and refinishing of all present work as made necessary by the alteration and the installation of new work.

C. All holes and openings occurring in the existing floors after equipment, partitions, floors, steel work, conduits and pipes are removed or installed shall be closed with materials like the adjacent work.

D. The size and location of items requiring an opening, chase, or other provisions to receive it shall be given by the trade requiring same in ample time to avoid undue cutting of any new work to be installed. These provisions shall not relieve the Contractor from keeping informed as to the required opening, chases, etc., nor from responsibility for the correctness thereof, nor for cutting and repairing after the new work is in place.

E. Include all cutting, repairing, and patching in connection with the work that may be required to make the several parts come together properly and fit it to receive or be received by the work of other trades, as shown on the drawings and/or specified, or reasonably implied by the drawings and specifications.

F. All repairing, patching, piecing-out, filling-in, restoring and refinishing shall be neatly done by mechanics skilled in their trade to leave same in condition satisfactory to the Owner.

G. Materials and their methods of application for patching shall comply with applicable requirements of the specifications. Materials and workmanship not covered by the specifications and items of work exposed to view adjoining existing work to remain shall conform to similar materials and workmanship existing in or adjacent to the spaces to be altered.

H. Cutting, repairing, and patching shall include all items shown on the drawings, specified in the specifications, or required by the installation of new work or the removal of existing work.

I. Remove partitions, walls, suspended ceilings, etc., as necessary to perform the required alterations or new construction work. Avoid damage to construction and finishes that are to remain.

J. Protect and be responsible for the existing building, facilities, and improvements. Any disturbance or damage to the work, the existing building, and improvements, or any impairment of facilities resulting from the construction operations, shall be promptly rectified, with the disturbed, damaged, or impaired work, restored, repaired, or replaced at no extra cost.

K. All alterations which are not indicated on the drawings nor specified herein but necessary to make good existing work disturbed by reason of the work shall be restored to a condition satisfactory to the Owner.

L. All holes in masonry floors and walls are to be core drilled.

M. Disturbed concrete and/or cement floor areas shall be patched with approved type latex mortar. When cement mortar is used for patching, the surfaces shall be depressed a minimum depth of 1".

N. Reinstall all weather protection work in waterproof manner.

O. Openings in roofs. Openings in roofs shall be kept properly plugged and always caulked, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of work, openings shall be permanently sealed.

P. Temporary openings. All temporary openings cut in walls, floors or ceilings for pipe or ductwork shall be closed off with non-combustible fiber cement boards containing no asbestos or other hazardous material, except when mechanics are working at the opening.

3.07 PENETRATIONS THROUGH FIRE SEPARATIONS

A. Where penetrating fire-rated floor slabs and partitions, pack the annular space between the sleeves (or core bore) and the pipes, conduits and cables with reusable fire-retardant modules, putty, sealant, or caulk. The sealant material shall be intumescent, asbestos free, and installed in accordance with UL and manufacturer's instructions. Sealant materials shall be easily removed and replaced for addition or deletion of pipe, conduit, and cables.

1. Penetrations with annular space greater than 1/2" shall be provided with approved backing material.

2. Sealants and assemblies shall match or exceed the rating of the item being penetrated. Refer to Architectural drawings for ratings.

3. Fire-retardant sealer and system shall be UL listed for the application and meet ASTM E-84, ASTM E-814, and UL-1479 requirements. Fire stop systems shall have F-ratings and T-ratings as required by the rating of the item being penetrated and shall never be rated

less than 1 hour.

B. Contractor shall photographically document proper fire stopping, sleeve and pathway products have been provided before locations are hidden from view.

C. Pack annular space between sleeve (or core bore) and pipe (insulation) and/or conduit in fire rated construction with fire retardant putty, sealant and/or caulk. Material shall be non-asbestos based and installed in accordance with manufacturer's instructions for fire rating required.

D. Penetrations of multiple items and penetrations with annular space greater than 1/2" shall be provided with approved backing material in accordance with manufacturer's instructions.

E. Fire retardant sealer and system shall meet ASTM E-84, ASTM E-814, and UL-1479.

F. MANUFACTURER MODEL

Provide manufacturer's standard products of their current offering, like or better than:

1.	Nelson	CLK, FSP
2.	Unifrax	Fiberfrax Fyre Putty
3.	3M	CP-25
4.	Hilti	Firestop Systems
5.	Grace Construction Products	Flamesafe

Or approved equal.

3.08 TEMPORARY HEAT

A. Provide all labor, fuels, materials, tools, appliances, and equipment and perform all operations necessary to maintain sufficient temporary heat to ensure uninterrupted progress in the work and to protect all work and materials against injury from dampness and cold until issuance of the Architect's Final Certificate. In addition to the foregoing, the contractor shall provide temporary heat to the extent itemized below, but not limited to the following:

1. During the placing, setting, and curing of all concrete, an ambient temperature of 50 degrees F shall be maintained in the areas involved.

2. During the placing, setting and/or curing of interior masonry, metal furring, plaster, tile; and taping and spackling of drywall an ambient temperature of 60 degrees F shall be maintained in the space involved.

3. In spaces where resilient floor coverings are stored an ambient temperature of 70 degrees F shall be maintained, and such temperature shall be maintained 48 hours before, during and 48 hours after installation in each space where such covering is required.

4. Except as noted above, all areas in which work is in progress, shall be maintained at 45 degrees F during working hours.

B. The building will be considered in an enclosed condition when roofing and exterior walls are in place and openings in exterior walls and roof have been provided with temporary or permanent closures.

C. The medium and procedure of providing temporary heat always shall be subject to the approval of the Owner and Architect.

D. Prior to the building being in an enclosed condition, temporary heat may be provided by approved type of heating and devices complete with covers, vents and/or smoke connections to the outer air so that all human hazards may be eliminated, and the surfaces of the buildings protected against damage by deleterious substances resulting from the heating operations.

E. Only heaters employing tanked gas will be permitted. The use of oil or coke as fuels will not be permitted. Provide thermal protection under heating units and pails of sand adjacent thereto.

F. Prior to starting the metal lathing, or drywall spackling, the work shall be sufficiently advanced for the building to be enclosed and for temporary heat to be produced by the permanent heating system.

G. After the building is enclosed and the permanent heating system or portion of the system is substantially complete and acceptable to the Owner for temporary heating use, the contractor may, at the Owner's discretion, be permitted to use such heating facilities for temporary heat.

H. The contractor in using the permanent heating system for temporary heating agrees to the following:

1. After the Architect and the Owner approve and accept the project heating system, or portion thereof, for temporary heating purposes, the heating system shall be turned over to the contractor. When the contractor has no further need for temporary heat, the heating system shall be returned to the Owner.

2. The contractor shall assume the cost of the fuel, the cost of other operating supplies used for temporary heating and the costs involved in the operation and maintenance of the temporary wiring and electricity. If the adaption of the temporary heating system to the contractor's temporary heating needs makes necessary the installation of temporary control valves, gauges, or piping, or the installation of temporary radiation units, the contractor shall bear the costs of such adaptations.

3. That portion of the project's heating system and other related mechanical equipment termed the temporary heating system shall be limited to equipment and the necessary piping, traps, valves, strainers, controls, pumps, starters, wiring and all other apparatus and equipment necessary to cause the temporary heating system to function correctly.

I. The cost of maintenance of the temporary heating system for temporary heating is the responsibility of the contractor.

J. Permanent duct work and air handling systems may not be utilized for temporary heat. The permanent boilers and piping systems may not be utilized for temporary heating without the operation of the permanent water treatment system.

K. These provisions for temporary heating do not alter the requirements of the "General and Supplementary General Conditions" with respect to "Guarantees" and/or any "General Guaranty" contained herein.

3.09 TEMPORARY COOLING

A. Provide all labor, materials, tools, appliances, and equipment and perform all operations necessary, once the building is in an enclosed and insulated condition, to maintain sufficient temporary cooling to ensure uninterrupted progress in the work and to protect all work and materials against injury from dampness and heat until issuance of the Architect's Final Certificate. In addition to the foregoing, the contractor shall provide temporary cooling to the extent itemized below, but not limited to the following:

1. In spaces where wood flooring systems, millwork and/or cabinetry will be stored and/or installed, a maximum ambient temperature of 78 degrees F and maximum relative humidity of 60% shall be maintained, and such conditions shall be maintained 48 hours before installation and/or storage, and continuously after installation in each space where such installation has occurred or where flooring systems, millwork and/or cabinetry items are stored.

2. In spaces where electronic equipment will be installed, maximum ambient temperature of 78 degrees F and maximum relative humidity of 60% shall be maintained, and such conditions shall be during installation, and continuously after installation in each space where such installation has occurred.

B. The building will be considered in an enclosed condition when roofing and exterior walls are in place and openings in exterior walls and roof have been provided with temporary or permanent closures.

C. The medium and procedure of providing temporary cooling always shall be subject to the approval of the Owner and Architect.

D. Prior to the building being in an enclosed condition, temporary cooling will not be required.

E. After the building is enclosed and the permanent cooling system or portion of the system is substantially complete and acceptable to the Owner for temporary cooling use, the contractor may, at the Owner's discretion, be permitted to use such cooling facilities for temporary cooling. Prior to such permanent cooling system components being used, all permanent overcurrent protection, conduit, wiring and controls shall be in place to protect the equipment and personnel. All piping pressure tests shall be performed prior to use of piping systems for temporary cooling purposes. Temporary cooling equipment shall be provided with overcurrent protection as required, coordinated with the various other contractors.

F. The contractor in using the permanent cooling system for temporary cooling agrees to the following:

1. After the Architect and the Owner approve and accept the project cooling system, or portion thereof, for temporary cooling purposes, the cooling system shall be turned over to the contractor. When the contractor has no further need for temporary cooling, the cooling system shall be returned to the Owner, after having been serviced and any normal maintenance having been performed.

2. The contractor shall assume the cost of the electricity and/or fuel, the cost of other operating supplies used for temporary cooling and the costs involved in the operation and maintenance of the temporary wiring and electricity. If the adaption of the temporary cooling system to the contractor's temporary cooling needs makes necessary the installation of temporary control valves, gauges, or piping, or the installation of temporary cooling units, the contractor shall bear the costs of such adaptations.

3. That portion of the project's cooling system and other related mechanical equipment termed the temporary cooling system shall be limited to equipment and the necessary chiller(s), cooling tower(s), heat exchanger(s), piping, valves, insulation, water treatment systems(s), strainers, controls, pumps, starters, permanent wiring, permanent overcurrent protection, permanent controls and all other apparatus and equipment necessary to cause the temporary cooling system to function correctly.

G. The cost of maintenance of the temporary cooling system for temporary cooling is the responsibility of the contractor. The contractor shall provide the Owner with a written summary of all maintenance, repairs, and service performed.

H. Permanent duct work and air handling systems may not be utilized for temporary cooling. The permanent chiller(s), cooling tower(s) and piping systems may not be utilized for temporary cooling without the operation of the permanent water treatment system.

I. These provisions for temporary cooling do not alter the requirements of the "General and Supplementary General Conditions" with respect to "Guarantees" and/or any "General Guaranty" contained herein.

3.10 CLEANING AND ADJUSTING

A. Blow out, clean, and flush each system of piping, and equipment as required to thoroughly clean the systems.

1. Clean all materials and equipment and leave in condition ready to operate and receive succeeding finishes where required.

2. Adjust and align all equipment interconnected with couplings or belts.

a. Adjust valves of all types and operating equipment of all types to provide proper operation.

b. Remove and clean elements in all steam trap bodies.

c. Clean all strainers.

B. Lubricate equipment as recommended by the manufacturer, during temporary construction use, and provide complete lubrication just prior to acceptance.

C. Permanent equipment operated during construction shall not be abused or be used in service different from its design application.

1. Temporary disposable filters shall be used during temporary operation.

2. All expendable media, including belts used for temporary operation and similar expendable materials shall be replaced just prior to acceptance.

3. Packing boxes of equipment operated during construction must be replaced just prior to system acceptance, using materials and methods specified by the supplying manufacturer.

D. Equipment furnished with factory finishes shall be retouched and repainted as required to present a new appearance.

E. Provide and maintain protection for all the work whether completed or in progress. Provide coverings and enclosures as required.

F. New and existing operating equipment and systems shall be clean and dust free inside and out. Concealed and unoccupied areas such as plenums, pipe and duct spaces and Equipment Rooms shall be free of rubbish and vacuumed clean at time of acceptance.

3.11 PAINTING

A. Thoroughly clean all surfaces, requiring prime painting, of rust, loose scale, oil and grease.

1. Dry surfaces before painting.

2. Do not paint controls, nameplates, or labels.

B. Paint all equipment not painted at the factory with one prime coat.

C. Provide field painting as follows:

1. All exposed iron work, including uninsulated ferrous piping and conduit system components, hangers, supports, equipment bases, and apparatus; prime coat with lead free primer suitable for application.

2. Uninsulated ductwork and casing exposed to view and exposed galvanized surfaces of conduit and piping and of equipment prime painted at the shop: Prime coat, zinc chromate for galvanized surfaces.

3. Inside of all ductworks where visible through registers and grilles: One coat of flat black paint.

3.12 CONNECTIONS TO EQUIPMENT

A. Provide mechanical connections to equipment and fixtures requiring such connections which are supplied by Owner or under other divisions.

B. Provide unions, nipples, adapters, valves, flexible connections, and other trim required for final connections for each such fixture or item of equipment, as required for complete and perfect operation.

3.13 LUBRICATION

A. All equipment furnished, installed, or connected under this division, shall be inspected for proper lubrication when connected and before operation of the equipment is begun.

B. The Contractor for the work of this division will be held responsible for any damage to equipment that is operated without having been properly lubricated.

3.14 SEISMIC RESTRAINT INTERNATIONAL BUILDING CODE 2015 (2018 NCBC)

A. Provide seismic restraint of all mechanical, electrical, plumbing and fire protection systems as required per International Building Code (IBC) 2015, including but not limited to Sections 1705, 1070 and 1708 and referenced sections and publications. The building is considered Seismic Design Category **B.**

1. Seismic Design Category B: All mechanical and electrical components are exempt from the seismic requirements of ASCE 7-10 Chapter 13.

3.15 HURRICANE ZONE CONSTRUCTION

A. Installation of HVAC equipment shall follow the requirements of the Chapter 16 of 2015 International Building Code and Chapter 7 of 2010 American Society of Civil Engineers. Contractor shall provide complete sealed wind load calculations performed by an engineer currently licensed by the State of North Carolina.

B. The HVAC installation shall comply but not limited to the following measures:

1. Exposed ductwork installation on the roof is not acceptable.
2. Vibration Isolation provided per section 230548 must provide uplift resistance.
3. The curb mounted equipment shall be anchored to the curbs with at least two screws at each side and the cowlings shall be attached to the curb with four (4) 3/8 SS cables. Curbs shall be properly affixed to the roof.
4. The base of the equipment. shall be anchored to the equipment stand and the stand shall be anchored to the roof. Wrap the units with at least 2 SS straps attached to the base with at least two screws or bolts at each end.
5. Roof-mounted equipment that uses latched access panels in lieu of hinges shall have hasps or other locking devices approved by equipment manufacturer.

3.16 WIND RESISTANT CONSTRUCTION

A. All roof mounted equipment shall be anchored and restrained such that the equipment will resist 110 MPH wind gust for 3 seconds.

B. Contractor shall provide complete signed and sealed wind load calculations performed by an engineer currently licensed by the State of North Carolina including the anchor details necessary to accomplish such restraint. Alternatively, Contractor may provide signed and sealed letter indicating that the weight of the equipment can resist the force of the wind.

3.17 TESTING AND BALANCING

A. Tests shall be performed in accordance with Division 1 - General Requirements, and the following.

B. Provide the services of an independent air and water balancing and testing firm which specializes in balancing and testing of heating, ventilating and air conditioning systems, and which is acceptable to the Owner. All instruments used shall be accurately calibrated and maintained in good working order. If requested, the balancing shall be conducted in the presence of the Architect/Owner.

C. Balancing shall not begin until the system has been completed and is in full working order. After completion of the balancing and testing submit copies of the results to the Architect.

D. Perform tests and make necessary adjustments to obtain the flow and distribution of air and water required to produce the operating criteria called for by the contract documents, in accordance with the latest standards of the National Environmental Balancing Bureau and the Associated Air Balance Council.

1. Occupied spaces shall be draft free upon completion.

2. Provide any necessary baffles at registers and diffusers.

3. Maintain the specified acoustical performance of the systems.

4. Mark final position of dampers and balancing valves.

E. Upon completion of the installation, test and balance all equipment and systems under field operating conditions to demonstrate its compliance with specification requirements. Submit three copies of the test report to the Architect. Refer to specification sections 230523 and 233000 for details of report requirements.

F. Should any part of the system fail to meet the contract requirements, adjust, repair, or replace all defective or inoperative parts again conduct the complete performance tests.

G. The Architect and Owner shall be notified, in writing, at least 48 hours prior to scheduled test dates.

3.18 COMMISSIONING PARTICIPATION

A. An independent commissioning agent (“Cx agent”) shall be hired by the Owner to verify the performance of the mechanical, plumbing and control systems. The commissioning agent shall include verifying operation of both the existing and new equipment and components as a complete integrated system.

B. The mechanical contractor shall work closely with and cooperate fully with the agent and attend all meetings and testing sessions as requested by the agent.

C. The mechanical contractor shall correct all system and installation deficiencies identified by the agent to achieve the goals outlined on the construction documents.

D. Testing shall include, but not be limited to, the following:

1. Demonstration of all control sequences described in the specifications and on the drawings to confirm correct equipment and control system operation including but not limited to:

    a. Operation of new chiller plant, including chillers, pumps, and controls.
    b. Operation and monitoring of new controls on new valves, fans, cooling coils, hot water coils, humidifiers, etc.
    c. Operation of heat tracing system with automatic system “off” based on ambient temperature control.
    d. Operation and calibration of new Owner electric metering equipment and surge protection equipment.
    e. Monitoring of space conditions (verification of sensor calibration).

3.19 GUARANTEES AND WARRANTEES

A. All workmanship, installation materials and equipment shall be maintained and serviced for the guarantee period at no additional cost to the Owner. Guarantee period shall begin upon final acceptance of the systems. The final acceptance of the equipment shall be after the manufacturer has adjusted the equipment, balanced the various systems, demonstrated that it fulfills the requirements of the drawings and specifications, and has furnished all the required close-out documents and certificates of inspection and approval.

B. Leave entire system installed under this Contract in perfect working order, and, without additional charge, replace any work or material which develops defects within the guarantee period, including all other work damaged because of such defects.

C. Non-durable, expendable items such as air filter media are not subject to replacement after the date of acceptance.

D. The guarantee period shall be a minimum of one year. The guarantee period shall be extended as follows:

1. For heating systems, one year plus the time necessary to include one continuous heating season from November 1st to April 1st.

2. For air-conditioning systems, one year plus the time necessary to include one continuous cooling season from May 1st to October 1st.

E. Manufacturers' Warranties

1. The manufacturer shall warrant that the equipment which he has furnished is free from defects in material and workmanship. Obligations under this warranty shall be as follows:

a. The equipment manufacturer or supplier shall provide and pay for all labor, parts, accessories, materials, freight, and other services to repair or replace any equipment or part thereof which, in the course of installation, start-up and testing is found to be defective.

b. For a period of one year from date of acceptance by the Owner or eighteen months from date of shipment, the manufacturer shall replace any defective equipment or part thereof; freight costs for return of defective parts, labor for parts replacement, and replacement of lost refrigerant, are the responsibility of the installing contractor.

c. The manufacturer shall provide an additional warranty on all refrigeration compressors under the same terms as Paragraph a, for a period of four years.

d. Tank linings – provide additional guarantee on all internal metal surfaces against corrosion for ten years.

e. Performance - where equipment is specified by size, guarantee that it will have the capacity specified in the system in which it is installed.

2. The final acceptance of the equipment will be made after the manufacturer has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirements of the drawings and specifications, and has furnished all the required certificates of inspection and approval.

3.20 MAINTENANCE OF EQUIPMENT AND SYSTEM PRIOR TO FINAL ACCEPTANCE

A. Maintain all equipment and systems installed until final acceptance by the Architect and the Owner and take such measures as necessary to ensure adequate protection of all equipment and materials during delivery, storage, installation, and shut-down conditions.

B. This responsibility shall include all provisions required to meet the conditions incidental to the delays pending final test of systems and equipment.

C. After installation of systems has been completed, operate the system to determine the capability of the equipment and controls to conform to the requirements of the drawings and specifications prior to performance testing.

END OF SECTION

SECTION 23 0513
MOTORS AND STARTERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the Contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

B. The installation and equipment are to conform to applicable building code articles and applicable reference standards cited therein.

1.03 SUBMITTALS

A. Procedure

1. Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

2. Shop Drawings

   a. Submit motors with individual items of driven equipment.
   b. Starters - Technical specs and application data.
   c. Schedule of starters including starter model, equipment served, starter enclosure, and accessories.
   d. Submit starter and drive unit wiring diagrams with the automatic control shop drawing submission required under Section 230000.
   e. Variable frequency drive units - Technical specs and application data.

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000

1.05 GENERAL REQUIREMENTS

A. Provide all necessary contacts, relays, and switches for motor operation in accordance with the control system sequences and safety device operation.

B. All motors, starters, push buttons, signal devices and motor controller equipment shall be NEMA standard, and UL listed.

C. All motors shall be covered by the warranty provided by the original equipment manufacturer which shall extend the full extent of the project warrantee. No motor shall be installed which has been manufactured more than two years prior to delivery.

PART 2 PRODUCTS

2.01 MOTORS

A. All motors shall be general purpose squirrel-cage induction type, NEMA Design B, Class B insulation, continuous duty, 40 °C ambient, single, or multiple speed as scheduled.

B. All three phase motors shall meet or exceed current NEMA Premium Efficiency design standards. Motor efficiency shall be indicated on the motor nameplate by the manufacturer per IEEE Standard 112 Method B and shall be no less than the following nominal efficiencies:

	Open Drip Proof (ODP)			**Totally Enclosed Fan-Cooled (TEFC)**		
Horsepower	1200 RPM	1800 RPM	3600 RPM	1200 RPM	1800 RPM	3600 RPM
1	82.5%	85.5%	77.0%	82.5%	85.5%	77.0%
1.5	86.5%	86.5%	84.0%	87.5%	86.5%	84.0%
2	87.5%	86.5%	85.5%	88.5%	86.5%	85.5%
3	88.5%	89.5%	85.5%	89.5%	89.5%	86.5%
5	89.5%	89.5%	86.5%	89.5%	89.5%	88.5%
7.5	90.2%	91.0%	88.5%	91.0%	91.7%	89.5%
10	91.7%	91.7%	89.5%	91.0%	91.7%	90.2%
15	91.7%	93.0%	90.2%	91.7%	92.4%	91.0%
20	92.4%	93.0%	91.0%	91.7%	93.0%	91.0%
25	93.0%	93.6%	91.7%	93.0%	93.6%	91.7%
30	93.6%	94.1%	91.7%	93.0%	93.6%	91.7%

C. Unless otherwise indicated, motors 1/2 horsepower and larger shall be three-phase; motors less than 1/2 horsepower shall be single phase. Motor voltage shall be as indicated; verify with Division 26.

D. All motors shall have a 1.15 minimum service factor.

E. Two speed motors shall be two winding type, RPM as noted on plans.

F. Single speed motors shall operate at 1750 RPM unless otherwise indicated.

G. Motors controlled by Variable Frequency Drive (VFD) units shall be rated for inverter duty (NEMA MG1, Part 31).

H. All motors shall have a terminal box, appropriate mounting base, and a ground post for connection of a ground conductor.

I. Motor enclosures shall be open drip-proof unless otherwise indicated or required.

J. Motor manufacturers:

1. General Electric Co.
2. Baldor
3. TECO-Westinghouse
4. Marathon
5. Reliance
6. U. S. Electric Motors

2.02 MANUAL STARTERS

A. Provide manual starters for single-phase motors that are not interlocked with other equipment.

B. Starter shall include quick make-quick break toggle mechanism in a suitable enclosure. The overload relay shall be field adjustable to +/-10% of nominal rating.

C.

Manufacturer	Series
Eaton	9101
General Electric	CR101
Siemens	SMF
Square D	Class 2510 Type F
Westinghouse	MS

2.03 MAGNETIC STARTERS

A. Provide electrically held magnetic starter for three-phase motors 1/2 horsepower and larger. Magnetic starters shall be combination type, with adjustable motor circuit protector, across-the-line contactor, and thermal overload relay in a common enclosure.

B. The motor circuit protector shall trip instantaneously when the motor current level is more than the trip setting. Trip settings of all poles shall be adjusted simultaneously by a single trip point adjustment.

C. The starter shall be suitable for connection to a power system having available fault current of 100,000 RMS symmetrical amperes.

D. Furnish contactors with one N.O. auxiliary interlock contact for the holding circuit, and a minimum of two additional auxiliary contacts. Coordinate auxiliary contacts with Section 230923.

E.

Manufacturer	Series
General Electric	CR387
Square D	Class 8539
TECO-Westinghouse	Class A206
Eaton	

2.04 STARTER ACCESSORIES

A. Enclosure shall be NEMA 1 for dry location, NEMA 4 for wet or outdoor locations.

B. The disconnect handle shall be capable of being padlocked in the open position.

C. Provide all starters unless otherwise specified with manual reset thermal type overload relays having inverse time delay characteristics and interchangeable heater elements.

D. Provide each starter with a red running light, neon type, mounted through cover.

E. Provide each starter with a three position, maintained contact, H-O-A selector switch, mounted through the cover.

F. Provide two speed starters for all motors listed with multiple speeds in the equipment schedules. Multiple speed starters shall be provided with a time delay relay when switching to a lower speed.

G. Furnish contactors with one N.O. auxiliary interlock contact for the holding circuit, and a minimum of two additional auxiliary contacts for each motor speed. Coordinate auxiliary contacts with Section 230923.

H. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage. Provide adjustable response delay.

2.05 VARIABLE FREQUENCY DRIVES

A. General

1. Where variable frequency control is indicated in drawings, schedules, or specifications, provide complete factory-assembled and -tested adjustable frequency AC drives as herein specified.

2. Variable frequency drives (VFD's) shall provide stepless speed control of standard NEMA Design B squirrel cage induction motors, without motor derating.

3. VFD's shall be variable torque design, suitable for HVAC pump, fan, and blower applications.

4. VFD's shall be tested and listed to the following standards:

   a. UL Standard 508C
   b. IEEE Standard 519-1992
   c. NEMA – ICS 7.0, AC Adjustable Speed Drives
   d. IEC 16800 Parts 1 and 2.

5. Each VFD shall be appropriately sized and rated to suit the driven load and input power characteristics.

6. VFD logic and control circuitry shall be microprocessor-based.

B. Design and Construction Features

1. Where located indoors in non-damp and non-wet environment, VFD enclosures shall be steel, ventilated NEMA 1, with hinged lockable door, suitable for wall mounting in sizes through 75 HP (at 460 VAC). Larger units shall have floor mounted, freestanding enclosures. Where located outdoors, provide NEMA 3R enclosures with strip heater and cooling system to meet manufacturer’s maximum temperature constraints. Where VFD is mounted in damp or wet environment, provide NEMA 3R enclosures with strip heater. Where located in plenums, provide VFD’s listed for plenums.

2. The input section shall include a full-wave diode bridge rectifier, padlockable door-interlocked disconnect switch, input power fuses, input line reactor, and output reactor / filter for circuits longer than 75 feet.

3. The inverter section shall be sine-coded pulse-width-modulated (PWM), utilizing Insulated Gate Bipolar Transistors (IGBT's).

C. Features

1. Produce rated output under the following service conditions:

   a. Rated input voltage +/- 10%.
   b. Ambient temperature 0°C. to 40°C.
   c. Relative humidity 0-95% non-condensing.
   d. Elevation up to 3300 feet above sea level.
   e. Input frequency 60 hertz, +/- 2 hertz.

2. Input displacement power factor - minimum 0.95 at any speed.

3. Output - 6 to 60 hertz, 0 to input volts, with adjustable volts/hertz.

4. Adjustable output current limit - to 115%.

5. Adjustable acceleration and deceleration rates.

6. Adjustable minimum and maximum speed limits.

7. Automatic restart after an input power loss, with adjustable time delay, if RUN command is still activated.

8. Input current THD - 5% maximum.

9. Efficiency - minimum 96% at full load, full speed.

10. Capable of a smooth start into a rotating motor (either direction).

11. Minimum 2 second power loss ride-through for logic and control power.

12. Motor noise attributable to the VFD shall be less than 3 dB above that with across-the-line operation, measured at 3 feet from the motor centerline.

13. Capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

14. Ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

15. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in NEC Table 430.250 for 3-phase alternating-current motors.

16. The VFD shall have an integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD’s with only one DC reactor shall add AC line reactors.

17. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD’s with higher input current ratings require the upstream wiring, protection devices and source transformers to be oversized per NEC 430.

18. Include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

19. Capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under-load condition.

20. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.

21. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

D. Protective Features

1. Integral I^2t electronic motor overload protection, adjustable.

2. Integral trip circuits for input power undervoltage, overvoltage, phase loss, and overcurrent.

3. Integral trip circuits for internal overtemperature, DC bus overvoltage, and internal or output circuit ground fault.

4. The VFD's shall be suitable for connection to a power system having available fault current of 100,000 RMS symmetrical amperes.

5. The VFD's shall be self-protecting against an open output circuit.

6. Provide input power line surge protection.

7. Provide user-selectable manual or automatic restart after a fault.

E. Controls and Indications

1. LED or LCD digital information display, including:

   a. Output frequency, voltage, and current.
   b. Input voltage, current, and KW.
   c. % Speed.
   d. % Load.

2. LED lamp or alphanumeric display indication of individual fault conditions.

3. Status indicators for POWER ON, READY, and RUN.

4. 3-position, maintained contact, Hand-Off-Auto selector switch.

5. Remote-Local speed reference selector.

6. Integral keypad for manual (local) speed control, adjustment, and programming functions.

7. Interfaces for remote safety contacts, start-stop contacts, and speed control (4-20 mA, 0-5 VDC, or 0-10 VDC, user selectable).

8. Form C (SPDT) dry contacts, wired to terminal blocks, for remote indication of RUN or FAULT.

9. Minimum of 3 programmable resonant frequency lockout bands.

F. Serial Communications

1. The VFD shall have an RS-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Optional protocols for LonWorks, BACnet, Profibus, Ethernet, and DeviceNet shall be available. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be “certified” by the governing authority. Use of non-certified protocols is not allowed.

2. The BACnet connection shall be an RS485, MSTP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

   a. Data Sharing – Read Property – B.
   b. Data Sharing – Write Property – B.
   c. Device Management – Dynamic Device Binding (Who-Is; I-AM).
   d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
   e. Device Management – Communication Control – B.

   f. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.

3. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.

4. The VFD shall allow the DDC to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the DDC system.

5. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass valve control, chilled water valve control, etc. Both the VFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The VFD shall keep the last good set-point command and last good DO & AO commands in memory in the event the serial communications connection is lost.

G. EMI / RFI Filtering

1. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assemble to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

H. Special Features

1. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection and shall be provided in both drive and bypass modes.

2. Door interlocked, pad-lockable, circuit breaker that will disconnect all input power from the drive and all internally mounted options.

3. Fused VFD only disconnect (service switch). Fast acting fuses exclusive to the VFD – fast acting fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which have no such fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted.

4. The drive / bypass shall provide single-phase motor protection in both the VFD and bypass modes.

5. The following operators shall be provided:

   a. Bypass Hand-Off-Auto
   b. Drive mode selector
   c. Bypass mode selector
   d. Bypass fault reset

6. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

   a. Power-on (Ready)
   b. Run enable (safeties) open
   c. Drive mode select damper opening
   d. Bypass mode selected
   e. Drive running
   f. Bypass running
   g. Drive fault
   h. Bypass fault
   i. Bypass H-O-A mode
   j. Automatic transfer to bypass selected
   k. Safety open
   l. Damper opening
   m. Damper end-switch made

7. The following relay (form C) outputs from the bypass shall be provided:

    a. System started
    b. System running
    c. Bypass override enabled
    d. Drive fault
    e. Bypass fault (motor overload or underload (broken belt))
    f. Bypass H-O-A position

8. The digital inputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.

9. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes (not functional in Fireman's Override 2). The remote start/stop contact shall operate in VFD and bypass modes.

10. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure for fireman's override. Two modes of operation are required.

    a. One mode forces the motor to bypass operation and overrides both the VFD and bypass H-O-A switches and forces the motor to operate across the line (test mode). The system will only respond to the digital inputs and motor protections.

    b. The second fireman's override mode remains as above, but will also defeat the overload and single-phase protection for bypass and ignore all keypad and digital inputs to the system (run until destruction).

11. The VFD shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in VFD or bypass mode). The VFD system (VFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the VFD system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.

12. Class 20 or 30 (selectable) electronic motor overload protection shall be included.

13. There shall be an internal switch to select manual or automatic bypass.

14. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode.

15. Output Reactor - A reactor (dv/dt filter) is to be installed between the drive and the motor if the total electric feeder distance between the two exceeds 75 feet.

I. Factory Testing and Warranty

1. Each unit shall be fully tested prior to shipment, including operation at full load for 8 hours in a 40^{o}C ambient.

2. Each unit shall be fully warranted by the manufacturer for a period of 36 months from date of shipment, including the cost of all parts, labor, and travel expenses.

J. Acceptable Manufacturers

1. Subject to compliance with requirements, provide variable frequency drives manufactured by one of the following:

a. Yaskawa Z1000 Series
b. Asea Brown Boveri (ABB)
c. Graham / Danfoss
d. Square D

2.06 BEARING PROTECTION RING

A. Whenever variable frequency Pulse Width Modulation (PWM) variable frequency drives are installed to control AC motors, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor to discharge shaft currents to ground.

B. Provide accessories as recommended by bearing protection ring manufacturer. Include Conductive Shaft Surface Coating (Colloidal Silver CS015).

C. Bearing Protection Ring shall be AEGIS®SGR or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. Motors shall be supplied as part of factory assembled equipment specified in other sections.

B. All starters and variable frequency drives (except where provided as integral to factory fabricated equipment) shall be turned over to the Division 26 contractor for mounting, installation, and wiring in conformance with all applicable codes and ordinances. Starters and drives shall be located within line-of-site of the associated equipment being controlled.

1. Starters and drives that are provided as integral to factory fabricated equipment shall be furnished and factory mounted by the equipment manufacturer, wired on the load side to the controlled motor and wired on the line side to single point power connection (where specified) by the equipment manufacturer in conformance with all applicable codes and ordinances. Where single point power connection to the factory fabricated equipment is not specified, starters and drives shall be provided with power terminal blocks for the Division 26 contractor to provide power wiring in conformance with all applicable codes and ordinances.

2. Where starters and drives are shipped loose with factory fabricated equipment, the Division 26 contractor shall receive same and mount, install, and wire in conformance with all applicable codes and ordinances.

C. Install overload heaters, adjust overload relays, and set motor circuit protectors in accordance with motor nameplate ratings and NEC Article 430.

D. Unless noted otherwise, starters for outdoor equipment shall be mounted attached to or adjacent to the equipment served and shall be provided with NEMA 3R enclosures with strip heaters.

3.02 MOTOR NOISE LEVEL

A. Motor drives for pumps and refrigeration machines, or other mechanical equipment having a motor installed within a mechanical room, shall operate with noise levels not exceeding 85 dBA.

B. Noise levels shall be determined in accordance with IEEE Standard #85 "Test Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment".

C. Motor drives for fans, regardless of where located, or other mechanical equipment located outside mechanical equipment spaces, shall not contribute to increase the manufacturer's sound power ratings by 2 dB in any octave band.

3.03 VARIABLE FREQUENCY DRIVE START-UP

A. A factory authorized field service technician shall perform inspection of the drive installation and wiring, initial energizing and start-up, and the adjustments and programming necessary to achieve specified operation and performance.

B. The factory-authorized field service technician shall program the 3 available resonant frequency lockout bands during motor/drive start-up based on actual motor/equipment performance for each drive. Provide the necessary frequency and vibration testing instruments.

C. After successful start-up, a factory authorized representative shall provide a minimum of four (4) hours training and demonstration to Owner's personnel.

END OF SECTION

SECTION 23 0523
PIPING, VALVES AND FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of section 230000, General Provisions, and with the provisions of all applicable codes and laws.

1.03 SUBMITTALS

A. Procedure

1. Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop drawings

1. Piping Materials, Joints and Fittings.
2. Piping Specialties.
3. Pre-insulated Piping
4. Valve Tags and Name Plates with Schedule and Location.
5. Valves.
6. Strainers.
7. Compression Tanks/Expansion tanks
8. Chilled water buffer tank
9. Hot water accessories
10. Anchors and guides
11. Safety valves
12. Expansion Joints
13. Thermometers, gauges, complete listing with scale range and normal operating point.
14. Water balance, contractors’ qualification, procedures, and report format
15. Water Balance Report.

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000. Produce and maintain required effect under operating criteria determined in advance by agreement with the Architect.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. All pipe shall be new, free from scale or rust, and of the material and weight specified under the various services. Each length of pipe shall be properly marked at the mill for proper identification with name of symbol or manufacturer.

B. All steel piping shall be standard or extra strong weight, in conformance with the ASTM designation A-53 or A-106 as manufactured by National Tube Division, Republic Steel Corp., or approved equal. Piping shall be seamless except as specified herein.

C. All brass piping shall be standard or extra heavy weight 85% red brass semi-annealed seamless-drawn, in conformance with the ASTM designation B-43, as manufactured by Anaconda, American Brass Co., Chase Brass and Copper Co., or Revere Copper and Brass, Inc.

D. All copper tubing shall be of weight as required for service specified in conformance with ASTM designation B-88-47 for types "L" and "K" tubing, as manufactured by Chase, Anaconda, Revere, or approved equal. Copper tubing shall be used as specified in the schedule. Tubing and fittings shall be thoroughly cleaned with sand cloth and treated with an approved flux before solder is applied.

E. All galvanized steel piping shall be standard or extra strong weight, as specified, in conformance with the ASTM designation A-53. Pipe shall be hot-dipped zinc-coated with prime western spelter and not wipes.

F. Generally, unless otherwise specified, joints in steel and wrought-iron piping of sizes 2 inches and under shall be screwed, and all sizes 2-1/2" inches and over shall be welded or flanged. All drain piping shall be screwed. Brass pipe shall be screwed 2 inches and smaller and flanged 2-1/2 inches and over. Copper tubing shall be silver-soldered or 95-5 solder as herein specified.

2.02 FITTINGS

A. Fittings shall be as specified under "Fitting Schedule" for various services.

B. Welding fittings shall be of the same material and schedule as the pipe to which they are welded. Welding elbows shall be long radius pattern unless clearances necessitate the use of standard radius pattern. Welding fittings shall be Tubeturn or Ladish.

Steel Welding Fittings	ASTM A-106
Wrought Iron Welding Fittings	ASTM A- 72
Malleable Iron Fittings	ASTM A-197
Cast-Iron Fittings	ASTM A-126
Brass Fittings	ASTM B- 62
Solder Fittings	ASME/ANSI B16.22

C. All fittings used at expansion loops or bends shall be extra heavy.

D. Cast-iron, malleable-iron and bronze fittings shall be of Crane Manufacture or approved equal.

E. Flanges shall be of the same weight as the fittings in each service category. All flanges shall be drilled and spot faced in conformance with fittings. Screwed and loose flanges shall be of cast iron. Welding flanges shall be of steel welding neck type, flanges on brass to be Crane No. 2104 or approved equal.

F. Flanges shall be faced and true and made up perfectly square and tight with gaskets. Bolts, nuts and gaskets shall be dipped in a mixture of graphite and oil just before installation.

G. Unions - Unions 2 inches and smaller shall be screwed. Unions 2-1/2" and larger shall be flanged. Screwed unions on steel pipe, unless otherwise specified, shall be of malleable iron with bronze ground seats suitable for 300 pounds, W.S.P. Screwed unions on brass pipe shall be brass, ground joint suitable for 300 pounds W.SP. Flanged unions shall be malleable iron, gasket type suitable for 150 pounds W.S.P. Unions shall be as manufactured by Crane, Dart or approved equal.

H. Brass pipe threads shall be cut with special brass threading dies, and the joints shall be made with lubricant. Strap wrenches, or equivalent, shall be used in making up brass pipe. Wrenches that gouge or scar the pipe will not be used.

I. Solder for each solder-type fitting shall be of 95% tin and 5% antimony or silver solder, as specified herein.

J. Fittings shall be of the eccentric reducing type unless otherwise noted, where changes of size occur in horizontal piping to provide for proper drainage or venting. Steel pipe bends shall be made of the very best grade open hearth, low carbon steel, leaving a smooth uniform exterior and interior finish. Pipe bends shall be made with seamless steel pipe, leaving a minimum radius of not less than five (5) pipe diameters.

2.03 PIPE SCHEDULE

A. All piping materials installed under this Section shall be new and shall consist of the following materials and construction:

Service	2" and Smaller	2-1/2" and Larger
Chilled Water Hot Water Vents and Drains		
Construction:	Solder joint construction with threaded adapters as required. 95-5 Tin/Antimony solder.	Welded construction with flanged connections to valves and equipment
Piping:	Copper, Type L, hard drawn, ANSI H23.1, ASTM B88.	Black steel, schedule 40, seamless, ASTM A106, Grade A or B.
Unions:	Bronze solder ends, ground joints, ANSI B16.19 or ANSI B16.22.	Steel, Class 150, weld type, ANSI B16.5, ASTM A181, Grade 1.
Flanges:	Cast bronze, Class 150, solder type, ANSI B16.24	Steel, Class 150, weld type, ANSI B16.5, ASTM A234, Grade WPA

Service		2" and Smaller	2-1/2" and Larger
Cooling Coil Drains Cold Water Make-Up			
	Construction:	Solder joint construction with threaded adapters as required. 95-5 Tin/Antimony solder.	Solder joint construction with threaded adapters as required. 95-5 Tin/Antimony solder.
	Piping:	Copper, Type L, hard drawn, ANSI H23.1, ASTM B88.	Copper, Type L, hard drawn, ANSI H23.1, ASTM B88.
	Fittings:	Cast bronze or wrought copper, solder ends, ANSI B16.189 or ANSI B16.22	Cast bronze or wrought copper with solder ends, ANSI B16.19 or ANSI B16.22.
Refrigerant:		Copper Type “K” ACR	Wrought silver brazed tempered tubing.

B. Flange Bolts and Nuts:

Bolts: ANSI B181, ASTM A307, Grade B, square head, course-thread series, Class 2B fit.

Nuts: ANSI B18.2.2, ASTM A307, Grade B, hexagonal, heavy series, semi-finished, course-thread series, Class 2B fit.

C. Gaskets: Flat ring 1/16-inch thick, compressed synthetic fiber with SBR binder. Garlock Style 3200, or an approved equal.

D. Welded Joints: Branch lines and changes in direction shall be made with factory weld fittings such as tees, 90 ells, 45 ells, weld-o-lets, thread-o-lets, and welding saddles. Job fabrication of fittings and stab-ins is not permitted.

2.04 UNDERGROUND PRE-INSULATED PIPING

A. Internal piping shall be ASTM A-106 B seamless black steel, schedule 40. All joints shall be butt-welded for 2½ inches and greater, and socket or butt-welded for 2 inches and below. Where possible, straight sections shall be supplied in 40-foot random lengths with piping exposed at each end for field joint fabrication.

B. Service pipe insulation shall be injected into the PVC casing annular spaces. The polyurethane foam insulation shall completely fill the casing. The polyurethane foam shall be 0.16k-factor, r141b blowing agent, nominal 2 pound per cubic foot density. The following are the minimum casing sizes:

Pipe Size	Casing Size
¾ to 1.25"	3”
1½ & 2"	4”
2.5 & 3"	5”
4 & 5"	8”
6"	10”

C. Finish: all preinsulated sections shall have PVC casing of 60mils for casing size 3", 70mils for 4", 80mils for 8", 100mils for 10", 120mils for 12" and 140mils for 14". All fittings and anchors of the insulated piping system shall be prefabricated to job dimensions. No field insulated kits will be allowed

D. Accessories: end seals, gland seals and anchors shall be designed and factory fabricated to prevent the ingress of moisture into the system

E. The manufacturer shall custom engineer and fabricate the underground piping system based on specific project conditions. This shall include, but not be limited to, expansion pads, support-guides, anchor assemblies, expansion loops (if required), etc.

F. Insulating Field Joints: The internal pipe shall be hydrostatically tested to 150 psig or 1½ times the operating pressure, whichever is greater. Insulation shall then be poured in place into the field weld area. All field applied insulation shall be placed only in straight sections. Field insulation of fittings shall not be acceptable. The mold for the polyurethane shall be made of clear adhesive backed polyester film. The installer shall seal the field joint area with a heat shrinkable adhesive backed wrap. All insulation and coating materials for making the field joint shall be furnished by the piping system manufacturer.

G. Manufacturer:

Perma-pipe terra-gard
Urecon
Thermacore feero-therm

H. Service:

1. Chilled water (underground) piping

2.05 JOINTS

A. Brass pipe threads shall be cut with special brass threading dies, and the joints shall be made up with lubricant. Strap wrenches or equivalent, shall be used in making up brass pipe. Wrenches which gouge or scar the pipe shall not be used.

B. Flange joints shall be faced true, packed and made up perfectly square and tight. Each flange joint shall be provided with best grades steel bolts and with hexagon nuts. Flanges shall be raised face, suitable for pressure of system in which they are installed.

2.06 PIPE HANGERS AND SUPPORTS

A. Provide necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported from concrete construction, do not weaken concrete or penetrate waterproofing. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted both in the vertical and horizontal direction, as required. Hangers in contact with copper or brass pipe shall be copper plated steel or provided with felt sleeve.

B. Pipe hangers shall be of the band type for piping 2" and smaller, clevis for pipe 2 1/2" and larger except where otherwise noted. Hangers for generator exhaust and steam pipe 2" and smaller shall be of the clevis roller type and two rod roller type for pipe 2 1/2" and larger except where otherwise noted.

C. All vertical piping shall be supported by means of heavy wrought iron or steel clamps securely bolted or welded to the piping, and with end extension bearing on the building. Riser clamps shall be constructed of two flat wrought steel bar yokes formed to fit the pipe and bolted together.

D. Beam clamps - hangers supported from steel shall be center loading beam clamps for hangers supporting piping 2 inches. For piping 2-1/2 inches and larger, I beam clamps shall be forged steel. "C" clamps are not to be used.

E. Where piping is run near the floor and not hung from the ceiling construction, but is supported from the floor or in a trench, such supports shall be of pipe stanchion with base flange and adjustable top yoke with u-bolt retainer.

F. Where piping is run above the floor and is not hung from the ceiling construction or not supported from the floor, such piping shall be supported from the wall with bracket hangers, expansion bolted or fish plated to the wall. Provide details for review by structural engineer.

G. For water piping (fluid less than 100F), provide insulated saddle with vapor barrier or pipe insulation plus protection shield with vapor barrier jacket. For steam, condensate, and hot-water heating piping 2 inches and smaller same as above. For hot-water heating piping 2-1/2 inches and larger, provide steel pipe covering protection saddles spot welded to pipe with insulation insert.

H. Piping in trenches shall rest or hang from angle iron cross supports provided by this Contractor.

I. Hanger rods of the following diameters shall be of hot-dipped galvanized steel with hot-dipped galvanized nuts and fasteners. Rods shall not exceed six (6) feet in length. Trim excess rod to within 1" of the support. Supplementary steel shall be provided as necessary. Rods shall not be bent.

PIPE SIZE	ROD DIAMETER
2 inches and below	3/8 in.
2-1/2 & 3 in.	1/2 in.
4 & 5 in.	5/8 in.
6 in.	3/4 in.
8 in. and above	7/8 in.

J. Support Schedule

All hanger components of hanger assembly shall be hot dip galvanized.

TYPE	GRINNELL	NATIONAL	SUPER TOLCO	CARPENTER & PATTERSON	M-CO
Band	70	110/115	2	1A	105
Clevis	260	215	1	100	401
Clevis roller	181	250	324	140	610
Two rod roller hanger	171/177	255/260	322	109	605
Riser Clamp	261	420	6	126	510
Stanchion w/U-bolt	259	X	102	125	721
Wall Bracket	199	710	30H	139	353
Insulation Shield	167	307	220	265	125
Insulation Saddle	160-165	310-340	260-265	351-357	X
Beam Clamp	133/228	680/695	62	82/287	360/361
Insert	281/282	600	309/310	108/650	355
Insert	X	555/560 561	107F/109F 109	104M/104F 143	320
Guide	255/256	500	420/421	S794	650 651
Insulated Shield	X	Pro-Shield	X	265CVB 465CVB	123 124

2.07 ANCHORS AND GUIDES

A. Anchor chair shall be fabricated of steel and welded to steel pipe for a minimum of 12" along top or bottom steel pipe centerline. Non-ferrous pipe anchor chair shall be clamped to pipe at each end of chair (chair to be a minimum of 12" long). Anchor chair shall be welded or bolted to steel restraining supports which are bolted to building structural steel.

B. Anchor chair shall be equal to Elcen Figure #278 for 4" and smaller pipe, and Figure #281 for pipe larger than 4".

C. Guides shall be fabricated of a split housing joined by a minimum of four bolts, and a split spider assembly of four arms joined by four bolts. Housing shall be at least three times the anticipated pipe movement. All guides for systems operating over 210^{o}F shall be a minimum of 12" long. Guide shall be welded or bolted to steel restraining supports which are bolted to building structural steel.

D. Guides shall be equal to Elcen Figure #411A, 411B, 412A, and 412B, of the approved equal of Metaflex.

E. Provide anchors and guides as indicated on plans or as required to properly restrain motion of piping without inducing undue pipe stress. Where mechanical expansion compensators are used, guides shall be placed 4 pipe diameters on each side of expansion joint, and additional guides placed a maximum of 14 pipe diameters from the first guides. Additional guides shall be placed an additional distance from the 2nd guide, as required by the expansion joint manufacturer.

2.08 VALVES - GENERAL

A. All valves shall be of a design which the manufacturer lists for the service and shall be of materials allowed by the latest edition of the ASME Code for Pressure Piping for the pressure and temperature contemplated, unless a higher grade or quality is herein specified. All valves shall be of the same manufacturer, except for special applications.

B. The system shall be supplied with gate or butterfly type isolation valves as specified herein, at all branches mains and risers.

C. All valves shall be installed with the best workmanship and are to have neat appearance and be arranged so that they are easily accessible.

D. Each valve shall have the maker's name or brand, the figure or list number and the guaranteed working pressure cast on the body and cast or stamped on the bonnet, or shall be provided with other means of easy identification.

E. Check valves installed in the horizontal position shall be swing checks; valves installed in the vertical position shall be silent checks, except that all check valves in pump discharges shall be silent checks.

F. Provide blow-off valves at all strainers, and where shown on the drawings.

G. Provide valve operating chain on all gate and globe valves in Mechanical Equipment Rooms - 3" and larger, which are more than 6'-6" above the operating floor. Unit shall be complete with adjustable sprocket, chain and guide (Crane "Babbit" type). Provide hook to keep chain out of the way.

H. Generally, all valves are to be of the gate type, except that globe valves shall be used for throttling services and on traps, and pressure reducing and control valve by-passes. Globe valves used on by-passes shall have Monel metal mountings.

I. All valves 2 inches in diameter and smaller shall be all bronze with bronze bodies. Valves 2-1/2 inches in diameter and larger shall have iron bodies with bronze mountings unless otherwise specified.

J. All flanged-end valves shall have renewable metal seat rings and discs. On gate valves these parts shall be of bronze, on all globe valves they shall be of bronze and suitable for throttling service.

K. All screwed-end globe valves shall be of the union bonnet type, non-rising stem with renewable metal seats and discs.

L. All valves shall have their bonnets back-seated to provide for packing under pressure.

M. All gate valves shall be of the solid tapered wedge type, union bonnet, rising stem.

N. All valves 5 inches in diameter and larger shall be furnished with an integral by-pass and a by-pass suitable for the operating pressure.

O. Drain valves shall be provided on tanks, receivers, risers and where they may be required or necessary, or directed for draining the lines and equipment. Drain valves or plug cocks shall be provided at the low points for proper drainage, and where required or directed cocks and valves shall be provided with threaded ends for hose connections.

P. All valves up to 2 inches in diameter shall have screw ends, 2-1/2" in diameter and over shall have flanged ends.

Q. Isolation valves shall be provided at all pumps, tanks, reducing and automatic or mechanical flow control devices, radiation, coils and heat exchangers, and at all other apparatus requiring partial drainage of the system for periodic maintenance or inspection. The isolation valves shall be so located as to permit removal and/or service of the isolated equipment without draining complete or substantial portions of the system.

1. Provide flanges or union(s) to permit removal of all equipment isolated as indicated above.

2. The flow and control diagrams **do not** indicate the complete requirement for isolation valves in the system. Manual valves are depicted in flow diagrams to show relative positions of division 230923 control devices.

2.09 VALVE SCHEDULE

A. All valves shall conform to the requirements of this Section for the services indicated and shall be provided as indicated on the Drawings

B. Valves for low pressure steam and condensate, hot water, chilled water, condenser water, heat pump loop, glycol, well water, cold water (make-up), and pumped condensate piping systems shall comply with the following table. Isolation valves for steam and condensate shall be gate valves. Isolation valves shall be gate {ball} for 2” & smaller, gate {butterfly} for 2 -1/2” & larger.

Valve Type	Manufacturer	Construction
Gate Valves 2" & smaller Class 150	Stockham B-124 Milwaukee 1169 NIBCO T-134	Bronze body, solid wedge disc, rising stem, union bonnet, threaded ends, 150 psi SWP, 300 psi WOG.
Gate Valves 2-1/2" & larger Class 125	Crane 465-1/2 Stockham G-623 Milwaukee F-2885 NIBCO F-617-0	Iron body, solid wedge disc, OS&Y, bolted bonnet, flanged ends, 125 psi SWP, 200 psi WOG.
Globe Valves 2" & smaller Class 150	Crane 7TF Stockham B-22T Milwaukee 590T NIBCO T-235-Y	Bronze body, composition steam disc, union bonnet, threaded ends, 150 psi SWP, 300 psi WOG.
PlugValves 2-1/2" & larger Class 125	DeZurik 118F	Cast iron body, eccentric acting, resilient plug facing, stainless steel bearings, nickel seat flanged ends, ANSI 125, 150 psi CWP

Valve Type(Cont.)	Manufacturer (Cont.)	Construction (Cont.)
Swing Check Valves 2” & smaller Class 150	Crane T/S-433 Stockham B-309/319 Milwaukee 07 NIBCO T-433	Bronze body, horizontal swing, bronze re-grinding disc, Y-pattern, threaded ends, 150 psi SWP, 300 psi WOG.
Swing Check Valves 2-1/2” & larger Class 125	Crane 373 Stockham F-931 Milwaukee F-2974 NIBCO F-918	Iron body, horizontal swing, bolted cap, flanged ends, 125 psi SWP, 200 psi WOG.
Spring Check Valves 2” & smaller Class 150	Mueller 109M-BP	Bronze body, globe type, stainless steel spring, bronze seat and disc, flanged ends.
Spring Check Valves 2-1/2” & larger Class 125	Mueller 105M-AP	Iron body, globe type, stainless steel spring, bronze seat and disc, flanged ends.
Ball Valves 2” & smaller Class 600	Watts FBV-3C, FBVS-3C Apollo 77-200, 77C-200 Crane 9211, 9212 Stockham S-285BR, T-285BR NIBCO T-FP-600A S-FP-600A	Bronze body, two-piece, full port, reinforced Teflon seats, lever operated. 150 psi SWP 600 psi WOG. Stem extensions with sleeves shall be provided to suit insulation thickness, so handle is located clear of insulation.
Butterfly Valves 2-1/2” & larger Class 125	Crane 44-FXZ Stockham LD-712 Milwaukee ML-123E NIBCO LD2000	Ductile iron body, lug type, stainless steel stem aluminum-bronze disc, bronze or Nylatrin GS bushings, EPDM liner, with lever lock handle for 6 inches and smaller and weatherproof gear operators for 8 inches and larger, and memory stop on return piping valves.
Triple Duty Valves Class 125	Bell & Gossett 3DS Mueller 721	Combination balancing, shut off and check valve. Cast iron body, bronze seat and disc, rising stem, 175 psi WOG, ANSI Class 125

C. Combination Shut Off, Balancing & Flow Valve

1. Valves 1/2-inch to 3-inch size shall be of bronze/brass ball construction with glass and carbon filled TFE seat rings. Valves shall have differential pressure read-out ports across valve seat area. Read-out ports shall be fitted with internal EPT inserts and check valves. Valve bodies to have 1/4" NPT tapped drain/purge port. Valves shall have memory stop feature allowing valve to be closed for service and then opened to setpoint without disturbing balance position. All valves to have calibrated nameplates to assure specific valve settings. Valves shall be designed for positive shut-off. Provide a differential pressure meter for the project and calibration chart(s) for each valve size and type to be turned over to the owner.

2. Valves shall be manufactured by Bell & Gossett, Armstrong or Griswold.

D. Refrigerant Full Port Valves

1. Variable Refrigerant Flow indoor units shall be isolated at each refrigerant connection with full port valves with integral Schrader valve (installed with Schrader valve on unit side of ball), forged body and seal cap, Teflon seal and gaskets, for use with R12, R22, R502, R134A and R410A. Design working pressure 700 PSIG. Temperature Range -40 to +325F.

2. Valves shall be manufactured by NDL Industries, Diamondback BV-Series or Emerson Alco.

2.10 PRESSURE RELIEF AND REDUCING VALVES (WATER)

A. Relief - bronze, approved adjustable type with test lever and drain extended to spill over floor drain. Approved by ASME and so stamped.

B. Reducing - in fill and makeup line. All bronze adjustable diaphragm type with built-in strainer.

C. Furnish lock-shield valve by-pass connection for quick filling of system.

2.11 AUTOMATIC AIR VENTS

A. Furnish where shown on drawings and wherever else required, for water systems, of float type to expel air from system and prevent air binding. Provide each valve with 1/2" shut-off valve and overflow of soft copper tubing extended to spill over nearest open drain. Similar to Sarco type 13W or approved equal.

2.12 STRAINERS

A. There shall be approved strainers in the inlet connections to each valve feeder and makeup connection, each water regulating valve, and each diaphragm valve, and where else indicated on the drawings. The intention is to protect by strainers, all apparatus of an automatic character, whose proper functioning would be interfered with by dirt on the seat, or by scoring of the seat.

B. All strainers shall have cast iron, semi-steel or bronze bodies of ample strength for the pressure to which they shall be subjected, removable cylindrical or conical screens of Monel or stainless steel and suitable flanges or tappings to connect with the piping they serve. They shall be of such a design as to allow blowing out of accumulated dirt, and to facilitate removal and replacement of a strainer screen, without disconnections of the main piping.

C. All strainers shall be Y-type with removable screen. Two-inch and smaller or where installed in non-ferrous piping system, screwed or flanged, bronze Sarco type BT.

1. 2-1/2" and larger in ferrous piping systems, flanged cast iron Sarco type AF-125. Brass screens for water 1/16" for 3" inclusive; 1/8" for 4" and above.

2.13 EXPANSION TANKS - DIAPHRAGM TYPE

A. Welded steel shell of size and volume indicated on equipment schedules. Tanks shall be constructed in accordance with ASME Section VIII, and shall bear the ASME stamp.

B. Diaphragm of heavy duty butyl, rated to 240^{O}F and 125 PSIG working pressure.

C. Accessories:

1-1/2" NPT system connection.
1-1/2" charging valve.
Lifting rings, welded to shell
Welded base or saddles (horizontal units).

D.

Manufacturer	Type/Series
Amtrol, Ex-Trol	AX, L
Bell & Gossett	B, D

2.22 CHILLED WATER BUFFER TANK

A. Provide a chilled water buffer tank with 300 gallon water storage capacity.

B. Pipe connections shall be 6” flanged pipe connections and baffle to water tank water storage temperature stratification.

C. Provide optional insulation package from tank manufacturer.

D. The buffer tank shall be constructed in accordance with the most recent addendum of Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code and constructed and stamped for 125 PSI working pressure @ 450°F.

E.

Manufacturer	Model
Wessels Company	CBT

2.23 WATER SYSTEM ACCESSORIES

E. Provide the following accessories in the water circulating systems.

1. Airtrol tank fitting.
2. Tank drain.
3. Make-up water pressure reducing valve.
4. Pressure relief valve.
5. Backflow preventer
6. Air vents - at all high points - Automatic in mechanical spaces, manual in concealed spaces.
7. Pipe line air separators – B&G Inline up to 1-1/2”, RolAirTrol 2”-24”, air scoop over 24”

2.24 EXPANSION JOINTS

A. Expansion joints to be of the packless, externally pressurized type. Pressure rated for 150psi @ 700 F or 300psi @ 700°F. Movement capabilities to be 4, 6 or 8" axial movement, as required. All welded construction with multiple ply stainless steel bellows, heavy gauge steel shroud, integral guide rings, and internal liner. System line pressure to be external to the bellows to minimize squirm. Double end joints shall have anchor base to act as intermediate anchor. All joints to be provided with drain connection and lifting lug. All materials of construction, pressure ratings, and end fittings shall be appropriate for the application. Guiding and anchoring per EJMA recommendations and guidelines shall be provided. Expansion joints shall be “MetraGator” as manufactured by The Metraflex Company®.

2.14 PRESSURE GAUGES

A. Phosphorous bronze Bourdon tube type, cast aluminum 4-1/2" diameter case with blowout disc, stainless steel movement with bronze bushing brass socket and black numerals on a white face.

B. Accuracy: 1/2 or 1% of scale range.

C. Scale to be selected so that normal operating point is between 35% and 65% of full scale.

D. Each gauge to include brass petcock. Gauges on steam piping to include syphon.

E. Gauges to be installed:

1. Across water coils.
2. Across tube bundles (e.g. chiller evaporator, chiller condenser, convertors}.
3. Suction and discharge of pumps.
   (Compound gauge on fuel oil pump suction)
4. Inlet and outlet of pressure reducing valves.
5. Inlet and outlet of steam control valves.
6. Additional locations as shown on plans.

F.

Manufacturer	Series
H.O. Trerice	500X
U.S.Gauge	
Albert A. Weiss	UG-1
Weksler Instruments	AA1

2.15 THERMOMETER

A. Organic, non-toxic blue fluid filled column type, 9" long, with one piece aluminum case and sealed replaceable glass element. Brass stem with union connection and adjustable angle to permit reading from any angle. Black numerals on white background.

B. Accuracy: 1% of scale range.

C. Scale to be selected so that normal operating point is between 35% and 65% of full scale.

D. Each thermometer to be installed in an extension neck brass separable socket. Extension neck length to be coordinated with insulation thickness. Socket and thermometer insertion length to be minimum of 75% pipe diameter.

E. Thermometers to be installed:

1. Supply and return of water coils (single return on multiple coil bank)
2. Supply and return of tube bundles (e.g. chiller evaporator, chiller condenser, convertors)
3. Circulating pump discharge .
4. Supply and return of water boilers.
5. Additional locations as shown on plans.

F.

Manufacturer	Series
Taylor	E
H.O. Trerice	BX
Weksler Instrument	AS5

2.16 REMOTE READING THERMOMETER

A. Bronze Bourdon tube type, cast aluminum 4-1/2" diameter flanged ease, stainless steel movement with bronze bushing, brass socket, and black numerals on a white face.

B. Braided capillary tube and sensing bulb shall be stainless steel and fully ambient compensated for its entire length, and shall be filled with an expandable chemical compound. Sensing bulb to be installed in an extension neck brass separable socket. Extension neck length to be coordinated with insulation thickness.

C. Accuracy 1% of scale range.

D. Scale to be selected so that normal operating point is between 35% and 65% of full scale.

E. Thermometers to be installed as shown on plans.

F.

Manufacturer	Series
H.O. Trerice	M80300
U.S. Gauge Supertherm	9100.
Weksler Instruments	415A.

2.17 AIR ELIMINATOR

A. Furnish and install as shown on the drawings and schedule a full flow coalescing type air eliminator for the hot and chilled water systems. In no case shall entering velocity exceed 10 feet per second.

B. Separator shall be fabricated steel, rated for 150 psig working pressure, and stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels. The vessel diameter and height above the inlet / outlet connections must be equal to the basis of design.

C. Unit shall include internal elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. The elements must consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

D.

Manufacturer	Series
Spirotherm	Spirovent Series VSR or VJR

PART 3 EXECUTION

3.01 PIPING INSTALLATION - GENERAL

A. Provide and erect in a workmanlike manner, according to the best practices of the trade, all piping shown on the drawings or required to complete the installation intended by these specifications.

B. The drawings indicate schematically the size and location of piping. Piping shall be set up and down and offset to meet field conditions.

C. This Contractor shall inform himself from the general construction specifications and plans, of the exact dimensions of finished work and of the height of finished ceilings in all rooms where radiation, units, equipment or pipes are to be placed and arrange his work in accordance with the schedule of interior finishes, as indicated on the architectural drawings.

D. All piping shall be run perpendicular and/or parallel to floors, interior walls, etc. Piping and valves shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance. All valves, controls and accessories concealed in furred spaces and requiring access for operation and maintenance shall be arranged to assure the use of a minimum number of access doors.

E. All pipe lines made with screwed fittings must be provided with as sufficient number of flanges or unions to make possible any taking down of the pipes without breakage of fittings.

F. All piping shall be erected so as to insure a perfect and noiseless circulation throughout the system. No bull head tees will be permitted.

G. All valves and specialties shall be so placed as to permit easy operation and access and all valves shall be packed at the completion of the work before final inspection.

H. Provide proper provisions for expansion and contraction in all portions of pipe work, and to prevent undue strains on piping or apparatus connected therewith. Provide double swings at riser transfers and other offsets wherever possible, to take up expansion. Arrange riser branches to take up motion of riser.

I. Approved bolted, gasketed, welded flanges shall be installed at all apparatus and appurtenances, and wherever else required to permit easy connection and disconnection. Screwed unions shall be used on piping 2" or less.

J. All piping connections to coils and equipment shall be made with offsets provided with screwed or welded bolted flanges so arranged that the equipment can be serviced or removed without dismantling the piping.

K. If after plant is in operation, any coils or other apparatus are stratified or air bound (by vacuum or pressure) they shall be repiped with new approved and necessary fittings, air vents, or vacuum breakers at no extra cost. If connections are concealed in furring, floors, or ceilings, this trade shall bear all expenses of tearing up and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

L. Make all changes in size and direction of piping with fittings. Do not use miter fittings, face, or flush bushing, close nipples or street elbows. Provide clean outs at all changes in direction and at other locations shown in drainage piping.

M. Make all branch connections with tees, except that on steel piping forged steel "Weldolets" as manufactured by Bonney Forge may be used where the branch pipe is not larger than one half the size of the main pipe.

N. Tubing shall be erected neatly in a workmanlike manner. Bends in soft copper tubing shall be made with approved tubing benders to prevent deformation of the tubing in the bends. Approved seat-to-pipe threaded adapters shall be provided for junctions with valves and other equipment having threaded connections.

O. Vertical sections of main risers shall be constructed of pipe lengths welded together. No couplings shall be used.

P. The ends of all pipe and nipples shall be thoroughly reamed to the full inside diameter of the pipe and all burrs formed in the cutting of the pipes shall be removed.

Q. Piping shall be installed in accordance with the latest edition of the ASME Code for pressure piping, and all other applicable codes.

R. All piping shall be concealed above furred ceilings in rooms where such ceilings are provided (except where specifically indicated otherwise on the drawings), or walls or partitions, except as otherwise indicated.

S. Dissimilar piping shall be connected with dielectric connector as made by Epco Company.

T. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional supports after these items are removed.

U. Pipe nipples - any piece of pipe 3" in length and less shall be considered a nipple. All nipples with unthreaded portion 1-1/2" and less shall be extra heavy. Only shoulder nipples shall be used. No close nipples will be provided.

V. Screw threads shall be cut clean and true; screw joints made tight without caulking. No caulking will be permitted. A non-hardening lubricant will be permitted. No bushings shall be used. Reductions, otherwise causing objectionable water or air pockets, to be made with eccentric reducers or eccentric fittings. All pipe shall be reamed out after cutting to remove all burrs.

W. Pitch water piping upward one inch per 100 feet in direction of flow to ensure adequate flow without air binding, and to prevent noise and water hammer.

X. Pitch drain piping l/8 inch per foot in the direction of flow.

Y. Branch connections to mains are to be made in such a manner as to prevent air trapping and permit free passage of air. To meet job conditions mains shall be set up to maintain headroom, and clear other trades.

Z. Provide air vents at all high points in water piping. Provide oversized float operated automatic air vent at high points of equipment connections and in mechanical rooms or as shown on piping details. Provide manual vents at all other locations. When installed above inaccessible ceilings, valves shall be installed remote and identified on valve tag chart.

AA. Avoid 90 degrees lift set-ups in supply lines by using 45 degree ells. Where 90 degree lifts exceed 12" install automatic air vent in supply lines. All lifts in return lines shall be installed with automatic air vents.

BB. Pipe outlet of all air vents to an open sight drain if the vent is concealed or to within two feet of the floor within Machine Rooms.

CC. All water piping shall pitch back to low points for drainage. Low points shall be provided with 3/4 inch hose cocks.

DD. Provide drain valves at the heel of all interior main water risers. Provide drain valves at the heel of all perimeter water risers if shown on drawings. Pipe all drain valves to an indirect waste.

EE. Miscellaneous drains, vents, reliefs, and overflows from tanks, equipment, piping, relief valves, pumps, etc., shall be run to the nearest open sight drain or roof drain. Provide drain valves whenever required for complete drainage of piping including the system side of all pumps.

FF. Where pipe penetrates walls, partitions or slabs provide Schedule 40 steel sleeves with an internal diameter at least 2" larger than the outside diameter of the pipe. Set sleeves before pouring concrete or securely fasten and grout with cement. Floor sleeves shall project l" above the finished floor. Pack void between pipe and sleeve with an approved firestop material. See Section 230000.

GG. Provide escutcheons fastened to pipe and covering sleeve on all penetrations visible within occupied spaces and within corridors, and on all penetrations in mechanical equipment rooms. Escutcheons are to be chrome plated brass, Ritter No. 36A for vertical lines, Ritter No. 3A for all other piping.

HH. Cross connection of any devices, or construction which will permit backflow connections between a water distribution system and any part of the drainage system shall not be installed.

II. Provide domestic water connections from valved outlets to any equipment requiring same.

JJ. Keep piping 2'-0" outside the vertical line of unprotected electrical equipment, or provide painted, watertight gutters or pans with pipe drains.

3.02 INSTALLATION OF BELOW GRADE PRE-INSULATED PIPE SYSTEMS

A. Pre-insulated piping shall be installed in accordance with manufacturer’s recommendations and the details as shown on the contract drawings.

B. The system will be installed with the fewest number of underground joints as possible.

C. The system does not require expansion loops, expansion joints or compensators of any type.

D. An EPDM rubber end cap shall be applied at all terminations of the pre-insulated piping system, including all fitting locations, to form a watertight seal.

E. All buried fittings will be installed, insulated and sealed in accordance with the piping manufacturer's instructions.

F. Connection Vaults or Insulation Kits are required for all below-grade installations.

G. Backfill

1. The pre-insulated piping system will be backfilled with clean sand material.

    a. Minimum vertical distance from the bottom of the tubing to the trench floor is 4 inches [100mm].

    b. Minimum lateral distance from the side of the tubing to the trench wall is 6 inches [150mm].

    c. Install a minimum of 12 inches [300mm] of clean fill over the top of the pre-insulated piping.

    d. The balance of the trench can be backfilled with native soil void of stone greater than 2 inches [50mm] in diameter.

e. The remaining trench shall be evenly and continuously backfilled in uniform layers with suitable excavated soil.

f. Place detection tape at minimum depth of 18” directly above piping.

2. Factory trained field technical assistance shall be provided for critical periods of installation; unloading, field joint instruction and testing. On completion of the installation, the contractor shall deliver to the owner a certificate from the manufacturer stating that the installation has been made in accordance with the manufacturer's recommendations.

H. FIELD QUALITY CONTROL

1. Site Tests

a. To ensure system integrity, pressure-test the tubing before and during backfilling.

b. The service tubing will be air tested at 1½ times the operating pressure for a minimum of 1 hour prior to system burial.

3.03 PIPING SUPPORT

A. Piping shall not be hung from other piping or from equipment of other trades.

B. Piping installed in existing buildings (or in new buildings where additional supports are required), shall be hung from supplemental steel attached to and spanning the existing (or new, in new buildings) steel structure or as noted below.

C. Where vertical support into masonry or concrete structure cannot be avoided, use supplemental steel as noted above, or vertical anchors rated for seismic and cracked concrete application, similar to:

1. Hilti torque-controlled expansion anchor, carbon steel, 304SS or 316 SS to match angle and rod material, or
2. Hilti KWIK HUS EZ-1 3/8” internally threaded screw anchor.
3. Vertical anchors shall be spaced so that maximum operating weight on any individual anchor is one-half of the manufacturer’s published pullout resistance for cracked 2500 psi concrete for the anchor’s diameter and embedment.

D. Hanger rods shall not pierce ducts.

E. All piping connected to pumps and compressors within 50 feet of such equipment, and where required or directed to eliminate vibration or isolate pipe from building structure, Contractor shall supply and install spring type antivibration isolators as called for in Section 230548 of these specifications.

F. Where additional steel is required for the support of hangers, the Contractor shall furnish and install same subject to the approval of the Structural engineer. Maximum deflection of supplemental steel shall not exceed L/360, where L is the distance in feet between supports.

G. All piping running on walls shall be supported by means of hangers suspended from heavy galvanized steel angle wall brackets. No wall hooks will be permitted.

H. Lateral bracing of horizontal pipe shall be provided where required to prevent side sway or vibration. The lateral bracing shall be of a type as required to limit lateral sway according to the Seismic requirements in Section 230000.

I. All horizontal copper tubing shall be supported by hangers not over 6' apart for piping 1-1/4" and smaller. Space hangers no more than 10' apart for piping 1-1/2"' and larger, or closer as shown on pipe hanger details. All branches shall have separate hangers. Hangers shall be Clevis type (with copper bottom support for uninsulated brass pipe or copper tubing). If channel or angle iron trapeze hangers are used, the hanger below uninsulated brass pipe or copper tubing shall be wrapped with neoprene shields to isolate pipe or tubing.

J. In Boiler Rooms, Chiller Rooms, Pump Rooms and Mechanical Rooms, hanger spacing shall be adjusted so that distance between hangers is no greater than shown on Pipe Hanger detail.

3.04 PIPING JOINTS

A. Welding

1. Joints between sections of pipe and between pipe and fittings shall be fusion welded in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, matching straight runs to form tees or any similar construction shall not be done.

2. All welding shall be done as outlined in the latest edition of the ASME Code for pressure piping.

3. Welding process - all welding shall be done by the oxyacetylene or electric arc welding process in accordance with the requirements set forth in welding of pipe joints of the codes for pressure piping.

4. Beveling and welding - all pipe 2-1/2 inches and larger may be purchased mill beveled or shall be machine beveled on both ends before welding. On odd lengths of pipe, beveling may be accomplished by means of the oxyacetylene cutting torch provided all paint, rust, scale and oxide are carefully removed with hammer, chisel or file and bevel left smooth and clean. Joints shall be prepared and welded to assure thorough fusion of alignment and the production of a joint that shall develop the full strength of the pipe and that shall be leakproof in service.

5. Welding tees - welding tees shall be used when specified hereinafter. Where necessary, branch connections shall be reinforced in an approved manner. For the smaller branches, where welding tees are unavailable, nozzles shall be welded to pipe. Where such nozzles are welded to the pipe, all cutting oxide which may drop inside the pipe shall be removed before welding the branch or section in place. Where branch size is one half the size of main or larger, use welding tees. Where branch size is two (2) sizes smaller than the size of main "Weldolets" or "Sockolets" may be used.

6. Welding rods - the welding rod used for welding steel and wrought iron shall be approved welding rod in accordance with ASTM SPEC. A233.

7. Welder shall be fully certified by the authorities having jurisdiction to certify welders for pressure piping.

B. Flanged Joints

1. Use matched flange faces and 1/16" thick compressed gaskets.

2. When connection to equipment with flat face flange, grind flange raised face flat and use full faced gaskets.

C. Screwed Joints

1. Do not damage fitting surface, remove burrs, and apply red lead and ground graphite in linseed oil to male threads only. Do not use wicking, cord or similar materials. Clean joint thoroughly of excess jointing material.

D. Soldered Joints

1. 95-5 wire solder. Completely clean all surfaces and coat with a thin layer of flux.

E. Brazed Joints

1. Conform to ASA-B31.1 and ASTM B-260-56T in accordance with the requirements of the manufacturers of the fittings and the brazing material.

3.05 CLEANING OF PIPING

A. Plug all open ends of piping, valves and equipment except when work is being performed. Protect connections to equipment and control valves with temporary screens and flush piping with water. Remove dirt and debris collected.

B. Thoroughly clean the piping to remove all organics, rust, and all foreign matters and to prepare the system for permanent treatment.

C. Perform chemical cleaning after completing all pressure and leakage tests and thoroughly flushing the systems.

D. Use cleansing agent which will not interact with any of the materials in the systems in any way to produce corrosions, form deposits, weaken, reduce the life or in any way have a detrimental effect on any system components.

E. Fill the system with clean water and add sufficient cleaning preparation to provide a concentration adequate to perform complete cleaning. Add the cleaning preparation at a point which will assure good mixing.

F. Provide temporary containers to accommodate the foam that may form and temporary pumps to circulate the chemical solution.

G. Circulate the mixture of cleanser and water for a sufficient length of time to complete the cleaning.

H. Drain the system, flush with clean water, clean all strainers and screens and refill the system.

I. Cleaner for the new piping shall be Nalprep 330 as manufactured by the Nalco Chemical Co., or the approved equal.

J. Entire cleaning operation shall be performed by a competent water treatment service in strict accordance with the manufacturer's recommendations. Provide written certifications after the cleaning operation is complete.

K. Steam, Condensate and Vent Piping: No flushing or chemical cleaning required. Clean by pulling all strainer screens and cleaning all drip/dirt legs during start-up operation. Replace all screens prior to placing into operation.

3.06 TESTS

A. Tests all piping except drainage connections, including valves, fittings and joints hydrostatically at a pressure equal to at least 1-1/2 times the rated pressure, but no less than 150 psig for a minimum of four hours. Blank-off or remove all elements or equipment which may be damaged by the pressure. Open but do not back-seat valves. Inspect all joints and connections.

B. Test drainage piping hydrostatically and with smoke in accordance with the local authorities.

   A. Repair all leaks, defects or damage revealed by resulting from the test and re-test the system.

C. Do not insulate or conceal piping until the system has been tested and the results approved.

D. Perform tests in the presence of the Engineer.

3.07 AIR ELIMINATION

A. The Contractor's attention is specifically directed to the problem of proper air elimination. When installing water piping systems and all equipment, the Contractor shall carefully plan the actual installation in such a manner that high points and air pockets be kept to a minimum and that they are properly vented where they are unavoidable. All air elimination devices called for on the drawings and in these specifications shall be provided and properly installed. In addition, this Contractor shall furnish and install all other air elimination devices which may be required due to job conditions. The liability of the Contractor under the guarantee provisions of the contract is intended to cover his responsibility for a proper, continuous and automatic air elimination to assure even and balanced distribution of water to all equipment.

3.08 ANCHORS

A. All anchors shall be separate and independent of all hangers and supports. Anchors shall be of heavy blacksmith construction suitable in every way for the work of this contract. Anchors shall be welded to steel pipe, clamped to copper pipe (with dielectric separation) and fastened to the structure with bolts.

B. Anchors shall be fabricated and assembled in such a form as to secure the piping in a fixed position. They shall permit the line to take up its expansion and contraction freely in opposite directions away from the anchored points; and shall be so arranged to be structurally suitable for particular location, and line loading. Submit details for approval.

C. The supports connecting the anchors to the building structure shall be designed by a qualified professional engineer retained by the contractor. Anchor location plans and the support design, with calculations, shall be signed, sealed and submitted for approval.

3.09 WATER BALANCE

A. Balance all new water systems and those designated existing water system to the quantities shown with the following tolerances:

Pumps:	Design Flow plus 5%
Coils:	Design Flow plus 5%

B. Balance in accordance with ASHRAE, AABC, or NEBB procedures and submit all readings.

C. Water system balancing is to be performed by a professional organization, other than the installing contractor, qualified by experience and practice to perform this service. Submit evidence of qualifications, balancing procedures, and report forms for approval prior to start of work.

D. Submit three bound copies of the water balance report to the Engineer. Balance Report to include the following data for each water system:

1. Pump Designation, location, system type.
2. Manufacturer, model number, size.
3. Suction and discharge pressure readings.
4. Balancing valve position.
5. Motor manufacturer, frame, horsepower, volts, phase, hertz, and RPM.
6. Motor amps - Design versus Actual.
7. Water coil GPM, entering water temperature, leaving water temperature and pressure drop (Design versus Actual) - Balancing valve position.
8. Tube bundle GPM, entering water temperature, Leaving water temperature, and pressure drop (Design versus Actual) - Balancing valve position.

END OF SECTION

SECTION 23 0548
EQUIPMENT BASES AND VIBRATION CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

1.03 SUBMITTALS

A. Procedure

1. Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Vibration isolation equipment.

2. Submittal data shall include complete mounting details of each isolated piece of equipment, including static deflection, operating and free heights, and outside spring diameter.

3. Steel bases and concrete inertia bases shall be completely detailed.

4. Include clearly outlined procedures for installing and adjusting the isolators.

5. Performance report and calculations for vibration isolation equipment.

6. Manufacturers' certified reports on motorized equipment alignment and installation.

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATIONS, GENERAL

A. All mechanical equipment shall be mounted in accordance with the specifications below and with the specific requirements shown in the equipment schedules. The vibration isolation manufacturer shall provide supervision to ensure proper application, installation and adjustment of the isolators. Upon completion of the installation and after the system is put into operation, the manufacturer shall make a final inspection and report. The Contractor shall submit this report to the Architect, in writing, certifying the proper performance of the installation.

B. The isolation manufacturer shall supply all unit isolators, complete rails, fan and motor bases and structural steel forms for concrete inertia blocks, where called for, and shall be responsible for the selection of all vibration eliminators and shall guarantee to meet the requirements of this specification.

C. Wherever rotational speed is mentioned as the disturbing frequency the lowest such speed in the system shall be used. All isolation devices shall be selected for uniform static deflections according to distribution of weight.

D. Vibration isolators shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated or phosphated and painted with rust-resistant enamel. Nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with metal etching primer and painted with rust-resistant enamel. Isolators exposed to the weather shall have all steel parts hot-dipped galvanized. Nuts, bolts and washers may be cadmium plated. Spring components shall be cadmium plated and neoprene coated.

E. All fan units and air handling units (except fans mounted on slab on grade) shall be isolated as follows:

1.	Up to 450 RPM	75% efficiency (3-l/2" max. defl.)
2.	450 RPM to 850 RPM	90%
3.	850 RPM and Over	95%

F. Submittals shall show disturbing frequency, required efficiency, designed deflection and outside diameter of springs, when pertinent.

G. Horizontal pipe runs - all horizontal pipe runs within Mechanical Equipment Rooms and within 50 feet of final connections to all equipment having motors of 1/2 horsepower or larger, shall be isolated from building structure by means of spring hanger units designed for insertion in rods.

H. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

I. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.

J. The ratio of lateral to vertical stiffness shall be not less than 0.9 nor greater than 1.5.

K. The theoretical vertical natural frequency for each support point based upon load per isolator and isolator stiffness shall not differ from the design objectives for the equipment as a whole by more than + 10%.

L. All neoprene mountings shall have a shore hardness of 40 to 65, after minimum aging of 20 days or corresponding oven-aging.

2.02 MOUNTINGS

A. Type A - double deflection neoprene mountings shall have a minimum static deflection of 0.35 inches. All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for those areas where bolting is required. On equipment such as small vent sets, steel rails shall be used above the mountings to compensate for the overhang.

MANUFACTURER	TYPE
Amber Booth	RVD
Korfund	WSC and TR Rails
Mason Industries, Inc.	ND and Rails RND
Vibration Eliminator Co.	T44 and D-Rails
Vibration Mountings	RD and DRB Rails

B. Type B - spring isolators shall be free-standing and laterally stable without any housing and complete with l/4" neoprene, acoustical friction pads between the base plate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Minimum static deflection: 1.0". Static deflection shall be selected. Required efficiency is attained throughout entire operating range.

MANUFACTURER	TYPE
Amber Booth	SW-1
Kinetics	FDS
Korfund	WSCS
Mason Industries, Inc.	SLF
Vibration Eliminator Co.	OSK
Vibration Mountings	Spring-Flex Series "A"

C. Type C - double neoprene in shear type within a steel housing suitable for suspension rod mounting. Minimum static deflection of 0.4"

MANUFACTURER	TYPE
Amber Booth	BRD
Kinetics	FLS
Korfund	Elastomer Series "H"
Mason Industries	HD
Vibration Eliminator Co.	3CD
Vibration Mountings	RHD

D. Type D - steel compression springs as described in paragraph above and neoprene sound absorbing element mounted in a steel housing, suitable for suspension mounting. Minimum spring static deflection of l.0".

MANUFACTURER	TYPE
Amber Booth	BSR, PBSR
Kinetics	SFH/SRH
Korfund	VIBRO Type "VX"
Mason Industries	PCDNHS
Vibration Eliminator Co.	SNRC2
Vibration Mountings	RSHP

E. Type E - ribbed rubber or neoprene isolator pads loaded to 40 pounds per square inch. l/4" thick steel baseplate. Minimum double pad with 16 gauge steel separator plate. Maximum pad loading of 50 psi; minimum pad static deflection of 0.1" when loaded.

MANUFACTURER	TYPE
Amber Booth	SP-NR
Korfund	KOR PAD-40
Kinetics	NPD
Mason Industries	WSW
Vibration Eliminator Co.	100 N
Vibration Mountings	SHEAR-FLEX

F. Type F - vibration isolation manufacturer shall furnish integral structural steel bases. Bases shall be in a rectangular shape except for pumps which may be tee-shaped. Pump bases for split case pumps shall include supports for suction and discharge base elbows. All perimeter members shall be equal to 1/10 longest span. Provide height saving brackets in all mounting locations. Fill base with reinforced concrete and mount on concrete sub-base. Provide a 1" minimum operating clearance below base. Minimum static deflection - 1-1/4".

MANUFACTURER	TYPE
Amber Booth	WSB-HS
Korfund	L
Kinetics	SFB/FBB
Mason Industries	BMK/KSL
Vibration Eliminator Co.	OSK
Vibration Mountings	WFB

G. Type G - vibration isolators shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with rust-resistant enamel. Nuts, bolts and washers may be cadmium plated. Spring components shall be cadmium plated and neoprene coated. The isolators shall have vertical and lateral stops. The springs shall be selected to provide minimum 2" deflection. The installing contractor shall provide and install steel beams of adequate size, strength and quantity to span between the isolators and to produce the necessary continuous support for the towers. Isolators shall include matched tapped holes in the top plate for fastening to equipment.

MANUFACTURER	TYPE
Amber Booth	CT
Korfund	WSCL
Mason Industries	SLR
Vibration Eliminator Co.	KW
Vibration Mountings	AWR

2.03 ISOLATION SCHEDULE

EQUIPMENT TYPE	ISOLATION TYPE
Air-Cooled Chiller	G
Boilers	E
Base Mounted Pumps	B, E, F
Suspended Fans	D
Suspended Chilled Water Piping	D
Suspended Hot Water Piping	D
Unit heaters	C
Air Handlers (Floor Mounted)	E

PART 3 EXECUTION

3.1 BASES AND SUPPORTS - GENERAL

A. Provide accurate templates showing all openings for anchor bolts, drains and other required openings and detailed installation instructions for equipment and motor bases and supports.

B. Align all equipment level throughout. Provide shims to facilitate pipe connections and leveling.

C. Position the isolation units in accordance with the load distribution. Locate isolation mounts so that the load, including the drive, is supported over or between the mounts with no overhang.

D. Construct all suspended or wall hung isolators, supports and accessories including hangers, cradles and wall brackets to sustain a load of at least five times the actual operating load.

END OF SECTION

SECTION 23 0700
INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

B. Conform to applicable performance standards, listings or approvals of the following organizations.

1. National Fire Protection Association (NFPA)
2. Underwriters Laboratories (UL)

C. All insulating materials shall comply with the following ratings:

1.	Flamespread	-25
2.	Smoke Developed	-50
3.	Fuel Contributed	-50

1.03 SUBMITTALS

A. Procedure: Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Insulating materials and jackets.
2. Insulating cements, mastics and adhesives.
3. Methods of installation.
4. Pump enclosure details.
5. Pipe shields.
6. Schedule of insulation (system, material, thickness, cover, method of installation).

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Type A - Fiberglass Insulation

1. The insulation should be sectional pipe jacketed with an embossed barrier laminate. 3.5 pound density insulation with a maximum thermal conductivity(k) as noted below (or maximum 0.29 Btu-in/hr-ft2-^{O}F if not listed below) and rated to 850^{O}F, composed of glass fibers bonded with a thermosetting resin. Insulation to be faced with vapor barrier of white flame resistant UL rated Kraft paper bonded to reinforced aluminum foil. Vapor barrier to have a m^{a}ximum permeance of ^{0}.02 perms.

2. Indoor Piping Pipe Size:

Service:	1-1/2"& smaller Thickness (in.):	Over 1-1/2"	Fitting Type
Steam/Condensate (<15psig/<250^{o}F)	1-1/2"	3"	F
Hot Water (<200^{o}F)	1"	2"	F
Chilled Water	1"-1/2”	1-1/2"	G
Condensate Drains	1/2"	1/2"	G
Water Make-up	1/2"	1/2"	G
Chemical Treatment	1/2"	1/2"	G
Domestic Water	1"	1"	G
Horiz. Roof Drains	1"	1"	G

3. Manufacturers:

Owens-Corning, SSL II
Johns Manville - Micro-Lok HP
Knauf 1000^{o} Pipe Insulation

B. Type B - TYPE NOT USED

C. Type C - Foamglass Insulation

1. 8.5 PCF average density, 100 psi compressive strength, max K = 0.38 at 75 ^{O}F mean, and operating temperature -320^{O}F to 300^{O}F, rigid glass cells.

Service:	Thickness:
Outdoor Piping	
Chilled water	2”

2. Manufacturers:

Pittsburgh-Corning, Type H/L.B. Foamglas
Upjohn - Type CPR Trymer L may not meet H/LB spec's

D. Type D - TYPE NOT USED

E. Type E - Aluminum Jacketing

1. 0.024” aluminum jacket lock-on or slip-on type jacketing to be covered with acrylic coating on one outer surface and the baked epoxy moisture barrier on the inner surface.

2. Service:

Outdoor Piping on Type C Insulation

3. Manufacturer: Childers Products Co. - Lock-on or slip-on type.

F. Type F - Fiberglass insulation for valves/fittings/flanges (other than vapor seal insulation).

1. Molded, factory-formed fibrous glass with 3.5 PCF minimum density, max. K = .3 at 200OF, mean, rated to 450OF. If mechanical joints are used, insulation to be cellular glass.

2. Finish with white 0.020”, 25/50 rated PVC jacket, as manufactured by Proto LoSMOKE, Zeston (for use with Hamfab inserts) or approved equal. Fitting covers and jacketing to be precurled.

3. Service: Thickness:

Hot Water Same as Piping

4. Manufacturers:

Fibrous Glass Products, Inc.
Insulcoustic Corp.
Hamfab
Extol of Ohio, Inc (for mechanical joints and fittings, with cellular glass insulation)

G. Type G - Fiberglass insulation for valves, fittings, flanges (vapor seal insulation).

1. Molded, factory-formed fibrous glass with 3.5 PCF minimum density, max. K=0.3 at 200^{o}F mean, rated to 450^{o}F. All joints to be sealed with vapor barrier adhesive and wrapped with glass mesh tape. Each fitting to be finished with two coats of Benjamin Foster 30-36 vapor seal. If mechanical joints are used, insulation to be cellular glass.

2. Finish with white 0.020”, 25/50 rated PVC jacket, as manufactured by Proto LoSMOKE, Zeston (for use with Hamfab inserts) or approved equal. All joints between PVC jacket and pipe covering shall be sealed with vapor barrier tape. Fitting covers and jacketing to be precurled.

3. Service: Thickness:

Chilled Water	Same as piping
Water Make-up	Same as piping
Domestic Water	Same as piping
Roof Drains	Same as piping

4. Manufacturers:

Fibrous Glass Products, Inc.
Insulcoustic Corp.
Hamfab
Extol of Ohio, Inc (for mechanical joints and fittings, with cellular glass insulation)

H. Type H - Blanket/wrap

1. One (1) pound density formaldehyde free insulation with a maximum thermal conductivity (k) of 0.27Btu-in/hr-ft^2-^{o}F at 75^{O}F, composed of glass fibers bonded with a thermosetting resin. Insulation to be faced with vapor barrier of reinforced aluminum foil bonded to flame resistant UL rated Kraft paper. Vapor barrier to have a maximum permeance of 0.02 perms.

2. Service: Thickness:

Concealed Ductwork	
Supply Air	2"
Outside Air	2"
Exhaust Air downstream & 5' upstream of motorized damper.	2"

3. Manufacturers:

CertainTeed Soft Touch duct wrap with FSK facing.
Johns Manville Microlite duct wrap with FSK facing.
Knauf – Duct Wrap with FSK jacket.
Owens-Corning Fiberglass – Type 100 all service duct wrap.

I. Type I - Duct Board

1. Six (6) pound density insulation with a maximum thermal conductivity (k) of 0.23Btu-in/hr-ft^2-^{o}F at 75^{O}F, composed of glass fibers bonded with a thermosetting resin. Insulation to be faced with vapor barrier of reinforced aluminum foil bonded to flame resistant UL rated Kraft paper. Vapor barrier to have a maximum permeance of 0.02 perms.

2. Service: Thickness:

Exposed ductwork	
Supply Air	1-1/2"
Outside Air	1-1/2"
Exhaust Air downstream & 5' upstream of motorized damper.	1-1/2"

3. Manufacturers:

Certainteed – CertaPro Commercial Board.
Johns Manville – Spin-Glas Board
Knauf - Insulation Board

J. Type J - Fiberglass for tanks and accessories.

1. Three pounds density, 450^{O}F max. operating temperature, K Max = .3 at 200^{O}F, mean semi-rigid board fibrous glass insulation, unfaced.

2. Service: Thickness:

Inline air separators	1"
Irregularly shaped pipe accessories	1"
Domestic Water Storage Tank	1"
Expansion Tank	1"

3. Manufacturers:

Owens-Corning, Type 703
Certainteed, Type IB
Knauf, Type elevated temperature board.
Manville, Type 814 Spin Glass

K. Type K - Pump Enclosures

1. Enclose pumps with an 18 gauge galvanized steel enclosure lined with a max. K = .3 at 75^{O}F, mean, 2" thick, 6# density rigid mineral fiber.

2. Service:

Chilled Water Pumps

3. Manufacturers:

Owens-Corning, Type 705
Manville, Type 817
Certainteed, Type iB600

L. Type L - TYPE NOT USED

PART 3 EXECUTION

3.01 INSULATION - GENERAL

A. All insulating materials shall be applied only by experienced workmen, in accordance with the best covering practice. All piping, duct or equipment shall be blown out, cleaned, tested and painted prior to the application of any covering.

B. At all openings insulation, insulate edges neatly and protect with sheet metal frames.

C. All items below described in general indicate the type of covering required, however, all piping, ductwork or equipment that transmits heat or will form condensation shall be insulated.

D. Insulate all piping, valves, fittings, and accessories that are part of the piping systems specified to be insulated in specification section 230700. Insulate valves and strainers to permit removal of bonnets or baskets without damage to insulation on valve or strainer bodies.

E. Where existing insulation is damaged by requirements of the work, replace all damaged insulation to match existing insulation's thermal value.

F. All insulation at duct access doors shall be set in sheet metal double-pan construction.

G. No piping, ductwork, or equipment shall be insulated until tested and approved for tightness. All piping and ducts shall be dry when covered.

3.02 APPLICATION - PIPE INSULATION (TYPE A)

A. Vapor barrier jacket: Seal longitudinal joints with vapor barrier adhesive, transverse joints sealed with vapor barrier strips and adhesive. Ends of pipe insulation sealed off with vapor barrier adhesive at all flanges, valves and fittings, and at not more than 20 feet on continuous runs of pipe.

B. Finish for concealed pipe insulation: Secure all concealed pipe insulation with staples and vapor seal adhesive at longitudinal; standard all service jacket pasted on lap.

C. Finish for exposed pipe insulation: Multiple layers (minimum 2) of glass weave jacket lap sealed with Childers CP-30. Alternatively, finish with white 0.020”, 25/50 rated PVC pre-curled and pre-cut jacket, as manufactured by Proto LoSMOKE or Zeston, covering over all service jacket. For exposed vapor seal insulation, same finish over vapor sealed all service jacket.

3.03 APPLICATION - PIPE INSULATION (TYPE C)

A. All piping shall be insulated with the proper thickness of Foamglas insulation as shown in the high-temperature thickness table. Insulation thickness shall be determined by highest operating temperature at which the piping normally operates.

B. Foamglas pipe insulation shall be applied to piping dry, in staggered joint fashion with all joints tightly butted. Stainless steel (1/2" x .015") or aluminum (1/2" wide x .020") bands shall be applied on 9" centers when using 18" length pipe covering, and 12" centers when 24" length pipe covering is used. Foamglas sections shall be fitted to eliminate voids. All voids shall be eliminated by refitting or replacing the Foamglas sections.

3.04 APPLICATION - PIPE INSULATION (TYPE E)

A. Install aluminum jacketing with a minimum 2" overlap lapped downward to shed water. Seal all joints with joint sealer mastic. Finish circumferential joints with 3/8" aluminum strapping and seals. Secure with aluminum bands on 8" centers.

3.05 APPLICATION - INSULATION AT PIPE HANGERS

A. Provide pipe hangers insulation protection saddles and shields.

B. Fill each pipe covering protection saddle with same insulation as specified for respective pipe or with suitable insulating cement.

C. Where shields are specified at hangers on piping with fibrous glass covering, provide for load bearing calcium silicate between shields and piping as follows:

1. For pipe covering without vapor barrier jacket, furnish at each shield 18" long calcium silicate section with canvas jacket continuous between shield and insulation.

2. For pipe covering with vapor barrier jacket, remove bottom half section of fibrous glass and replace with half section of calcium silicate. Make vapor barrier jacket continuous between shield and insulation.

3.06 APPLICATION - DUCT INSULATION (TYPE H)

A. Install duct wrap over clean, dry sheet metal ducts. All duct joints and seams must be sealed to prevent air leakage from the duct.

B. Duct wrap shall be cut to stretch-out dimensions. 2” piece of insulation is removed from the facing at the longitudinal and circumferential ends of the piece to form an overlap. Wrap the insulation around the perimeter of the duct with the facing out. Duct wrap shall be compressed a maximum of 25% in order to maintain thermal efficiency. Adjacent sections of insulation shall be tightly butted with the 2” overlapping. Staple seams on 6” centers.

C. Minimize compression of the insulation to assure maximum thermal performance. Longitudinal seam of the vapor barrier must be overlapped a minimum of 2".

D. All seams should be finished with appropriate pressure sensitive tape or glass fabric and mastic.

E. Pressure sensitive tapes should be a minimum 3" wide and be applied with moving pressure using an appropriate sealing tool.

F. Closure systems should have a 25/50 F.H.C. per UL 723.

G. For rectangular ducts over 18" wide, the duct wrap should be secured to the duct with mechanical fasteners spaced on 18" centers to reduce sag. Care should be taken to avoid overcompressing the insulation with the retaining washer.

H. Unfaced duct wrap should be overlapped a minimum of 2" and fastened with 4" to 6" nails or skewers spaced 4" apart, or secured with a wire or banding system.

I. Where vapor barrier performance is necessary, all seams, joints, penetrations, washers and damage to the facing should be repaired with a minimum 2" overlap of tape prior to system startup.

3.07 APPLICATION - DUCT INSULATION (TYPE I)

A. Fasten insulation in place with wed pins and washers or equivalent mechanical fastening method, as approved.

B. Seal all joints with vapor barrier adhesive to provide continuous vapor barrier.

C. All edges, corners, penetrations, and joints shall be reinforced and sealed with vapor barrier adhesive tape to provide continuous vapor barrier. Tape shall be 4" wide, of type, and applied in strict conformance with manufacturer's recommendations. Tape shall be applied over insulation support washers.

3.08 APPLICATION - TANK INSULATION (TYPE J)

A. Point joints with lagging cement prior to application of finish. Finish with two layers of 8 oz. glass mesh weave. Coat each layer of weave with vapor barrier adhesive.

B. Insulation shall be fastened with welded pins or stick clips on flat surfaces and with stainless steel bands on irregular surfaces.

3.09 APPLICATION - PUMP ENCLOSURE (TYPE K)

A. Fabricate the enclosure with a division coinciding with the pump split case so that part of the enclosure can be removed and the pump serviced and dismantled without destroying the insulation.

B. Fill voids in the interior of the insulated enclosure with scraps of fiberglass insulation.

END OF SECTION

SECTION 23 0923

CONTROLS AND INSTRUMENTATION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

C. Provide all labor, materials, tools, equipment, and services for a complete direct digital control (DDC) system as indicated, in accordance with provisions of contract documents.

1.02 SUMMARY/SYSTEM DESCRIPTION

A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.

B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.

C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in 23 09 93 – “Sequence of Operations for HVAC Controls” shall be BACnet objects.

1.03 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer’s recommended hardware and software for operator workstation (server and browser for web-based systems).

B. Graphic Display: A graphic with 20 dynamic points shall display with current data within 10 sec.

C. Graphic Refresh: A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.

D. Configuration and Tuning Screens: Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.

E. Object Command: Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.

F. Alarm Response Time: An object that goes into alarm shall be annunciated at the workstation within 45 sec.

G. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.

H. Performance: Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.

I. Multiple Alarm Annunciation: Each workstation on the network shall receive alarms within 5 sec of other workstations.

J. Reporting Accuracy: System shall report values with minimum end-to-end accuracy listed in Table 1.

K. Control Stability and Accuracy: Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table-1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±1ºF
Ducted Air	±1ºF
Outside Air	±2ºF
Dew Point	±3ºF
Water Temperature	±1ºF
Delta-T	±0.25ºF
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.
Water Pressure	±2% of full scale (see Note 2)
Electrical	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm
Note 1: Accuracy applies to 10%–100% of scale	

Table 2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0–6 in. w.g. -0.1 to 0.1 in. w.g.
Airflow	±10% of full scale	
Space	±2.0ºF	
Duct Temperature	±3ºF	
Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1–150 psi 0–50 in. w.g. differential

1.04 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

B. The installation and equipment is to conform to applicable building code articles and applicable reference standards cited therein.

1.05 QUALITY ASSURANCE

A. The work of this section shall be performed by a company which specializes in the type of automatic temperature control work required for this Project, with a minimum of 5 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

1. Work shall be performed in compliance with Owner's insurance underwriters' requirements, and UL approvals and testing for materials, assemblies and procedures.

B. Manufacturer shall specialize in manufacturing the type of automatic temperature controls specified in this section, with a minimum of 5 years of documented successful experience and have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty.

1.06 SUBMITTALS

A. In addition to submittal requirements in accordance with Conditions of the Construction Contract, Division 1 Specification Sections, Section 230000 and other provisions of these documents, submittals shall meet the following requirements.

B. Product Data and Shop Drawings: Meet requirements of Section 01 30 00 on Shop Drawings, Product Data, and Samples. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and three 11” x 17” prints of each drawing. When manufacturer’s cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:

1. DDC System Hardware

a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

b. Manufacturer’s description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:

1) Direct digital controllers (controller panels)
2) Transducers and transmitters
3) Sensors (including accuracy data)

4) Actuators
5) Valves
6) Relays and switches
7) Control panels
8) Power supplies
9) Batteries
10) Operator interface equipment
11) Wiring

c. Wiring diagrams and layouts for each control panel. Show termination numbers.

d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Central System Hardware and Software

a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical.

b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:

1) Central Processing Unit (CPU) or web server
2) Monitors
3) Keyboards
4) Power supplies
5) Battery backups
6) Interface equipment between CPU or server and control panels
7) Operating System software

8) Operator interface software
9) Color graphic software
10) Third-party software

c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.

d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems

a. Riser diagrams showing control network layout, communication protocol, and wire types.

b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.

c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.

d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.

e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.

f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.

g. A point list for each control system. List I/O points and software points specified in Section 23 09 93. Indicate alarmed and trended points.

4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.

5. A description of the proposed process along with all report formats and checklists to be used in Section 23 09 23 Article 3.18 (Control System Demonstration and Acceptance).

6. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

C. Schedules

1. Within one month of contract award, provide a schedule of the work indicating the following:

a. Intended sequence of work items

b. Start date of each work item

c. Duration of each work item

d. Planned delivery dates for ordered material and equipment and expected lead times

e. Milestones indicating possible restraints on work by other trades or situations

2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

D. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD compatible files on magnetic or optical media (file format: .DWG, .DXF, .VSD, or comparable) and as 11" x 17" prints.

2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 23 Article 3.18 (Control System Demonstration and Acceptance).

3. Operation and Maintenance (O&M) Manual.

4. As-built versions of submittal product data.

5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.

7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.

10. Graphic files, programs, and database on magnetic or optical media.

11. List of recommended spare parts with part numbers and suppliers.

12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.

14. Licenses, guarantees, and warranty documents for equipment and systems.

15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

E. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.07 WARRANTY

A. Comply with General Conditions and Division 1 Section “Product Requirements”.

B. Warranty requirements below shall be in addition to and complementary to warranty requirements in General Conditions, Division 1 Section “Product Requirements”, Section 230000 and other provisions of these documents. In addition to the specified warranty, the EMS vendor shall warrant all system components for a period of two years from the date of final acceptance by the Owner and Engineer. The warranty shall include parts, labor, and debugging of system software.

C. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner’s warranty service request.

2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.

4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner’s written authorization.

5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer’s acceptance.

1.08 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics
2. Record drawings
3. Database
4. Application programming code
5. Documentation

1.09 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

B. The installation and equipment is to conform to applicable building code articles and applicable reference standards cited therein.

C. It is the responsibility of the DDC system contractor to be familiar with all codes, rules, ordinances, and regulations of the Authority Having Jurisdiction and their interpretations which are in effect at the site of the work.

D. The latest issue of applicable standards and recommended practices of the following agencies in effect shall form a part of the specification to the extent each agency's relative standards or recommended practices apply to the Systems and its components as specified herein.

1. Federal Communications Commission (FCC)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. Electronic Industries Association (EIA)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)
8. Underwriters Laboratories (UL)
9. Occupational Safety and Health Administration (OSHA)
10. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

E. The DDC system contractor shall be solely responsible for compliance with all health and safety regulations, performing the work in a safe and competent manner, and use industry accepted installation procedures required for the work as outlined in these documents.

F. All systems equipment, components, accessories, and installation hardware shall be new and free from defects and shall be UL listed where applicable. All components shall be in current production and shall be a standard product of the system or device manufacturer. Refurbished or reconditioned components are unacceptable. Each component shall bear the make, model number, device tag number (if any), and the UL label as applicable. All Systems components of a given type shall be the product of the same manufacturer.

1.10 SUBMITTALS

A. Procedure: Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

Automatic control components
Sequences of operation
Starter wiring of all automatically controlled motors
Control diagrams
Color coded wiring diagrams
Control valves
Variable speed drive unit
Sample of panel graphics
Direct digital control panels
Computer program
Accessories and auxiliaries
Library of custom computer graphics to be installed under this contract.
Outline of system test and commissioning procedure and anticipated schedule for testing and commissioning using project milestones.

C. Hazardous Materials Notification: In the event no product or material is available that does not contain asbestos, PCB or other hazardous materials as determined by the Owner, a "Safety Data Sheet" (SDS) equivalent to OSHA Form 20 shall be submitted to the Owner for that proposed product or material prior to installation with concurrent notification to the Architect.

D. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB), using format in Article 3 of General Conditions.

1.11 SYSTEM TESTING AND COMMISSIONING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000.

B. Control system shall be set up and checked out by factory trained competent technicians skilled in the setting and adjustment of FMS equipment used in this project. This technician shall be experienced in the type of systems associated with this FMS.

C. At the time of final observation, demonstrate the sequence of operation for each system to the Engineer or other designated Owner's representative.

1.12 IDENTIFICATION TAGS AND DRAWINGS

A. Provide two copies of the as-installed control system, mounted on masonite and covered with heat bonded clear plastic laminate.

B. Provide identifying tags on all controls to conform to the designation of the control diagrams.

C. Provide nameplate on each starter equal to equipment identification (Section 230000) indicating equipment controlled, source of control voltage, and equipment interlocked through starter. Size of identification nameplate to be a function of information contained (minimum 1-1/2" x 3-1/2").

1.13 TRAINING OF OWNER'S OPERATING PERSONNEL

A. In addition to the on-site training specified elsewhere, the control contractor shall train two facilities personnel at the manufacturer's regional training facility.

B. The course shall be the same course used in the training of the manufacturer's own service personnel. The course shall have a minimum of 40 classroom hours and shall cover the following curriculum.

-Programming
-Maintenance of hardware
-Trouble shooting
-Repairing and rebuilding system components

C. Furnish the cost of training additional facilities personnel during the guarantee period.

1.14 DELIVERY, HANDLING, STORAGE

A. Comply with General Conditions and Division 1 Section “Product Requirements”.

PART 2 PRODUCTS

2.01 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.

2.02 ACCEPTABLE MANUFACTURERS

A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

B. Substitutions: Comply with General Conditions and Division 1 Section “Product Requirements” using form in Division 1 Section “Substitution Request Form”.

2.03 ELECTRIC CONTROLS

A. General

1. Electrical controls of the low voltage type shall be minimum #18AWG THHN/THWN, plenum-rated, with copper conductors. 120 volt control wiring shall be minimum #12AWG, THHN/THWN, terminated in appropriate lugs.

2. Safety controls shall be 120 volts or less, with one leg grounded.

2.04 INDIVIDUAL INDICATING PANELS

A. Provide separate indicating panels in each mechanical room, to house all miscellaneous controls, relays, etc. serving systems located in the room. Mount controls, control setting indicator, all control pressure gauges and all remote mounted system temperature and pressure gauges on the panel.

B. Locate the panels near the central equipment for each system. The panel mounted controls for air systems may be mounted in a common panel.

C. Construct the panels of a minimum of 16 gauge steel or formica properly braced and stiffened and supported on an angle iron frame.

D. Provide a diagram of each device and its position in the panel, with nomenclature matching the final control diagrams.

2.05 FLOW METERS AND ENERGY BTU METERS

1. Flow meters shall be applied based on criteria in table below, and the following paragraphs. Where questions arise on application, refer to engineer for selection.

2. Insertion Turbine Flow Meters for Chilled Water (CHW) and Heating Hot Water (HHW):

a. Provide Turbine Flow Meter complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand-insertable up to 400 psi. The flow meter shall have axial turbines, with electronic impedance-based sensing.

b. The flow meter shall be installed in accordance with the manufacturer’s installation guide including meter orientation and straight pipe recommendations.

c. Wetted metal components shall be nickel-plated brass for applications operating below 250 degrees F, 316L SS construction for DW applications, HTHW applications operating over 250 degrees F, and for any application in non-metallic pipe. The maximum operating temperature shall be 280 degrees F, 300 F peak.

d. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. The manufacturer's certificate of calibration shall be provided with each flow meter.

e. Accuracy shall be within ± 0.5% of rate at the calibrated velocity, within ± 1% of rate over a 10:1 turndown (3.0 to 30 ft/s) and within ± 2% of rate over a 50:1 turndown (from 0.4 to 20 ft/s).

f. The flow meter shall include integral analog output(s), 4-20 mA, 0-10V, or 0-5V, and a high resolution frequency output for use with peripheral devices (remote display or BTU Meter). FB-1210 for Bi-directional applications shall include an isolated contact closure output for direction.

g. The flow meter shall be covered by the manufacturer's two year warranty.

h. Turbine meter shall be ONICON Incorporated Model F-1100 or F-1200 Dual Turbine, as shown in chart below, or as approved by the Engineer.

3. Insertion Electromagnetic Flow Meters for Hydronic Measurements including CHW, HHW, Open Loop CW:

a. Provide Insertion Electromagnetic Flow Meter complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand-insertable up to 400 psi. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes.

b. The flow meter shall be installed in accordance with the manufacturer's installation guide including meter orientation and straight pipe recommendations.

c. The flow meter shall be installed either in the supply or return pipe of the system to be measured following the manufacturer's instructions. For installations in non-metallic pipe, install grounding rings or grounding probes.

d. Materials of construction for wetted metal components shall be 316 SS. The maximum operating temperature shall be 250 degrees F.

e. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. A certificate of calibration shall be provided with each flow meter.

f. Accuracy shall be within ± 1% of rate from 2-20 ft/s. Overall turndown shall exceed 80:1.

g. Output signals shall be completely isolated and shall consist of the following: (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable, (1) scalable dry contact output for totalization, and (1) high resolution frequency output for use with peripheral devices (remote display or BTU Meter). FB-3500 for Bi-directional applications shall provide additional contact outputs for direction and flow totalization in each direction.

h. Each flow meter shall be covered by the manufacturer's two-year warranty.

i. Insertion Electromagnetic Flow Meter shall be ONICON Incorporated Model F-3500, as shown in chart below, or as approved by the Engineer.

4. In-Line Flanged Electromagnetic Flow Meters for Hydronic Measurements including CHW, HHW, CW, DW, Make Up, Blow Down:

a. Provide an In-line flanged Electromagnetic Flow Meter complete with integral or remote electronics module. The electronics module shall include a backlit graphic display and external keypad. The principle of operation shall be based of Faraday's Law of Electromagnetic Induction.

b. The flow meter shall be installed in accordance with the manufacturer's installation guide including meter orientation and straight pipe recommendations. Connections to the piping shall be ANSI class 150 flanges *(ANSI class 300 where required)*. For installations in non-metallic pipe, install grounding rings between flanges. The installing contractor is responsible for providing suitable mating flanges and any required reducer/expander.

c. The flow tube shall be epoxy coated steel; the sensing electrodes shall be 316SS; the liner shall be polypropylene or ebonite for low temperature service, PFTE for hot water service (266 F maximum).

d. Each flow meter shall be individually wet-calibrated and accurate to within +/- 0.20% of reading from 1.6 to 33 feet per second velocity. A certificate of calibration shall be provided with each flow meter.

e. Manufacturer's grounding rings shall be provided upstream and downstream of each flow meter when used in non-metallic or lined pipe. Gaskets shall be provided on flow meter flanges for sensors with ebonite, polypropylene or PTFE liners.

f. Output signals shall be 4-20 mA and programmable pulse. The flow meter shall be capable of measuring bi-directional flow. Each flow meter shall be factory programmed for its specific application, and shall be re-programmable using the integral keypad on the electronics module (no special interface device or computer required).

g. Each flow meter shall be covered by the manufacturer's two-year warranty.

h. In-line flanged Electromagnetic Flow Meter shall be ONICON Incorporated Model F-3100 or F-3200, as shown in chart below, or as approved by the Engineer.

5. Clamp-On Ultrasonic Flow Meters for Hydronic Measurements:

a. Provide Clamp-on Transit Time Ultrasonic Flow Meter, complete with matched transducers, all necessary installation hardware and coaxial transducer cables. The flow meter shall be installed without making any openings in the pipe wall and shall utilize non-wetted ultrasonic transducers that may be located up to 300 ft from the meter.

b. Installation hardware shall support the transducers independent of the pipe clamping mechanism and provide precise spacing with an integral calibrated scale.

c. The flow meter shall be installed in accordance with the manufacturer's installation guide including meter orientation and straight pipe recommendations.

d. Multiple-frequency axial beam transducers provided must be optimized for the specific pipe & process conditions for each application and the transducer frequency shall be

automatically matched to the resonant frequency of the pipe at start-up. The use of single frequency transducer technology or shear mode detection technology shall not be acceptable.

e. An integral auto-zero function shall be provided for zero precision. The flow meter shall be capable of measuring bi-directional flow.

f. Accuracy shall be within ± 1% of rate from 1 to 40 ft/sec and ± 0.01 ft/sec for velocities below 1 ft/sec. Overall turndown shall exceed 400:1.

g. Each flow meter shall be covered by the manufacturer's two-year warranty.

h. Clamp-On Ultrasonic Flow Meter shall be ONICON Incorporated Model F-4200, as shown in chart below, or as approved by the Engineer.

6. In line Ultrasonic Flowmeters for Small Pipes 2" or smaller:

a. Provide an inline flowmeter complete with direct beam wetted ultrasonic transducers and calibration certificate.

b. Application Range: This contractor shall be responsible for selecting the flowmeter options submitted based on the application. Flowmeter shall be constructed, calibrated and scaled for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions and fluid characteristics which include but are not limited to pressure, temperature, and viscosity.

c. Sensing Technology: Direct beam, transit time ultrasonic velocity measurement element with matched transducers.

d. Design: Ultrasonic flow sensing element shall utilize matched direct path wetted ultrasonic transducers.

e. Construction: Flowmeter shall consist of a flow body with process connections, integral transducers and a processor / transmitter. Individual calibration tag shall be attached indicating calibration and programming information.

f. Maximum Pressure Rating: 400 psi

g. Maximum Temperature Rating: 250F

h. Mounting Connections: For NPS ½" – 2", piping connections shall be male NPT threads.

i. Flow Range: Flow-measuring element and transmitter shall cover operating range of equipment or system served. Flow meter shall be sized by manufacturer for intended application prior to submittal.

j. Accuracy: Flowmeter shall provide calibrated outputs directly from the transmitter, throughout the operating range with the accuracy stated as follows:

1) Plus or minus 1.0% of flow rate over a 25:1 turndown

2) Plus or minus 2.0% of flow rate over a 100:1 turndown

3) Overall turndown of 500:1

k. Transmitter: Transmitter shall provide instantaneous flow rate information over a 4-20mA scale, a pulse output for totalized flow information and shall be factory configured for a specific flowmeter application.

l. Operating and Installation Instructions: Installation and operating instructions shall be provided for each flowmeter.

m. Warranty: Flowmeter shall be covered by the manufacturer's two year warranty.

n. Manufacturer: ONICON Incorporated Model F-4600, as shown in chart below.

7. Energy BTU Measurement System:

a. The entire Energy BTU Measurement System shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation hardware. The BTU meter and associated sensors and flow meter shall be installed in accordance with the manufacturer's installation guide.

b. The BTU meter shall provide the following points both at the integral LCD and as outputs to the building control system: Energy Total, Energy Rate, Flow Rate, Supply Temperature and Return Temperature. Output signals shall be either serial network (protocol conforming to BACnet® MS/TP, BACnet/IP, LONWORKS®, JCI-N2, MODBUS RTU, MODBUS TCP, or Siemens-P1) and/or via individual analog and pulse outputs.

c. Each BTU meter shall be factory programmed and tagged for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).

d. Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within $\pm$0.15˚F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).

e. A certificate of NIST traceable calibration shall be provided with each system.

f. Flow Meter shall be in accordance with paragraphs A, B, C, or D above. Refer to meter schedule for specific flow meter type.

g. All equipment shall be covered by the manufacturer's two year warranty.

h. Energy BTU Measurement System shall be ONICON Incorporated System-10 BTU Meter, or as approved by the Engineer.

8. Flow Meter Schedule: Flow meters shall be as follows:

Meter Selection Guide (Based on Onicon)						
Applications	Ultrasonic Meters		Turbine Meters		Electromagnetic Meters	
Chilled Water			✓			
Hot Water < 280 F			✓			
Condenser Water - Open Loop						
Domestic (potable) water						
Processed Gasses						
Compressed Air						
Natural Gas						
Meters	F-4600	F-4200	F-1100	F-1200	F-3500	F-3100 (0.4%) F-3200 (0.2%)
Style	Inline	Clamp-on	Insertion	Insertion	Insertion	Inline
Pipe Size Range	0.5"-2.5"	0.5"-42"	1.25"-72"	2.5"-72"	3"-72"	.25"-72"
Accuracy	1%	1%	1%	1%	1%	0.2-0.4%
Bi-Directional	No	Yes	No	Optional	Optional	Yes
System Shutdown Required	Yes	No	No	No	No	Yes
Straight Run Required Pipe Diameter (Upstream/Downstream)	Minimal	10/5	20/5	10/5	10/5	3/2

2.06 BREAK GLASS STATIONS

A. Non-metallic housing, suitable for coastal and harsh chemical environments. Housing shall be NEMA 4X surface mounted, waterproof, dustproof and oiltight.

B. Provide legends for HVAC, Boiler, Ventilation, Fuel, Gas, Exhaust as required for application.

C. Provide contact block(s) as required for proper operation. Contact blocks shall be rated 10 AMP continuous up to 600 Volts. Max Duty contacts rated 20AMP up to 600Volts, if required. Unit shall accept up to 3 contact blocks PILNOCB or PILNCCB; or 2 Max Duty contacts rated 3HP@24V, 1.5HP@120V.

D. Contacts shall remain open/closed with lens intact--close/open when lens is broken.

E. Provide one extra replacement lens included with each unit; turn over to owner.

F. Manufacturer: Model:
Pilla Series ST120-SN4XNM

2.07 DIRECT DIGITAL CONTROL SYSTEM

A. Materials

1. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

B. Communication

1. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

2. Install new wiring and network devices as required to provide a complete and workable control network.

3. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

4. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

5. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

   a. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

   b. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

6. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.

C. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

D. Operator Interface

1. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. The Operator Workstation or server shall conform to the BACnet Operator Workstation (B-OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L.

2. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J.

3. Hardware.

   a. Workstation or web server. Industry-standard hardware shall meet or exceed DDC system manufacturer’s recommended specifications and shall meet response times specified elsewhere in this document. The following hardware requirements also apply:

b. The hard disk shall have sufficient memory to store:

1) All required operator workstation software.
2) A DDC database at least twice the size of the delivered system database.
3) One year of trend data based on the points specified to be trended at their specified trend intervals.

4. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.

a. Minimum hardware configuration shall include the following:

1) Minimum 3.2 GHz Intel i7-9700 9th generation processor.
2) 16 GB RAM
3) Minimum 1TB SSD Hard Drive
4) 24” Wide Screen 16:9 Full HD (1920x1080) HDMI Monitor
5) 4 USB ports
6) Video Card able to support 2 Full HD monitors
7) Latest Windows operating system
8) Latest Version of Microsoft Office
9) Serial, parallel, and network communication ports and cables as required for proper DDC system operation

5. System Software.

a. Operating System. Web server or workstation shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturers minimum requirements for their software. Acceptable systems include Microsoft Windows 10 or 11, Windows Server 2019 or 2022.

b. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.

1) Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
2) Animation. Graphics shall be able to animate by displaying different image files for changed object status.
3) Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
4) Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in or shall only require widely available no-cost plug-ins (such as Adobe Flash).

c. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that

are saved in the same formats as are used for system graphics.

d. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

6. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

a. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.

b. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.

c. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.

d. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

e. Security. Each operator shall be required to log on to the system with username and password in order to view, edit, add, or delete data.

1) Operator Access. The username and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users.
2) Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
3) Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

f. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.

g. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93 (Sequences of Operation). Alarms shall be BACnet alarm objects and shall use BACnet alarm services.

h. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms or mnemonics.

i. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.

j. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.

k. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 23 09 93 (Sequences of Operation). Trends shall be BACnet trend objects.

l. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.

m. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

n. Standard Reports. Furnish the following standard system reports:

1) Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
2) Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
3) Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
   a) Alarm History.
   b) Trend Data. Operator shall be able to select trends to be logged.
   c) Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

7. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.

a. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.

b. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.

c. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:

1) Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on thesyntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
2) A full-screen character editor programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete custom programming code. It also shall incorporate features such as cut/ paste and find.
3) The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
4) The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and observe any intermediate values and/or results.
5) The programming language shall support conditional statements (IF/THEN/ELSE/ ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
6) The programming language shall support floating-point arithmetic using the following operators: +, , ÷, ×, and square root. The following mathematical functions also shall be provided: absolute value and minimum/maximum value.
7) The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval-timing functions can be stopped and started within a program. Values from all of the above variables shall be readable by the language so that they can be used in a program for such purposes as IF/ THEN comparisons, calculations, etc.
8) The language shall be able to read the values of the variables and use them in programming statement logic, comparisons, and calculations.

9) The programming language shall have predefined variables representing the status and results of the system software and shall be able to enable, disable, and change the setpoints of the system software described below.

8. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator’s Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

E. Controller Software

1. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.

2. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:

    a. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).

    b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.

    c. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.

3. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.

4. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

5. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.

6. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.

7. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

8. Demand Limiting.

    a. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.

    b. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Sequences of Operation. When demand drops below adjustable levels, system shall restore loads as specified.

9. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Sequences of Operation.

10. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Sequences of Operation.

11. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value

that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.

12. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

13. Energy Calculations.

    a. The system shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.

    b. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

14. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

15. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.

16. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 09 93 (Sequence of Operations).

F. Controllers

1. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 09 23 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

2. BACnet.

    a. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.

    b. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.

    c. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

d. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.

e. BACnet Communication.

1) Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.

2) BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
3) Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
4) Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
5) Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
6) Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

3. Communication

a. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.

b. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

c. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.

d. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

4. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

a. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).

b. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

5. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.

6. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

7. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

8. Memory.

   a. Controller memory shall support operating system, database, and programming requirements.

   b. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.

   c. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

   d. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

9. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

G. Input and Output Interface

1. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

2. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.

3. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

4. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.

5. Analog Inputs. Analog inputs shall allow the monitoring of low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

6. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

7. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

8. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

9. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

10. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system

H. Power Supplies and Line Filtering

1. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

a. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

1) Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
2) Line voltage units shall be UL recognized and CSA listed.

2. Power Line Filtering.

a. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:

1) Dielectric strength of 1000 V minimum
2) Response time of 10 nanoseconds or less
3) Transverse mode noise attenuation of 65 dB or greater
4) Common mode noise attenuation of 150 dB or greater at 40–100 Hz

I. Auxiliary Control Devices

1. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follow.

a. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.

1) Outdoor and return air mixing dampers and face-and-bypass dampers shall be

parallel-blade and shall direct airstreams toward each other.
2) Other modulating dampers shall be opposed blade.
3) Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.

b. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (⅛ in.) extruded aluminum with reinforced corner bracing.

c. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).

d. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.

e. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m2 (10 cfm per ft2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).

f. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.

g. Modulating dampers shall provide a linear flow characteristic where possible.

h. Linkages. Dampers shall have exposed linkages.

2. Electric Damper and Valve Actuators.

a. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator’s rotation.

b. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).

c. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)

d. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.

e. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.

3. Control Valves.

a. Control valves shall be two-way or three-way type for two-position or modulating service as shown.

b. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

1) Water Valves:
   a) Two-way: 150% of total system (pump) head.
   b) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

c. Water Valves.

1) Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
2) Sizing Criteria:
   a) Two-position service: Line size.
   b) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
   c) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.

   d) Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
   e) Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.

3) Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
   a) Water zone valves—normally open preferred.
   b) Hot water control valves—normally open.
   c) Chilled water control valves—normally closed.
   d) Other applications—as scheduled or as required by sequences of operation.

4. Pressure Independent Control Valves.

a. Application: 2-way valves for system water and hot water.

b. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

c. Forged brass body rated at no less than 600psi, chrome plated brass ball and stem, female, NPT union ends, p/t plugs.

d. The modulating control valves shall be pressure independent with characterized flow control providing near linear heat transfer control.

e. The control valve shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic. The flow shall not vary more than +/- 5% due to system pressure fluctuations across the valve with a minimum of 5 PSID and maximum of 50 PSID across the valve.

f. Combination of actuator and valve shall provide a minimum close-off pressure rating of 200 PSI.

g. The control valve shall require no maintenance and shall not include replaceable cartridges.

h. The actuator shall be directly coupled to the valve at the factory.

i. Actuators shall be Multi-Function Technology as manufactured by Belimo Aircontrols (USA), Inc. Running time shall be 100 seconds independent of the flow setting while rotating a maximum of 90 degrees.

j. The valves and actuators shall be suitable for the expected ambient operating temperature.

k. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

l. The valves shall be quiet in operation and fail-safe open, closed, or in their last position.

m. The valves shall be quiet in operation and fail-safe open, closed, or in their last position as required for specific application:

AHU heating coil – fail-safe open
AHU cooling coil – fail-safe closed
UH/CUH heating coil – fail-safe open
VAV/CV heating coil – fail-safe open

n. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer and shall be guaranteed to meet the heating and cooling loads, as specified.

o. Manufacturers: Belimo AirControls, Griswald (MVP only), Delta-P

5. Binary Temperature Devices.

a. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

b. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

c. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

6. Temperature Sensors.

a. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.

b. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m2(10 ft2) of duct cross-section.

c. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.

d. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.

e. Differential Sensors. Provide matched sensors for differential temperature measurement.

7. Humidity Sensors.

a. Duct and room sensors shall have a sensing range of 20%–80%.

b. Duct sensors shall have a sampling chamber.

c. Outdoor air humidity sensors shall have a sensing range of 20%–95% RH and shall be suitable for ambient conditions of -40°C–75°C (-40°F–170°F).

d. Humidity sensors shall not drift more than 1% of full scale annually.

8. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

a. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
b. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

9. Relays.

a. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

b. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

10. Override Timers.

a. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

11. Current Transmitters.

a. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.

b. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

c. Unit shall be split-core type for clamp-on installation on existing wiring.

12. Current Transformers.

a. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.

b. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.

c. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

13. Voltage Transmitters.

a. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.

b. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.

c. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

14. Voltage Transformers.

a. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

b. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.

c. Windings (except for terminals) shall be completely enclosed with metal or plastic.

15. Power Monitors.

a. Selectable rate pulse output for kWh reading, 4–20 mA output for kW reading, N.O. alarm contact, and ability to operate with 5.0 amp current inputs or 0–0.33 volt inputs.

b. 1.0% full-scale true RMS power accuracy, +0.5 Hz, voltage input range 120–600 V, and auto range select.

c. Under voltage/phase monitor circuitry.

d. NEMA 1 enclosure.

e. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0–0.33 V output. If 0–5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.

16. Hydronic Flowmeters refer to separate paragraph in Section 230923.

Current Switches.

a. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

17. Pressure Transducers.

a. Transducers shall have linear output signal and field-adjustable zero and span.

b. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

c. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4–20 mA output, suitable mounting provisions, and block and bleed valves.

d. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300psi.) Transducer shall have 4–20 mA output, suitable mounting provisions, and 5-valve manifold.

18. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

19. Pressure-Electric (PE) Switches.

a. Shall be metal or neoprene diaphragm actuated, operating pressure rated for 0–175 kPa (0–25 psig), with calibrated scale minimum setpoint range of 14–125 kPa (2–18 psig) minimum, UL listed.

b. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application. Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.

c. Switches shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.

d. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

20. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.

21. Local Control Panels.

a. All indoor control cabinets shall be fully enclosed NEMA 1 construction with hinged door, key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.

b. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

c. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

J. Wiring and Raceways

1. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

2. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

K. Fiber Optic Cable System

1. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

2. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

L. Approved manufacturers for the automatic control systems are as follows:

Manufacturers	SERIES
Andover	Continuum
Automated Logic	WebCTRL
Honeywell	EXCEL 5000 w/ Symmetre software
Johnson Controls	Metasys
Siemens	Apogee

G. SUMMARY OF INPUT/OUTPUT POINTS

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
CHILLED WATER SYSTEM (30% GLYCOL)						
CH-1	CHILLER CONTROL PANEL					NET
CHWP-1	CHILLED WATER PUMP	S	S/S	P	C	
CHWP-2	CHILLED WATER PUMP	S	S/S	P	C	
	CHILLED WATER SUPPLY			GPM, T		
	CHILLED WATER RETURN			T		
	CHILLED WATER BYPASS			GPM		
	CHW BYPASS VALVE			P	C	
	CHW DIFF. PRESSURE			DP		

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
HOT WATER SYSTEM (30% GLYCOL)						
B-1	BOILER CONTROL PANEL					NET
B-2	BOILER CONTROL PANEL					NET
HWP-1	HOT WATER PUMP	S	S/S	P	C	
HWP-2	HOT WATER PUMP	S	S/S	P	C	
	HOT WATER SUPPLY			GPM, T		
	HOT WATER RETURN			T		
	HOT WATER BYPASS			GPM		
	HW BYPASS VALVE			P	C	
	HW DIFF. PRESSURE			DP		

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
DEDICATED OUTSIDE AIR UNIT						
OAU-1	SUPPLY AIR FAN	S	S/S	P ,CFM	SPEED	
OAU-1	SUPPLY AIR			T, H, DP		
OAU-1	RETURN AIR			T, H		
OAU-1	RETURN AIR			CFM,CO_2		
OAU-1	RETURN AIR FILTER			DP		
OAU-1	OUTSIDE AIR			T,H,CFM		
OAU-1	OUTSIDE AIR DAMPER			P	C	
OAU-1	OUTSIDE AIR FILTER			DP		
OAU-1	EXHAUST AIR			T		
OAU-1	EXHAUST AIR DAMPER			P	C	
OAU-1	EXHAUST AIR FAN	S	S/S	P ,CFM	SPEED	
OAU-1	MIXED AIR			T		
OAU-1	HW COIL VALVE			P	C	
OAU-1	CHW COIL VALVE			P	C	

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
NON-COLLECTION SYSTEM AIR HANDLING UNIT						
AHU	SUPPLY AIR FAN	S	S/S	P ,CFM	SPEED	
AHU	SUPPLY AIR			T, H, DP		
AHU	RETURN AIR			T, H		
AHU	RETURN AIR			CFM,CO_2		
AHU	OUTSIDE AIR			T,H,CFM		
AHU	OUTSIDE AIR DAMPER			P	C	
AHU	OUTSIDE AIR FILTER			DP		
AHU	RELIEF AIR			CFM		
AHU	RELIEF AIR DAMPER			P	C	
AHU	MIXED AIR FILTER			DP		
AHU	MIXED AIR			T, H		
AHU	HW COIL VALVE			P	C	
AHU	CHW COIL VALVE			P	C	
AHU	ELECTRONIC HUMIDIFIER					NET
AHU	SPACE CONDITIONS			T, H, CO_2		

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
VAV BOX						
VAV-n	ZONE SPACE CONDITIONS			T, CO_2		
VAV-n	VAV DAMPER			P	C	
VAV-n	VAV INLET			CFM		
VAV-n	SUPPLY AIR			T		
VAV-n	HW COIL VALVE (IF PRESENT)			P	C	
VAV-n	HW FTR VALVE (IF PRESENT)			P	C	

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
~~HW~~ ***ELECTRIC*** **CABINET UNIT HEATER (CUH-1 & CUH-3)**						
CUH	SUPPLY FAN	S				
CUH	LOW TEMP ALARM	A				

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
ELECTRIC UNIT HEATER						
UH	SUPPLY FAN	S				

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
TOILET EXHAUST FAN – GANG TOILETS						
EF-2	EXHAUST FAN	S	S/S			

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
MISCELLANEOUS ELECTRICAL BMS CONTACTS						
	SURGE PROTECTION	A				
	FIRE ALARM SYSTEM	A				
	SECURITY SYSTEM	A				
	INVERTOR SYSTEM	A				
	GUTTER DE-ICING SYSTEM	A				
	ELECTRIC METERING (EACH CASE)					NET

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
MISCELLANEOUS PLUMBING BMS CONTACTS						
	WATER DETECTOR	A				
	WATER METERING (2 CASES)					NET
	DOMESTIC RECIRC PUMP	S	S/S			
	NATURAL GAS METERING (1 CASE)					NET

Unit	Description	D. I.	D.O.	A. I.	A. O.	LINK
MISCELLANEOUS MECHANICAL BMS CONTACTS						
	OUTSIDE AIR (COMMON)			T, H		
	BREAKGLASS (2 CASES)	A	S/S			

Abbreviations:

A –	ALARM
C -	CONTROL
CFM -	MEASURED AIRFLOW
CO_2 –	MEASURED CARBON DIOXIDE
DP -	DIFFERENTIAL PRESSURE
H -	RELATIVE HUMIDITY
L -	LIGHTING
LT -	LOW TEMPERATURE
O/C -	OPEN/CLOSE
P –	POSITION
PU –	PULSE COUNT FROM WATER METER
S –	STATUS
SPEED-	FAN SPEED
SP –	STATIC PRESSURE
S/S -	START/STOP
T –	TEMPERATURE
NET –	NETWORK INTERFACE CONNECTION – RS-485 or as applicable to ModBus,LonWorks, BACnet or other. Provide interface as required.

PART 3 EXECUTION

3.01 AUTOMATIC CONTROLS - GENERAL

A. Install controls so that adjustments and calibrations can be readily made. Controls are to be installed by, or under the supervision of the control equipment manufacturer.

B. Mount surface-mounted control devices on brackets to clear the final finished surface on insulation.

C. Conceal control conduit and piping and capillaries in all spaces except in the Mechanical Equipment Rooms and in unfinished spaces. Install in parallel banks with all changes in directions made at 90 degree angles.

D. Install control valves horizontally with the power unit up.

E. Unless otherwise noted, install wall mounted thermostats and humidistats 4'-6" above the floor measured to the center line of the instrument. Room devices are to be of the concealed adjustment type without indicator.

F. Static pressure sensors shall be located as directed in the field, typically 2/3s of the way along the longest duct or pipe run.

G. Electronic and pneumatic space mounted devices are to be identical in appearance. All devices shall be mounted under the same style cover.

3.02 EXAMINATION

A. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.

B. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of—this contractor.

3.03 PROTECTION

A. The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.

B. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.04 COORDINATION

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.

2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Submittals. See Section 230000, Submittals.

C. Test and Balance.

1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.

3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

D. Life Safety.

1. Duct smoke detectors required for air handler shutdown are provided under Division 26. Interlock smoke detectors to air handlers for shutdown as specified in Sequences of Operation.

2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23. Interlock smoke dampers to air handlers as specified on drawings, in electrical specifications and/or in Sequences of Operation.

3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided as specified on drawings, in electrical specifications and/or in Sequences of Operation.

E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. All communication media and equipment shall be provided as specified in Section 23 09 23 Paragraph “Communication”.

2. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation.

3. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.

5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.05 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.06 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Paragraph Codes and Standards.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

C. Contractor shall have work inspection by local and/or state authorities having jurisdiction over the work.

3.07 WIRING

A. Provide all relays, switches, sources of electricity and all other auxiliaries, accessories and connections necessary to make a complete operable system in accordance with the sequences specified. Junction boxes and/or circuit breakers for the automatic control system are provided under another division of these specifications. All field wiring (including low voltage and 120 volt power), to all control panels and electric control components of the automatic control system shall be provided and installed by the Division 23 mechanical contractor, extended from sources indicated on the electrical drawings.

B. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification, Where the requirements of this section differ from Division 26, the requirements of this section shall take precedence.

C. Control wiring for engineered smoke control systems and components shall be completely enclosed within continuous EMT raceways. Exposed raceways run within 8’ of finished floor in garages, mechanical rooms, elevator machine rooms, loading docks and elsewhere where subject to mechanical damage shall be rigid galvanized steel conduit.

D. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements. Flexible metal conduit, up to 36 inches in length, shall be permitted for final connections to devices.

E. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.

F. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.

G. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in EMT raceway at levels below 8 feet.

H. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

I. Do not install wiring in raceway containing tubing.

J. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 10 foot intervals.

K. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems. “Bridle ring” type supports may be used for support of control system cables where permitted above to be run without conduit. “Bridle rings” shall be supported by bolt-on C-clamps or trapeze hangers. Do not use “tie-wraps” for cable attachment to other support systems.

L. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

M. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

N. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.

O. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

P. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

Q. Size of raceway and size and type of wire type shall be the responsibility of the contractor in keeping with the manufacturer’s recommendations and NEC requirements, except as noted elsewhere.

R. Include one pull string in each raceway 1 in. or larger.

S. Use color-coded conductors throughout with conductors of different colors.

T. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

U. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 in. from high-temperature equipment (e.g. steam pipes or flues).

V. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

W. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.

X. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.

Y. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

Z. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 3 ft in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight,

flexible metal raceways shall be used.

AA. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.08 COMMUNICATION WIRING

A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.

B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

C. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.

D. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

E. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to manufacturer’s instructions.

G. All runs of communication wiring shall be unspliced length when that length is commercially available.

H. All communication wiring shall be labeled to indicate origination and destination data.

I. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

J. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:

1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 30 pF per foot.

2. The maximum length of an MS/TP segment is 4000 ft with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.

3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.

4. An MS/TP EIA-485 network shall have no T connections.

3.09 FIBER OPTIC CABLE

A. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications.

B. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii, as specified by cable manufacturer, shall be maintained.

3.10 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.

D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.

E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 ft of sensing element for each 1 ft^2 of coil area.

G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 10 ft downstream, where possible. Consult with Engineer if not possible.

H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

I. Install outdoor air temperature sensors on north wall, complete with perforated tube and sun shield.

J. Differential Air Static Pressure.

1. Supply Duct Static Pressure. Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.

2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.

3. Building Static Pressure. Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.

4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.

5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.

6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.

K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

L. Install humidity sensors for duct mounted humidifiers at least 3 m (10 ft) downstream of the humidifier. Do not install filters between the humidifier and the sensor.

3.11 FLOW SWITCH INSTALLATION

A. Use correct paddle for pipe diameter.

B. Adjust flow switch according to manufacturer's instructions.

3.12 ACTUATORS

A. General. Mount and link control damper actuators according to manufacturer's instructions.

1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

3. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer’s recommendations.

2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.13 WARNING LABELS

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.

1. Labels shall use white lettering (12-point type or larger) on a red background.

2. Warning labels shall read as follows.

C A U T I O N
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

B. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.

1. Labels shall use white lettering (12-point type or larger) on a red background.

2. Warning labels shall read as follows.

C A U T I O N
This equipment is fed from more than one power source with separate disconnects.
Disconnect all power sources before servicing.

3.14 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 2 in. of termination with control system address or termination number.

B. All pneumatic tubing shall be labeled at each end within 2 in. of termination with a descriptive identifier.

C. Permanently label or code each point of field terminal strips to show the instrument or item served.

D. Identify control panels with minimum ½ in. letters on laminated plastic nameplates.

E. Identify all other control components with permanent labels. All plug-in components shall be labeled such that label removal of the component does not remove the label.

F. Identify room sensors related to terminal boxes or valves with nameplates.

G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

H. Identifiers shall match record documents.

3.15 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all the hardware points listed in Section 23 09 93 (Sequences of Operation).

3.16 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging.

B. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 23 09 93 (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 09 93 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.

C. Software Programming.

1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in

this document, also shall be provided by the contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:

a. Text-based:

1) Must provide actions for all possible situations

2) Must be modular and structured

3) Must be commented

b. Graphic-based:

1) Must provide actions for all possible situations

2) Must be documented

c. Parameter-based:

1) Must provide actions for all possible situations

2) Must be documented.

D. Operator Interface.

1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all relevant input and output points for that equipment. Also show relevant calculated points such as setpoints. As a minimum, show on each equipment graphic the input and output points and relevant calculated points as indicated on the applicable Points List in Section 23 09 93.

2. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.17 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.

4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.

7. Alarms and Interlocks:

   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

   c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.18 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration.

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.

2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.

3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.

4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.

5. As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed.

6. Demonstrate compliance with Part 1, "System Performance."

7. Demonstrate compliance with sequences of operation through all modes of operation.

8. Demonstrate complete operation of operator interface.

9. Additionally, the following items shall be demonstrated:

   a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.

   b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.

   c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

   d. Interface to the building fire alarm system.

   e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance.

1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.

2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.19 CLEANING

A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.20 TRAINING

A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.

B. Training shall enable students to accomplish the following objectives.

1. Day-to-day Operators:

a. Proficiently operate the system

b. Understand control system architecture and configuration

c. Understand DDC system components

d. Understand system operation, including DDC system control and optimizing routines (algorithms)

e. Operate the workstation and peripherals

f. Log on and off the system

g. Access graphics, point reports, and logs

h. Adjust and change system set points, time schedules, and holiday schedules

i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals

j. Understand system drawings and Operation and Maintenance manual

k. Understand the job layout and location of control components

l. Access data from DDC controllers and ASCs

m. Operate portable operator's terminals

2. Advanced Operators:

a. Make and change graphics on the workstation

b. Create, delete, and modify alarms, including annunciation and routing of these

c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals

d. Create, delete, and modify reports

e. Add, remove, and modify system's physical points

f. Create, modify, and delete programming

g. Add panels when required

h. Add operator interface stations

i. Create, delete, and modify system displays, both graphical and others

j. Perform DDC system field checkout procedures

k. Perform DDC controller unit operation and maintenance procedures

l. Perform workstation and peripheral operation and maintenance procedures

m. Perform DDC system diagnostic procedures

n. Configure hardware including PC boards, switches, communication, and I/O points

o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware

p. Adjust, calibrate, and replace system components

3. System Managers/Administrators:

a. Maintain software and prepare backups

b. Interface with job-specific, third-party operator software

c. Add new users and understand password security procedures

C. Organize the training into sessions or modules for the three levels of operators listed above. (Day-to-Day Operators, Advanced Operators, System Managers and Administrators). Students will receive one or more of the training packages, depending on knowledge level required.

D. Provide course outline and materials according to the "Submittals" article in Part 1 of this specification. Provide one copy of training material per student.

E. The instructor(s) shall be factory-trained and experienced in presenting this material.

F. Classroom training shall be done using a network of working controllers representative of installed hardware.

3.21 CONTROL VALVE INSTALLATION

A. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.

B. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.

C. Valves shall be installed in accordance with the manufacturer's recommendations.

D. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.

E. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.

F. Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5 inch in diameter, with ¼ inch high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

3.22 CONTROL DAMPER INSTALLATION

A. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.

B. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.

C. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 1/8 in. of each other.

D. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.

E. Install extended shaft or jackshaft according to manufacturer’s instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)

F. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.

G. Provide a visible and accessible indication of damper position on the drive shaft end.

H. Support ductwork in area of damper when required to prevent sagging due to damper weight.

I. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

3.23 DUCT SMOKE DETECTION

A. Submit data for coordination of duct smoke detector interface to HVAC systems as required in Part 1, "Submittals."

B. This Contractor shall provide a dry-contact alarm output in the same room as the HVAC equipment to be controlled.

3.24 PACKAGED EQUIPMENT CONTROLS

A. General. The electronic controls packaged with any equipment furnished under this contract shall communicate with the building direct digital control (DDC) system. The DDC system shall

communicate with these controls to read the information and change the control setpoints as shown in the points list, sequences of operation, and control schematics. The information to be communicated between the DDC system and these controls shall be in the standard object format as defined in ANSI/ASHRAE Standard 135 (BACnet). Controllers shall communicate with other BACnet objects on the internetwork using the Read (Execute) Property service as defined in Clause 15.5 of Standard 135.

B. Distributed Processing. The controller shall be capable of stand-alone operation and shall continue to provide control functions if the network connection is lost.

C. I/O Capacity. The controller shall contain sufficient I/ O capacity to control the target system.

D. The Controller shall have a physical connection for a laptop computer or a portable operator's tool.

E. Environment. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 40°F to 140°F.

2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 32°F to 120°F.

F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

G. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 30 days.

H. Power. Controller shall be able to operate at 90% to 110% of nominal voltage rating.

I. Transformer. Power supply for the Controller must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

3.25 START-UP AND CHECKOUT PROCEDURES

A. Start up, check out, and test all hardware and software and verify communication between all components.

1. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

2. Verify that all analog and binary input/output points read properly.

3. Verify alarms and interlocks.

4. Verify operation of the integrated system

3.26 ADJUSTMENTS AND TESTS

A. Adjust and calibrate controls and test all safety devices when systems are operative for the required performance prior to the performance tests.

B. At final performance test, demonstrate performance of controls and safety devices.

C. Adjustment and tests are to be performed by the control manufacturer.

D. Excluding the work called for in Paragraphs A through C above, the control contractor shall, as part of his proposal, allow for an additional 120 hours of qualified mechanics' time for system readjustment and/or instruction of Owner's personnel.

3.27 PERFORMANCE

A. Unless stated otherwise, control temperatures within plus or minus 2^{o}F and humidity within plus or minus 5% of the set point.

B. Provide fully compensated capillaries with remote bulb instruments.

3.28 EVENT INITIATED TRENDING

A. In the event that the temperature or humidity of any zone shall enter alarm condition, the DDC system shall begin a trend of the parameters which affect the ability of the system to maintain conditions.

B. The points trended shall be similar but not limited to:

1. Air handling unit discharge temperature.
2. Air handling unit discharge humidity.
3. Zone supply air temperature.
4. Chilled water supply and return temperature.
5. Hot water supply and return temperature.
6. Outside air temperature and humidity.

C. The DDC system shall plot the variables on a single real time graphic display.

D. The DDC system shall monitor these points at 2 minute intervals and periodically download the values into Microsoft Excel.

3.29 SEQUENCE OF OPERATION – MEASUREMENT AND VERIFICATION

A. Electrical meters are provided under the electrical division of these specifications. Provide connections to these meters and integration of monthly consumption data (kW and kWH) into the DDC system.

B. Water meter is provided under the plumbing division of these specifications. Provide connection to the water meter, and integration of monthly consumption data into the DDC system.

C. The building’s energy usage readings shall be totaled as specified above and exported to hard drive in CSV format.

D. Natural gas meter is provided under the plumbing division of these specifications. Provide connection to the natural gas meter and integration of monthly consumption data into the DDC system.

END OF SECTION

SECTION 23 2000
PUMPING EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, general provision, and with the provisions of all applicable codes and laws.

1.03 SUBMITTALS

A. Procedure: Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Centrifugal end suction pumps.
2. Air conditioning condensate pumps.
3. Glycol feed pump and tank.
4. Pump related accessories.
5. Pump curves.

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000.

PART 2 PRODUCTS

2.01 GENERAL

A. Construct all apparatus of materials and pressure ratings suitable for the conditions encountered during continuous operation.

B. Provide casing connections for vent, drain, suction and discharge pressure gauges.

C. Balance impellers and all other moving components statically and dynamically.

D. Completely align and level pumps, motors and bases. Where pumps and motors are shipped as a unit, realign them in the field.

E. Install and align mechanical seals in accordance with the manufacturer's recommendations.

F. Provide water supply for cooling and lubricating of seals and/or packing.

G. Match centrifugal pump impellers and casings so that at specified operating conditions, the impeller diameter is not more than 90% of the maximum diameter impeller which can satisfactorily operate in the casing.

H. Pumps must operate stably without pulsation, vibration or internal recirculation. Pump operating characteristics at the design point must be such that a variation of 10% in head results in not more than 15% variation in GPM and does not affect the stability of operation of the pump.

I. Motor sizes scheduled are minimum for the specific pumps indicated on pump schedules. When submitting pumps other than those specifically selected, size motors so that when operating at rated RPM, the pump motor brake horsepower does not exceed the nominal motor rating despite variations in pumping head or when operated singly or in parallel with other pumps serving the same system.

J. Motors to be high efficiency type with guaranteed minimum efficiency rated in accordance with IEEE standard 112, method B - General Electric Company "Energy Saver" or equal.

K. Bearing Protection Ring: Whenever variable frequency drives are installed to control motor driven equipment, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor to discharge shaft currents to ground. Refer to Specification Section 230513.

2.02 PUMP - CENTRIFUGAL - END-SUCTION - SINGLE STAGE, STANDARD CONSTRUCTION

A. Single suction base mounted single stage centrifugal type with pump flexibly coupled to the motor and the assembly mounted as a unit on a cast iron or formed steel base plate. Provide a steel coupling guard bolted to the pump base plate.

B. Casing - Cast iron volute, vertically split, bolted at the division, replaceable bronze wearing rings locked on.

C. Pressure ratings - minimum 125 PSI WWP, 125 PSI ANSI-Standard flanged or screwed connections.

D. Impellers: Fully enclosed, bronze, keyed to the shaft.

E. Shaft - Alloy steel, ground smooth.

F. Shaft sleeves - aluminum bronze locked on the shaft extending from the impeller through the shaft seal.

G. Mechanical seals - Ni-resist and carbon sealing faces, Crane Packing Co. type 1. Provide water lubrication by copper tubing connections with casing.

H. Bearings - Heavy duty grease lubricated ball type. Protected from water by slinger rings on shaft.

I.

Manufacturer:	Model/Series:
Bell & Gossett	1510
Peerless	F
Weinman	500

2.03 AIR CONDITIONING CONDENSATE PUMP (SMALL)

A. Complete assembly of receiver, pump, and motor float switch.

B. Receiver shall be cast aluminum with 1 gallon capacity. Inlets shall be at top, with alternate inlet on side, at bottom.

C. Vertical type pump shall be constructed with stainless steel shaft bronze bearing and Polypropylene impeller. Pump shall be capable of 139 GPH at 12 ft. head, with a maximum lift of 22 feet.

D. Motor shall be 1/10HP, 3000 RPM, 120 volts, single phase, 60 Hz, 3.1 ampere, with built-in overload protection. Motor shall be suitable for use at 230V, single phase, 60 Hz, 1.5 ampere. Unit shall have integral junction box, and 6 foot cord and plug.

E. Pump features a safety switch that can be connected to shut down the air conditioner condenser or wired to an alarm to warn of possible tank overflow.

F. Discharge shall be a 3/8" O.D. barbed tubing adapter. Pump shall be rated for high-efficiency gas furnace applications that produce an acidic condensate.

G. Thermally protected motor shall be UL and CSA listed.

H.

Manufacturer:	Model/Series:
Hartell	A2

2.04 PREMIXED GLYCOL FEED SYSTEM:

A. A complete system including a vertical polyethylene steel tank, support frame, dual feed pumps, piping, control panel, and all controls and accessories necessary for a complete operating system lid, carbon steel frame, NEMA 4X control panel, low level float switch, 1/3 HP open motor bronze gear pump with internal relief valve, pressure switch, relief valve, check valve and threaded carbon steel plumbing.

B. MATERIALS

1. Tank and Frame: Minimum 50 gallon ribbed polyethylene tank shall be provided with 1/3-hinged polyethelyne lid. Tank frame shall be constructed of carbon steel with bracing for plumbing and control panel. Tank frame shall have 10-gauge pump mount shelf and be coated with epoxy paint.

2. Pumps: Gear pump shall be Teel brand, close coupled with internal pressure relief valve. Gear pump will be capable of 1.6GPM @ 100PSI. Pump motor is 1/3 HP, 115V, 1 phase, 60 hertz, open drip proof type and shall be wired to control panel.

3. Control Panel: Fiber filled polycarbonate NEMA 4X control panel shall be of ample size for equipment needed and servicing of electrical components. All exterior components shall be rated NEMA 4X and installed per manufacturers instructions. Wiring and wiring diagram shall be color Coded for easy troubleshooting. All internal wire shall be 16-gauge minimum. Controls module, but are not limited to, main power switch and indicator light, pump hand/off/auto switch and indicator light, and red low-level indicator light.

C. Automatic Feed:

1. Pressure switch shall be Square D brand series 9013.
2. Pressure switch shall be pre-wired to control panel to turn the gear pump on and off based on rising and falling pressure settings.

    a. (10-45 cut-in, 20-50 cut-out, 10-30 pressure differential)
    b. (40-80 cut-in, 65-100 cut-out, 20-40 pressure differential)
    c. (3-10 cut-in, 9-30 cut-out, 6-20 pressure differential)

D. Pressure Relief Valve: Pressure relief valve shall be brass body and seat with a stainless steel spring.

E. Check Valve: Check valve is constructed of brass with carbon steel seat and stainless spring.

F. Low Level Switch: Polypropylene low-level switch shall be interlocked with pump feed and low-level indicator. Low level will stop all pump operations when level falls below the factory set point.

G. Optional Features:

1. Audible Alarm: Audible alarm shall be 95 decibel @ 10 ft. with silence switch, which shall sound on low level.
2. Dry Contact: Dry contact shall be SPST NO switch, which shall be wired to level for connection to DDC system or other alarm system.

H. Manufacturer/Model: J. L. Wingert Co. Model GL50-2E1 or approved equal.

I. Warranty: Glycol Feed Packages shall be guaranteed for one year from date of shipment against manufacturing defects in material and workmanship, which develop in the service for which they are designed. Manufacturer shall repair or replace defective material when returned to manufacturer's factory with transportation prepaid: providing that the material is found to be defective upon inspection. Manufacturer shall assume no liability for labor and/or other expenses in making repairs or adjustments. All replacements shall be F.O.B. factory.

2.05 SEPARATORS FOR MECHANICAL SHAFT SEALS

A. Provide a separate high efficiency stainless steel centrifugal separator with inlet and discharge shut-off valves in the copper water tubing connections to each of the pumps mechanical shaft seals.

B. Bolt each separator securely to a steel angle mounting bracket bolted to the pump casing.

C. The separator tubing and valve assembly shall be of copper and have a pressure rating equal or greater than the pumps.

D. The separator shall be manufactured by the John Crane Company specifically to protect mechanical shaft seals by removing abrasive solids.

E. Provide filter assembly in lieu of separator for pumps that do not develop sufficient differential pressure for proper separator operation. Filter assembly to be as manufactured by AMF Cuno. Provide two additional replacement cartridges per assembly.

PART 3 EXECUTION

3.01 EQUIPMENT

A. Install equipment in conformance with manufacturer's recommendations.

END OF SECTION

SECTION 232500
SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

B. The installation and equipment is to conform to applicable building Code articles and applicable reference standards cited therein.

C. Conform to the applicable performance standards, listing or approvals of the following organizations where cited in the Sections or on Drawings.

Underwriters Laboratories (UL)
National Fire Protection Association (NFPA)
American Society for Testing Materials (ASTM)

1.03 SUBMITTALS

A. Procedure

1. Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Water treatment equipment components, trim, controls and performance data.
2. A complete list of all chemicals to be used.
3. Readings required on all indicating instruments for proper operation.
4. Equipment maintenance requirements.
5. Provide complete wiring diagrams for use by the electrician in connecting motors and equipment.
6. Complete piping diagrams for use by the Mechanical Contractor in installing interconnecting piping, tanks, pumps and metering devices.
7. Certification, on the company's letterhead, of qualifications of key personnel.
8. Inhibited Propylene Glycol data sheets and MSDS
9. Electric heat trace system

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000.

PART 2 PRODUCTS

2.01 WATER TREATMENT

A. General requirements.

1. The water treatment contractor shall provide a supervised water treatment program for a period of one year from the date of initial treatment, for the systems and/or equipment indicated hereafter.

2. The water treatment company shall have at least one officer or official holding a college or university degree in chemistry, chemical engineering, or sanitary engineering. He should have at least ten years experience in treating the water in systems of similar size and capacity, and he shall be in active responsible charge of all treatment work.

3. The company's laboratory shall be equipped to analyze samples in accordance with the standard methods of the American Water Works Association and the American Society for Testing Materials.

4. The water treatment contractor shall supply all feeding equipment including tanks, pumps, interconnecting piping and wiring, metering devices and accessories necessary to make a complete operable system. The Mechanical Contractor shall be responsible for installation of the above equipment and shall provide all piping, valves, fittings, switches and miscellaneous equipment shown on the water treatment company's drawings but not supplied by the water treatment company.

5. The water treatment company shall provide the following services:

   a. Provide the Owner with complete written instructions for chemical feeding bleed-off and testing procedures.

   b. Demonstrate to Owner's personnel the proper application of written instructions.

   c. Provide all chemicals, chemical feeding equipment and testing equipment, as described in the following paragraphs. The products shall be biodegradable compounds.

   d. Obtain samples from all systems, at least once per month, analyze these samples and furnish written reports and recommendations to Owner and/or Engineer.

   e. Instruct Mechanical Contractor on installation of feeding equipment.

B. Initial Cleanout.

1. All new recirculating water systems, both open and closed, shall be filled and flushed with a 0.25 solution, by weight, of a non-foaming chemical detergent, to remove all foreign matter.

2. Solution shall be circulated for a minimum of 8 hours and drained as rapidly as possible to remove all suspended matter.

3. The system should be flushed with fresh water, drained a second time and refilled. After final filling, the PH of the water shall not exceed the PH of the fresh incoming water by more than 0.5 PH.

B. Chemicals

1. Hot water

Treatment and Chemical Conditions	Control Level
Non-chromate corrosion inhibitor Vaporene N liquid or equal	500 PPM nitrite (Hot water 1000 - 1200 PPM nitrate

Testing equipment specifications: Provide all necessary field test equipment for maintaining control of treatment standards and cycles of concentration as above. Test kits shall be supplied by the water treatment contractor and remain the property of the Owner.

C. Closed Systems

1. Chilled and Hot water system: Mechanical Contractor shall install across the recirculating pump of each closed system a 5-gallon by-pass feeder with minimum 300 PSI test pressure with 4" fill line and cap with funnel package, or 4” wide-mouth cap, and pedestal mounting. By-pass feeder to be Griswold Water Systems Professional Series, Neptune DBF-5HP or approved equal.

D. Service Contract.

1. Furnish test unit with apparatus for treatment control of all chemical formulas supplied.

2. A service contract shall also be furnished for a one-year period which shall include the following: Initial water analysis and recommendations, system start-up assistance, training of operating personnel, periodic field service and consultation.

2.02 GLYCOL SYSTEM

A. Glycol: Dowfrost HD, USP grade propylene glycol with fortified inhibitor, either concentrate or premixed solution.

B. Initial glycol fill, if provided as concentrate, shall be mixed with distilled or de-ionized water, or domestic water with:
1. Chlorides <25 ppm.
2. Sulfates <25 ppm.
3. Total hardness (as CaCO3) <300 ppm, or as required by glycol manufacturer.

C. Domestic water is not acceptable for initial fill, unless it fulfils this criteria.
1. Provide water analysis of domestic water prior to mixing with concentrated inhibited propylene glycol, to ensure compliance.

2.03 ELECTRICAL HEAT TRACE SYSTEM

A. Codes, Approvals, and Standards: The electric heat-tracing system shall conform to the specification. It shall be designed, manufactured, and tested in accordance with the applicable requirements of the latest edition of the following codes and standards:

FM	Factory Mutual Research Corporation
IEEE 515	Institute of Electrical and Electronics Engineers
NEC	U.S. National Electric Code (NFPA 70)
NECA 202-2013	Installing and Maintaining Industrial heat Trace Systems
NEMA	National Electrical Manufacturers Association
UL 746B	Underwriters' Laboratories, Inc.
ANSI	American National Standards Institute
CSA	Canadian Standards Association

B. Materials

1. Self-Regulating Heating Cables: All heat-tracing systems for use at temperatures up to a continuous exposure (maintain) of 302°F (150°C) and intermittent exposure temperature of 420°F (215°C) shall use a self-regulating heating cable.

   a. Self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.

   b. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously.

   c. All cables shall be capable of passing a 1.6 kV dielectric test for one minute after undergoing a 10 ft-lb. impact (IEEE 515-1997 test 4.1.8)

2. Freeze Protection Systems

   a. The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on plastic or metallic pipes. Cables shall have a temperature identification number (T-rating) without the use of thermostats of the following.

Heating Cable	T-rating	Maximum Temperature
3 W/ft	T6	185°F (85°C)
5 W/ft	T6	185°F (85°C)
8 W/ft	T5	212°F (100°C)
10 W/ft	T4A	248°F (120°C)

   b. The heating cable shall have a tinned copper braid with a resistance less than 8 mΩ/ft as determined by metallic covering conductivity test (IEEE 515-1997 test 4.1.13). The braid may be protected from chemical attack and mechanical abuse by an optional polyolefin or fluoropolymer outer jacket.

c. In order to provide rapid heat-up, and to prevent overheating of fluids and plastic pipe, the heating cable shall have the following minimum self-regulating indices:

Heating Cable	S.R.Index (W/°F)	S.R. Index (W/°C)
3 W/ft	-0.020	-0.036
5 W/ft	-0.045	-0.080
8 W/ft	-0.058	-0.104
10 W/ft	-0.071	-0.127

d. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit or watts per degree Celsius, as measured between the temperatures of 50°F (10°C) and 100°F (38°C) and confirmed by the type test and published data sheets.

e. In order to facilitate longer circuit lengths and smaller breaker sizing. The heating cable shall have the following maximum inrush current at 50°F (10°C).

Heating Cable	Maximum Inrush @ time = 1 sec	Maximum Inrush @ time = 10 sec	Maximum Inrush @ time = 300 sec
3 W/ft, 120V	58 mA/ft	54 mA/ft	41 mA/ft
5 W/ft, 120V	155 mA/ft	128 mA/ft	66 mA/ft
8 W/ft, 120V	210 mA/ft	180 mA/ft	83 mA/ft
10 W/ft, 120V	432 mA/ft	319 mA/ft	123 mA/ft
3 W/ft, 240V	38 mA/ft	36 mA/ft	20 mA/ft
5 W/ft, 240V	92 mA/ft	80 mA/ft	33 mA/ft
8 W/ft, 240V	127 mA/ft	106 mA/ft	41 mA/ft
10 W/ft, 240V	281 mA/ft	205 mA/ft	62 mA/ft

f. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal runaway and self-ignition, the cable shall produce less than 10 percent of rated power when energized and heated to 302°F (150°C) for 30 minutes. After this test, if the cable is allowed to cool to 50°F (10°C) and is reenergized, it must not have an increasing power output leading to thermal runaway.

g. In order to confirm the specified useful life with “power on”, the self-regulating heating cable shall maintain between 75 and 110 percent of its original power output after having been cycled 500 times between 50°F (10°C) and 150°F (65°C), allowing no more than 12 minutes of dwell time at each temperature.

h. The heating cable shall have the following third party approvals:

UL listed	Ordinary areas
CSA certified	Ordinary areas
	Class I, Division 2 groups A, B, C, D
	Class II, Division 2 groups F, G
FM approved	Ordinary areas
	Class I, Division 2 groups B, C, D
	Class II, Division 2 groups F, G
	Class III, Division 2

i. The heating cable shall be type SRL with continuous exposure (maintain) capability up to 150°F (65°C) and continuous exposure capability up to 185°F (85°C) with power off, as manufactured by Chromalox.

D. Termination For Self-Regulating Heating Cables

1. All connection components used to terminate self-regulating heating cables, including power connectors, splices, tees, and connectors, shall be approved for the respective area classification and approved as a system with the particular type of heating cable in use. Under no circumstances shall terminations be used which are manufactured by a vendor other than the cable manufacture.

2. In order to keep connections dry, components shall be rated NEMA 4.

E. Thermostats and Contactors

1. Freeze protection systems shall operate using self-regulating control, the RTAS-X thermostat in ordinary and Division 2 hazardous areas, or the B121 thermostat in Division 1 hazardous areas.

2. Process temperature maintenance system shall operate using the RTBC-X thermostat in ordinary and Division 2 hazardous areas or the E121 thermostat in Division 1 hazardous areas.

3. Chromalox contactor type CONT shall be used where the heat tracing circuit current exceeds the thermostat switch rating. Contactor enclosure type NEMA 1, 4, or 7 shall be used according to enclosure location.

F. Control, Monitoring and Power Distribution Systems

1. For single or dual loop applications, a UL listed microprocessor based temperature control, monitoring and power distribution system shall be used. The controller shall accept (2) 100 ohm platinum RTD sensor inputs per circuit. The system shall be compatible with self-regulating and MI cables and shall have the following features.

a. NEMA 4X fiberglass enclosure

b. Controller shall be provided with 30-mA Ground Fault protection per NEC Article 427.22.

c. Supply voltage: (select: 120, 240 or 277 Vac single phase).

d. Field power connection terminal block must accept (2) RTD sensor inputs per circuit.

e. Control must operate in 32-104°F (0-40°C) environments.

f. Solid state relay rated 40A at 104°F (40°C) output.

g. Optional RS-485 MODBUS® communications capable with interfacing with personal computers and PLC's.

h. Low current alarm: 0-30A in 1A increments.

i. Optional 5-100mA ground fault alarm trip.

j. Process, deviation, band, high/low and latching/non-latching (manual/automatic reset) programmable temperature alarms.

k. On/Off and PID control modes.

l. Selectable Soft start control mode to eliminate self regulating cable in-rush current.

m. High Resolution TFT display for ease of programming and monitoring (single/dual line LCD display is not acceptable)

n. Separate LED indication for power, load and alarm for each circuit shall be provided on front panel

o. Controller shall be Chromalox ITC-XX1 for single loop application or ITC-XX2 for dual loop applications.

2. Control, Monitoring and Power Distribution Systems shall be IntelliTrace ITLS / ITAS as supplied by Chromalox.

G. Engineering

1. The manufacturer shall design and estimate a complete heat-tracing system. Submittals shall include area layout and orthographic drawings.

2. The manufacturer shall provide a detailed design utilizing standard heat-tracing design software, such as Chromatrace. At minimum, the design must provide the following:

a. Circuit identification number.

b. Maintain temperature.

c. Line size and insulation.

d. Heat loss for pipe, valves, and supports.

e. Amount and type of heating cable required.

f. Spiral requirements.

g. Heating cable service voltage.

h. Heating cable power output at the maintain temperature.

i. Uncontrolled pipe temperature at maximum ambient.

H. Manufacturers
Chromalox
Raychem XL-Trace
Thermon

PART 3 EXECUTION

3.01 HEAT TRACE INSTALLATION

A. The system shall be installed per manufacturers engineering details, isometric drawings, line lists and other pertinent data.

B. The installing contractor shall have a minimum of 5 years experience installing industrial electric heat trace systems as demonstrated by a manufacturer approved experience list

C. See Electrical Drawings for location of power sources.

D. Installation techniques shall be governed by the manufactures installation instructions, and the NEC202-2013 Installing and Maintaining Industrial Heat Trace Systems document. In event of conflict the order or precedence is manufacturers design details, manufactures installation instructions and then the NEC202-2013 document.

E. The Installation contractor shall maintain licensed, trained and qualified personnel on site throughout the installation process.

F. Installer shall keep records of all heating cable installed on site per job requirements – at a minimum circuit number corresponding with heat trace isometric drawing with model number, batch number, reel number and actual footage installed shall be documented on provided heat trace isometrics. Actual location of power connection, end seals and splice/tee boxes shall be indicated on isometric drawings as well. This documentation is required prior to final payment for install services.

G. Where control panels are remotely located from the origination points of the heat trace circuits, installing contractor shall provide standard copper conductors in rigid galvanized conduit between the control panel and the heat trace circuit origination point. Refer to 260500 for conduit, fittings and accessory requirements and for minimum conductor sizing based on length of run.

3.02 HEAT TRACE SYSTEM COMMISSIONING

A. System commissioning shall be performed by manufacturer or approved manufacturer's representative.

B. System commissioning testing and documentation shall conform to manufacturers standard procedures and at a minimum confirm –

1. Correct cable model number installed on each circuit per circuit isometric drawings
2. Circuit electrical data conforms to heat trace isometric data including
3. Circuit current
4. Circuit insulation resistance
5. Circuit voltage
6. Location and coordinates of power connection kits, end seals, splice/tee kits for each circuit

C. Documentation of commissioning activities and test results shall be provided per contract requirements, manufacturer's instructions, and NEC202-2013 document.

END OF SECTION

SECTION 23 3000
DUCTWORK AND AIR OUTLETS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the Contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

1.03 SUBMITTALS

A. Procedure: Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Typical duct construction details (elbows, taps, splits, transitions, plenums, supports).
2. Ductwork layouts at 3/8" scale, with match lines as necessary to maintain maximum sheet size of 48x36.
3. Volume & motorized dampers, accessories and access doors.
4. Duct mounted smoke detector locations.
5. Grilles, registers, diffusers and terminal outlets, with specific NC levels per inlet and outlet.
6. Acoustical lining and application methods.
7. Air duct leakage test procedures.
8. Air duct leakage test report.
9. Air balance contractors qualifications, procedures and report format.
10. Air balance report.

C. Samples: Typical finished grilles and terminal air distributing devices. Color samples for pre-finished items. Samples will not be returned, nor used in the project.

D. Sheetmetal shop drawings shall be coordinated, showing the work of other trades, including but not limited to, sprinklers, light fixtures, conduits, structural steel, plumbing and HVAC piping. Refer to Specification Section 230000 1.??, Coordination drawings, for submission requirements. Drawings shall show the following, as a minimum:

1. Ductwork including sizes, bottom of duct elevations, material and pressure class.
2. Duct fittings, transitions, takeoffs, and flexible connections.
3. Equipment including, but not limited to, diffusers, grilles, fans, air handling units, air flow stations, humidifiers, coils, and sound attenuators.
4. Volume and automatic control dampers. Dampers shall be uniquely identified on the shop drawing as to type (VD, COD, FD, SD, FSD, MD) and location within building, and provided with a unique sequential number. A chart shall be provided on each sheet metal shop drawing identifying the dampers on that sheet by type, location, number and size.

5. Duct smoke detectors.
6. Duct access doors.
7. Section views shall be provided for mechanical rooms and other sheet metal intensive spaces to clearly represent all sheet metal work.

E. Sheetmetal shop drawings shall be submitted on drawings no larger than 48” long by 36” high, at minimum 3/8” = 1’-0” scale. Provide match lines and key plans as required.

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000. Produce and maintain ventilation and air conditioning under operating criteria.

PART 2 PRODUCTS

2.01 RECTANGULAR DUCTWORK

A. Construct all ducts and casings of lock forming quality sheet, light commercial galvanized coating class - ASTM – A924, 653; stainless steel sheet ASTM - A480; aluminum sheet Alloy 3003-H-14. Metal thicknesses are U.S. Standard gauge. Duct joints, seams and reinforcing shall meet or exceed requirements as per SMACNA HVAC Duct Construction Standards Third Edition 2005.

B. Duct construction shall follow standards set forth in Tables 2-3 through 2-29M of SMACNA HVAC Duct Construction Standards Third Edition 2005. Ductwork shall be fabricated for the pressure and minimum gauge listed below. Minimum pressure construction shall be +/- 2" WG.

C. Minimum gauges for rectangular ducts and fittings: +/-3" to +/-4" w.g. where either dimension is:

STEEL	DUCT DIMENSION
No. 24 ga.	Up to 12"
No. 22 ga.	13" to 30"
No. 20 ga.	31" to 54"
No. 18 ga.	55" to 72"
No. 16 ga.	73" and larger

2.02 ROUND AND FLAT OVAL DUCTWORK

A. Construct all ducts and fittings of lock forming quality sheet, light commercial galvanized coating class - ASTM - A924, 653; stainless steel sheet ASTM - A480; aluminum sheet Alloy 3003-H-14. Metal thicknesses are U.S. Standard gauge.

B. Gauges for round and flat-oval ducts - low and medium pressure - unless noted otherwise on plans -

	SPIRAL LOCK SEAM	LONGI. SEAM
No. 26 gauge	Up to 8" dia.	---
No. 24 gauge	9" to 22"	Up to 8" dia.
No. 22 gauge	23" to 36"	9" to 22"
No. 20 gauge	37" to 50"	23" to 50"
No. 18 gauge	---	51" to 60"
No. 16 gauge	---	61" and larger

C. Gauges for round fittings.

No. 20 gauge	up to 36" dia.
No. 18 gauge	37" to 50"
No. 16 gauge	51" and larger.

2.03 DUCT CLASSIFICATION

A. The following ductwork shall be constructed to commercial SMACNA standards for internal pressures of +/- 4 inches of static pressure (water gauge):

1. Air handling unit to supply risers (horizontal mains).
2. Supply duct risers.
3. Supply ductwork horizontal mains.

B. The following ductwork shall be constructed to commercial SMACNA standards for internal pressures of +/- 3 inches of static pressure (water gauge):

1. Supply ductwork downstream of VAV boxes and reheat coils.
2. Return ductwork
3. Relief ductwork
4. Exhaust ductwork.

2.04 DUCT SEALING

A. The following ductwork shall be sealed to SMACNA Seal Class A.

1. Air handling unit to supply risers (horizontal mains).
2. Supply duct risers.
3. Supply ductwork horizontal mains.

B. The following ductwork shall be sealed to SMACNA Seal Class B.

1. Supply ductwork downstream of VAV boxes and reheat coils.
2. Return ductwork
3. Relief ductwork
4. Exhaust ductwork.

2.05 VOLUME DAMPERS

A. General - provide in ALL branch duct connections at mains to control and adjust the total volume of the system. Outlet dampers shall not be used for system adjustment.

B. Single Blade Dampers. Maximum width of single blade shall be 14”, use opposed blade damper for height exceeding 14”. Pre-manufactured dampers shall be part of an assembly complete with damper, frame, axle and bearings. The damper frame shall be installed internal to the duct and fastened with the appropriate hardware. The installation shall not interfere with the operation of the damper blade(s). Approved products for pre-manufactured devices are as follows:

Device	Manufacturer	Model
Rectangular	Air Balance	AC-111
	Greenheck	MBD-10
	Ruskin	MD25
Round	Air Balance	AC-112
	Greenheck	MBDR50
	Ruskin	MDRS25

C. Multiple Blade Dampers. Opposed blade damper shall be used where duct height exceeds 14”. Approved products for pre-manufactured devices are as follows:

Opposed Blade	Air Balance	AC-2
	Greenheck	MBD-15
	Ruskin	MD35OB

D. On uninsulated round ducts, equip dampers with heavy duty locking quadrant. The locking quadrant shall be mounted on a 2” x 3” x 1/8” standoff plate held to duct in a manner so as not to interfere with the operation of the damper blade. Hardware for the manual volume dampers shall be as follows:

Duct diameter	Shaft size	Quadrant
All sizes	per manufacturer	Ventlok #555/560

E. On uninsulated rectangular ducts, equip dampers with heavy duty locking quadrant and one close end gasketed damper bearing. The end bearing shall be mounted on a 4” x 4” x 1/8” plate held to duct in a manner so as not to interfere with damper blade operation. The locking quadrant shall be mounted on a 2” x 3” x 1/8” standoff plate held to duct in a manner so as not to interfere with the operation of the damper blade. Hardware for the manual volume dampers shall be as follows:

Duct dimension	Shaft size	Quadrant	Bearings
Up to 18 inches	3/8”	Ventlok #555/560	Ventlok #609
19” & larger	½”	Ventlok #555/560	Ventlok #609

F. On insulated round ducts, equip dampers with heavy duty locking quadrant. The locking quadrant shall be mounted on an 8” x 8” x 1/8” standoff plate. The standoff shall be the insulation thickness plus ½” and shall be insulated under the standoff. The plate shall be held to duct in a manner so as not to interfere with the operation of the damper blade. Hardware for the manual volume dampers shall be as follows:

Duct diameter	Shaft size	Quadrant	Bearings
All sizes	per mfgr	Ventlok #555/560	Ventlok #607&609

G. On insulated rectangular ducts, equip dampers with heavy duty locking quadrant and one close end gasketed damper bearing. The locking quadrant shall be mounted on an 8” x 8” x 1/8” stand off plate. The standoff shall be the insulation thickness plus ½”, and shall be insulated under the standoff. The end bearing shall be mounted on a 4” x 4” x 1/8” plate. Both plates shall be held

to duct in a manner so as not to interfere with damper blade operation. Hardware for the manual volume dampers shall be as follows:

Duct dimension	Shaft size	Quadrant	Bearing
Up to 18 inches	3/8”	Ventlok #555/560	Ventlok #607&609
19” & larger	½”	Ventlok #555/560	Ventlok #607&609

H. Cable operated dampers (COD) shall be provided where indicated on plans, and/or where required due to damper location above/behind finished construction, where access to damper would require access door in finished construction. Rectangular dampers shall have opposed blade action. Dampers shall be equipped with internally controlled operators and cable. Cable shall terminate at face of outlet. Dampers shall be provided with insulation standoff and close end gasketed damper bearing. The standoff shall be the insulation thickness plus ½” and shall be insulated under the standoff.

Manufacturer	Model
Anemostsat	OB-ASL
Young Regulator	830A-CC/830A-CC2 w/270-275 operator

I. Remote Operated Volume Dampers – The remote operated volume dampers shall provide a means of balancing the air distribution in ductwork above inaccessible ceiling and other non-accessible locations from a remote location.

1. Dampers shall have 0.081” extruded aluminum frames, 0.125” extruded aluminum blades (except for formed aluminum single blade dampers through 12” height), Bronze iolite bearings, ½” dia. cast zinc axle with thrust bearing, and 6-1/4” side plates constructed of 18 gauge galvanized steel. Multiple blade dampers shall be opposed blade type.

2. The drive actuator shall be DC voltage. Cable shall be RJ-11 plenum rated type capable of lengths up to 100 feet from the damper actuator to the female outlet.

3. Cables shall terminate in the nearest mechanical room at female connections ganged on multi-port wall plates. Wall-plates shall be permanently marked to indicate the damper size, location and area served. Cables and wallplates shall be installed by Division 15.

4. The hand-held, battery-powered power pack shall plug into the female RJ-11 connectors at the wall plates and shall provide continuous range adjustment to the dampers. A minimum of two battery packs shall be provided for each wall plate location and shall be turned over to the Owner after balancing is completed.

5.

Manufacturer	Model
United Enertech Corp.	I-4

J. Volume extractors shall be used where radius tap or split is not possible or where square elbows inlet and outlet throat radii vary by more than 15%.

Manufacturer	Model
Titus	AG-45 /AG-225

2.06 ACOUSTICAL LINING

A. Sound insulation - where indicated on drawings, and within 10 lineal feet of fans, ductwork shall be lined with fiberglass duct liner of minimum 3 lbs. per cubic foot density and covered with a fire resistant black coating that includes an EPA-registered antimicrobial agent bonded to fiberglass. Minimum k-factor = 0.25 per inch. NRC rating of 0.7 min. Thickness of liner 1-1/2" in ducts, 2" in fan and outside air plena. Duct called to have Type H and/or Type I thermal

insulation (refer to Specification Section 230700), but also indicated on drawings for sound insulation, shall receive sound insulation on inside only consisting of 1-1/2" thick fiberglass minimum 3 lbs. density rigid duct liner with fire resistant coating that includes an EPA-registered antimicrobial agent bonded to fiberglass.

B. Manufacturer:	Model:
Owens Corning	QuietR (3# density)
Certainteed	ToughGard Rigid Liner Board (3# density)

2.07 TERMINAL AIR DISTRIBUTING OUTLETS

A. Finishes - all exposed surfaces of terminal air distributing devices shall be finished as scheduled on drawings.

1. Baked enamel - chemically clean all surfaces after fabrication and apply rust resisting primer. Apply two finish coats of baked or heat-dried enamel of color and gloss matching Architect's samples.

2. Aluminum - anodized natural aluminum of uniform appearance and matching Architect's samples.

3. All ductwork and accessories visible through the air inlets and outlets shall be painted flat black.

B. Seal all air outlets around edges with foam rubber gaskets to minimize leakage.

C. Size and type, with specific NC levels per inlet and outlet. - tabulated on the drawings.

D. Manufacturer:
Anemostat
Metalaire
Titus
Price

PART 3 EXECUTION

3.01 RECTANGULAR DUCT CONSTRUCTION - GENERAL

A. Make turns in main duct runs affecting the static of the system with elbows having a throat radius not less than the width of the duct.

B. Make turns in duct branch runs with elbows having a throat radius not less than one half the width of the duct or with square elbows with internal factory manufactured duct turns of a type acceptable to the Engineer. Where shown on the drawings, or where expressly approved by Engineer, elbows having a throat radius less than one half the width of the duct shall be made with elbows having vanes constructed, supported and fastened as recommended by SMACNA.

C. Low and medium pressure ducts shall be constructed in a substantial and airtight manner with "Pittsburgh" and double locked longitudinal seams, properly hammered down. Other seams shall be SMACNA tables.

D. Make transitions and reducing sections of sufficient length to maintain the angle of deflection of any side less than 20 degrees.

E. Cut sheet metal screws extending inside accessible casing to be smooth and flush with inside of duct.

F. Make airtight, caulked connections between metal ducts and grilles or masonry.

G. Insulate joints between non-ferrous and galvanized iron materials with non-ferrous and galvanized iron angles separated with tar paper strips and fastened with non-ferrous stove bolts.

H. Each section of ductwork shall be covered at each end during transport to site, during storage on-site and during installation, with dual ply polyethylene film with a high-tack acrylic adhesive similar to Ductmate ProGuard Heavy Duty. Duct ends shall be uncovered only during connections of adjacent ductwork or equipment.

3.02 DUCT ACCESSORIES, AND HARDWARE

A. Provide access doors to all equipment. Make doors not less than 16" x 16" where not otherwise sized on the drawings. Provide rigid pan construction with two hinges and latch. Provide access on entering and leaving sides of coil and heater sections, and at leaving side of volume boxes. Reinforce duct openings with angle iron frame. Where ducts are insulated, frame is to be raised to surface acting as an insulation stop. Provide felt between door and duct to make airtight seal when locked. Door shall be the double wall insulated type.

B. Latches similar to Ventfabrics, Inc. No. 100 for small doors and No. 310 where physical access is possible. Window latch type hardware is specifically prohibited except where the door swing for a hinged door is restricted by the hung ceiling or some other obstruction.

C. Provide 8" x 8" frame around damper quadrants in insulated ducts for insulation stop, of same height as insulation thickness.

D. Fan and unit connections – metal and fabric interlocked connection with 2" clear distance, double wrapped, securely strapped or fastened to fan and/or duct and cut and sewn airtight. Provide in each connection, including mixing box discharge. Duro-Dyne 30 oz. neoprene coated fiberglass cloth on uninsulated ducts with continuous temperatures up to 200^{o}F; Duro-Dyne Insulflex 9 oz/sq. yd polyester base with vinyl coated 1” fiberglass insulation (R=4.2) on internally or externally insulated ducts with continuous operating temperatures under 180^{o}F (intermittent 200^{o}F); Duro-Dyne Thermafab 17 oz/sq. yd silicon coated fiberglass cloth on ducts exposed to 500^{o}F maximum continuous temperature.

3.03 DUCT SUPPORT

A. Rectangular ducts 30 inches or less in width shall be hung with 1" x 18 ga. galvanized strap iron bent 2" under bottom side of the duct and fastened to the duct with sheet metal screws using one on underside and not less than 2 screws per side and as many more needed so that they are no greater than 6" centers.

B. Rectangular ducts above 30 inches in width shall be hung with galvanized rods fastened to galvanized minimum 1-1/2" angles running under the ducts as per detail.

C. Structural attachment of hanging rods and straps to be per detail. Friction type beam attachments for rod or strap hangers are not acceptable. Attachment to metal deck tabs is also not acceptable (refer to detail on plans). Expansion shield shall be rated for cracked concrete, similar to Hilti Kwik Bolt TZ.

D. Provide hangers on not greater than 8 feet centers.

E. Provide 18 gauge galvanized sheet metal escutcheon plates attached to ducts and on both sides around all exposed ducts passing through partitions, where visible, except within equipment rooms. Escutcheon plate to cover opening in partition.

F. Provide 2" galvanized ground angles secured to floor on all ducts passing through floors.

3.04 BRACING OF RECTANGULAR DUCTS

A. Ducts shall be reinforced per SMACNA HVAC Duct Construction Standards Third Edition 2005 Tables 2-3 through 2-29M.

B. Tie rods reinforcement shall be per SMACNA HVAC Duct Construction Standards Third Edition 2005 edition Tables 2-3 through 2-29M.

3.05 ROUND AND FLAT-OVAL DUCTS

A. Round ducts with fittings and accessories are to be machine made, spiral type welded, factory manufactured by United Sheet Metal Co., or another acceptable to the Architect.

B. Make duct sections not longer than 20'-0".

C. Make elbows with welded sections using 5 pieces for 90 degree and 3 pieces for 45 degree turns and having a center line radius of one times the diameter of the duct.

D. Make joints in ducts with inside couplings not less than 6" long and seal joint with Minnesota Mining No. EC 800 adhesive or equal as recommended by the Supplier. Butt ends of duct tight to coupling bead.

E. Hang and encircle all round ducts with l" x l/8" galvanized strap iron. On ducts below 10 ft. circumference, clamp strap iron at top and hang with single rod. Above 10 ft. circumference, clamp strap iron on both sides and hang with 2 rods. Provide hangers on not greater than 8 ft. centers unless noted otherwise on drawings.

F. Make all reducers and reducing fittings concentric and of sufficient length to maintain the angle of deflection of the perimeter below 15 degrees.

G. Make all other fittings including, rectangular to round transitions, access doors with sleeves, volume dampers, and fire damper to conform to manufacturer's standards.

H. Where ducts pass through floors use short length of duct for sleeve. Provide couplings and temporary caps at both ends.

I. Where ducts pass through walls provide sleeves using a coupling one size larger than duct and of length to conform to the thickness of the finished wall. Pack annular spaces with fiberglass insulation.

J. Factory, cut, reinforce, and provide flanges on main ducts for grille and branch connections.

K. Each section of ductwork shall be covered at each end during transport to site, during storage on-site and during installation, with dual ply polyethylene film with a high-tack acrylic adhesive similar to Ductmate ProGuard Heavy Duty. Duct ends shall be uncovered only during connections of adjacent ductwork or equipment.

3.06 FLUSH SEAM DUCTWORK

A. Provide flush seam ductwork for all ductwork where un-insulated and exposed in finished spaces or where required to maintain clearances.

Transverse joints	
Thru 18"	Flush seam end slip, maximum 96"on centers.
19" thru 30"	Flush seam end slip stiffened with 1-1/4" x 3/8" bar, maximum 48" on centers.
31" thru 42"	Same as (2) above, spaced 36" on centers. Provide internal bracing between joints and at hangers.
43" thru 70"	Top-angle reinforced standby "S" slip. 1-1/2" x 1-1/2" x 1/4 edge. Sides and bottom--bar stiffened full "S" slip 1-1/4 x 3/8" bar, spaced 36" on centers. Provide internal bracing of 1" x 1/8" bar flat galv. bar. Everdur bronzed on centers, between joints and hangers.

3.07 ALUMINUM DUCTWORK

A. Construct ductwork where indicated below from aluminum in accordance with duct construction tables. Construct bars and angles from aluminum. Construct supports and hangers of galvanized steel.

System	Extent	Comment
OAU-1	Outside air	Up to connection at unit.
Toilet exhaust	All	

B. Locate all longitudinal joints above the center line of the duct. Solder or braze all joints watertight.

C. Construct access doors of aluminum with rubber watertight and airtight gaskets. Locate above the duct centerline.

D. Do not penetrate the ductwork for hangers or supports.

E. Horizontal ductwork to first elbow shall be pitched back towards the equipment. All other horizontal ducts shall be pitched in the direction of flow. Provide valved drains and hose bibbs at low points.

3.08 TURNING VANES

A. Turning vanes in square elbows shall be double wall construction of minimum 24 gauge galvanized metal. Each vane shall be securely riveted or welded to minimum 22 gauge runner or directly to duct.

B. Turning vanes in square elbows shall have 2" inside radius spaced 2-1/8" apart through 36" wide duct. Turning vanes in square elbows larger than 36" shall have a 4 1/2" radius and be spaced 3 1/4" apart.

C. Turning vanes in square elbows shall be installed in sections to reduce unsupported length for duct depths exceeding 60".

3.09 TEST CONNECTIONS

A. On the discharge duct from each air handling unit downstream at least 5'-0" from unit if duct is accessible, or closer to unit if necessary, install a #699 Ventlock instrument test hold device for balancing and testing of system.

3.10 ACOUSTICAL LINING

A. Install sound insulation over adhesive, with fasteners. Fasteners to be installed 3" from end of duct, 4" from corners of duct, 12" on center across width of duct, and 18" on center along the length of the duct. A minimum of 2 rows of fasteners per side. Fasteners are not to compress the lining more than 1/8".

B. Lining to be adhered to duct with an adhesive that conforms to ASTM C916. Adhesive to cover 90% of duct surface.

C. Metal C-channel nosing shall be installed at each transverse joint facing the airstream. C-channel shall be secured to the duct.

D. Transverse edges not receiving metal nosing shall be coated with an adhesive conforming to ASTM C916.

E. Longitudinal joints shall only occur at the corners of the duct. Corners shall either be folded or lapped and butted.

F. Accessories such as turning vanes, coils or dampers shall be mounted on hat channels. Hat channel shall be thickness of lining x width of the accessory with 1" flanges secured to duct. Hat section shall be filled with liner.

G. Lining shall be interrupted at fire, combination fire/smoke, and smoke damper sleeves. Provide equivalent external insulation at the exposed sleeve surfaces. Refer to Section 230700 for insulation requirements.

3.11 COORDINATION AND COMPLETION

A. Conform to all applicable provisions of Section 230000 and coordinate with the requirements of the other mechanical work specification sections to provide complete operating systems.

3.12 AIR BALANCE

A. Balance all new air systems and those designated existing air systems to the quantities shown with the following tolerances:

Fans:	Design volume plus 5%
	Outlets: Design volume plus 5%
Leakage:	3% maximum.

B. Balance in accordance with ASHRAE, AABC or NEBB procedures and submit all readings.

C. Air system balancing is to be performed by a professional organization, other than the installing contractor, qualified by experience and practice to perform this service. Submit evidence of qualifications, balancing procedures, and report forms for approval prior to start of work.

D. Provide one extra set of drive sheaves per fan as part of the system balancing. Sheaves shall be installed as directed by the balancing subcontractor to achieve design CFM at the minimum RPM with an allowance for filter loading.

E. Submit three bound copies of the air balance report to the Engineer. Balance Report to include the following data for each fan system (supply, return, relief and exhaust).

1. System designation and location.
2. System description including areas served.
3. Manufacturer, model number, size designation, class and arrangement.
4. Supply/return/outside air CFM - Design vs. Actual (unit air quantities to be determined by duct traverse not sum of outlets - Submit data of traverse/minimum traverse points = 16 - max. distance between traverse points = 6")
5. Unit suction and discharge static pressure - design vs. actual.
6. Individual unit component static pressure drops (coils, filters, dampers)
7. Motor manufacturer, frame, horsepower, volts, phase, hertz and RPM.
8. Motor AMPS - design vs. actual.
9. Fan RPM
10. Sheave and belt data.
11. Air outlet number, type, size, Ak, design CFM and velocity, intermediate velocity readings, final CFM and velocity.
12. Reduced plans with air outlets cross-referenced to number.
13. CFM, static pressure drop, (CFM and static pressure at minimum setting for VAV boxes) for all duct mounted items such as coils, VAV boxes, filters, induction units.

3.13 AIR DUCT LEAKAGE TEST

A. All supply and return sir ductwork shall be subject to inspection and leakage testing by the testing, adjusting, and balancing (tab) agency.

B. Outside air and relief ductwork from intake/exhaust louvers to air handling units shall be subject to inspection and leakage testing by the testing, adjusting, and balancing (tab) agency.

C. The duct system testing shall be performed before the installation of duct insulation and ceilings. Testing shall be conducted at the design pressure of the ductwork being tested. Duct leakage test shall be coordinated with the various contractors through the HVAC contractor. The HVAC contractor shall prepare a schedule for testing indicating specific dates and procedures. The owner and architect shall be notified a minimum of two (2) weeks before testing is performed.

D. Procedures for conducting the leakage test shall be in accordance with SMACNA Air Duct Leakage Test Manual Second Edition (2012). Procedures shall be submitted to the architect for approval prior to actual testing.

E. Maximum leakage shall not exceed the requirements for the following:

1. Leakage Class 2, round duct with Seal Class A.
2. Leakage Class 4, round duct with Seal Class B.
3. Leakage Class 4, rectangular duct with Seal Class A.
4. Leakage Class 8, rectangular duct with Seal Class B.

F. Leakage for non-duct components such as fire, smoke, and volume dampers, and terminal boxes is an integral part of the overall system leakage, and these components shall be included in the duct leakage tests.

G. Ductwork failing to meet the maximum leakage criteria shall be resealed and or reconstructed as required.

H. The tab contractor shall submit a report on the leakage test. The report shall include an accurate description of the test procedure and results, including recommendations for any remedial action required to meet the specified leakage criteria. Copies of certified calibration data for the leakage test apparatus shall be provided as part of the test report.

3.14 DUCT MOUNTED SMOKE DETECTORS

A. Coordinate with Electrical Contractor for quantities of duct mounted smoke detectors.

B. Exact locations of duct mounted smoke detectors shall be determined by the Mechanical Contractor and indicated on sheet metal shop drawings.

C. Duct mounted smoke detectors shall be furnished and wired by the Electrical Contractor. Installation of the duct mounted smoke detectors in the ductwork shall be by the Mechanical Contractor.

END OF SECTION

SECTION 23 5000
HEATING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the Contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of Section 230000, General Provisions, and with the provisions of all applicable codes and laws.

1.03 SUBMITTALS

A. Procedure: Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Boilers
2. Pre-fabricated chimney
3. Heating plant accessories
4. Operating instruction including sequence of starting, stopping and shutdown.
5. Readings required on all indicating instruments for proper operation.
6. System maintenance requirements not covered by equipment manufacturer's instructions.
7. Provide complete wiring diagrams for use by the electrician in connecting motors and equipment.
8. Coordinate with the temperature control requirements in preparing these diagrams.

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000. Produce and maintain ventilation and air conditioning under operating criteria.

PART 2 PRODUCTS

2.01 HEATING - GENERAL

A. Match capacities, characteristics and dimension of all components to make a completely compatible system over its entire operating range.

B. Equipment shall be constructed and rated in accordance with AGA and IBR standards and applicable provisions of the ASME code.

C. Equipment shall comply with all state and local codes governing the performance of gas burning equipment, including the organizations listed in Section 230000.

2.02 CONDENSING BOILER

A. Construction

1. Description: Boiler shall be either natural gas, propane or dual fuel fired (nat. gas/propane) fully condensing fire tube design. It shall be designed to operate in variable primary or primary secondary piping configuration. Power burner shall have full modulation, discharge into a positive or negative pressure vent and the minimum firing rate shall not exceed the following per model:

   - BMK 750: 50,000 BTU/hr input

   Boilers that have an input greater than what is specified above at minimum fire will not be considered. Boiler efficiency shall increase with decreasing load (output), while maintaining setpoint. Boiler shall be factory-fabricated, factory-assembled and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base, including insulated jacket, flue-gas vent connections, combustion-air intake connections, water supply, dual inlet returns condensate drain connections, and controls.

2. Heat Exchanger: The heat exchanger shall be constructed of 439 stainless steel fire tubes and tubesheets, with a one-pass combustion gas flow design. The fire tubes shall be 1/2” or 5/8” OD, with no less than 0.049” wall thickness. The upper and lower stainless steel tubesheet shall be no less than 0.25” thick. The pressure vessel/heat exchanger shall be welded construction. The heat exchanger shall be ASME stamped for a working pressure not less than 150 psig. Access to the tubesheets and heat exchanger shall be available by burner and exhaust manifold removal. Minimum access opening shall be no less than 8 inch diameter.

3. Pressure Vessel: The pressure vessel shall have a maximum water volume per each model as listed below:

   - BMK750: 16.25 gallons (61.5 liters)

   The boiler water pressure drop shall not exceed the following per model size:

   - BMK750: 3 psig @ 100 gpm

   The boiler water connections shall be flanged 150-pound, ANSI rated.

   - BMK750: 3 inch flange

   The pressure vessel shall be constructed of ASME SA53 carbon steel, with a 0.25 inch thick wall and 0.50 inch thick upper head. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases.

4. Dual Returns: The boiler shall include dual return connections for low and high return temperature zones for added flexibility and thermal efficiency optimization. The boiler shall not have a minimum flow rate requirement through either return connection as long as the specified minimum flow of the boiler is met through a combination of the two return connections. Boilers with single return will be deemed unacceptable.

5. Modulating Air/Fuel Valve and Burner: The boiler burner shall be capable of the following firing turndown ratios without loss of combustion efficiency or staging of gas valves. The turndown ratios shall be as follows and are based on BTU size:

   - BMK750: 15:1

   The burner shall not operate above 7.5% oxygen level or 55% excess air. The burner shall produce less than 13 ppm of NOx, under standard calibration, corrected to 3% excess oxygen when firing on natural gas. The burner shall be metal-fiber mesh covering a stainless steel body with spark or proven pilot ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment. A variable speed cast aluminum pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner.

6. Fuel: The boiler shall use one of the following gas train options:

   a. Natural gas: The unit gas train shall be specifically designed and calibrated for a single predetermined fuel. The gas train shall be a ventless gas train.

7. Minimum boiler efficiencies shall be as follows at a 20ºF delta-T:

EWT	100% Fire	50% Fire	7% Fire
160 °F	86.5%	87%	87%
140 °F	87%	87.5%	87.5%
120 °F	88.5%	89%	90%
100 °F	93.2%	94.5%	95.2%
80 °F	95.6%	96.8%	98.2%

8. Exhaust Manifold: The exhaust manifold shall be of corrosion resistant cast aluminum or 316 stainless steel with the following diameter flue connections:

   a. BMK750: 6 inch

   The exhaust manifold shall have a collecting reservoir and a gravity drain for the elimination of condensation.

9. Blower: The boiler shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.

   a. Motors: Blower motors shall comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

      1) Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require a motor to operate in the service factor range above 1.0.

10. Ignition: Ignition shall be via spark or proven pilot ignition with 100 percent main-valve shutoff and electronic flame supervision.

11. Combustion Air: The boiler shall be designed such that the combustion air is drawn from the inside of the boiler enclosure, decoupling it from the combustion air supply and preheating the air to increase efficiency.

12. Combustion Air Filter: The boiler shall be equipped with an automotive high flow air filter to ensure efficient combustion and unhindered burner components operation.

13. Enclosure: The plastic and sheet metal enclosure shall be fully removable, allowing for easy access during servicing.

14. O2 sensor located in the Combustion Chamber: The boiler shall be equipped with an Oxygen sensor. The sensor shall be located in the boiler combustion chamber. Boilers without Oxygen sensor or boilers with an Oxygen sensor in the exhaust shall not be acceptable due to measurement estimation and performance accuracy.

B. Controls

1. Refer to specification section 230923 for additional control information.

2. The boiler shall have an integrated boiler control that is capable of operating the boiler and associated accessories including but not limited to: its pumps, valves and dampers.

    a. The control shall have a 5 inch color touch screen display as well as six function buttons that are separate from the display. User shall have the ability to navigate the menus via touchscreen or navigation buttons. Controls not equipped with navigation button options shall not be permitted.
    b. The control shall be equipped with a multi-color linear LED light to indicate the level of firing and/or air/fuel valve position.
    c. The control shall display two temperatures using two dedicated three-digit seven-segment displays.
    d. The control shall offer an Enable/Disable toggle switch as well as two buttons for Testing and Resetting the Low Water Cutoff.

3. The Manager designated boiler control shall be capable of the following functions without the need for additional external controls:
    a. Sequence up to 16 boilers,
    b. Control boiler variable speed or single speed pumps and/or modulating motorized valves,
    c. Operate or modulate a variable or single speed system pump or rotate two system pumps,
    d. Control and communicate with up to 6 SmartPlate domestic water heaters and their domestic hot water pump,
    e. The control shall connect to other plant boiler controls using RS485 and communicate using Modbus protocol.

4. The control system shall be segregated into three components: “Edge [ii]” Control Panel, Power Panel and Input/Output Connection Box. The entire system shall be Underwriters Laboratories recognized.

5. The control panel shall consist of seven individual circuit boards using surface-mount technology in a single enclosure. Each board shall be individually field replaceable. These circuit boards shall include:

    a. A microcontroller board with integrated 5 inch touchscreen color display providing the user interface.
    b. A 7-segment display board. This board includes two 3-digit 7-segment displays. These displays shall be used to view a variety of temperature sensor values and operating and startup function status.
    c. An Interface board connects the microcontroller board to internal components using ribbon cables.
    d. An electric low-water cutoff board connects to the test and manual reset functions on the microcontroller board.
    e. A power supply board is designed to provide the different DC voltages to the rest of the boards. It also acts as voltage regulator and reduce power noise.
    f. An ignition and combustion board. This board controls the air/fuel valve and Safety Shutoff Valve, flame status and ignition transformer
    g. A connector board used to connect all external electrical connection.

6. Combination plant: The managing boiler control shall be capable of setting and managing a combination plant that consist of up to two groups of boilers, their swing boilers and swing valves. The control shall be capable of performing all the listed features without the need for any additional controls. The use of additional controls to achieve any of these functionalities shall be prohibited to simplify installation and plant management. The combination plant control shall have the following capabilities:

    a. The control shall operate one group of boilers for heating and another group of boilers for domestic hot water using plate heat exchangers or indirect tanks.
    b. The control shall manage and rotate the lead boiler in each of the two groups independent of the other group.
    c. The control shall be capable of managing one or two swing boilers and their motorized swing valves to direct the output of the swing boiler(s) to one of the two groups based on the plant priority settings. The control shall also connect to the header and return sensors for each of the two groups of boilers and use those values to manage the set point for each group.
    d. The control shall offer two independent logics that run simultaneously managing each group of boilers. Each boiler group logic shall have its temperature values, setpoints, PID and feedback parameters that is independent of the other group settings and parameters.

7. System Pump lead/lag rotation: The control shall be capable of operating two system pumps. It shall rotate the lead pump based on user time setting. The use of an external pump lead-lag control shall not be permitted unless function is performed by building management system.

8. Variable Speed Pump: The control shall be capable of modulating a variable speed pump. It shall modulate the pump based on the boiler firing rate, the boiler plant firing rate, or based on the return header temperature differential from supply water temperature on a primary secondary piping application.

9. Minimum number of boiler plant open valves: The control shall manage the minimum number of boiler motorized valves to reduce variable speed pump flow and energy used. The control shall offer a setting to control the number of valves open during low load and standby operation. Manufacturers without this feature shall offer additional pump controller

and a smaller single speed pump to run during the low load and standby periods.

10. Control settings transfer using USB: The control shall simplify and significantly lessen startup and boiler setting time by being able to use a USB flash drive to copy settings from one boiler to another boiler. Installers shall use successfully preconfigured boiler settings in their portfolio to newly installed boilers.

11. Combustion calibration: The control shall offer at least 5 calibration points. The use of less than 5 calibration points is not permitted to improve overall system efficiency under all firing rates. Each combustion calibration point shall operate with 5 to 7% O2 levels to improve operating efficiency. Deviating away from these values shall not be acceptable.

12. Assisted Combustion Calibration: The control shall offer an assisted combustion calibration feature to help reduce setup time and improve setup accuracy. The assisted combustion calibration shall adjust the O2 level at each calibration point to help keep O2 level within allowable efficiency. The control shall log, date and time stamp the calibrated point combustion values of O2 and allow the user to log NOx, CO and flame strength. The control shall check these values against manufacturer allowable combustion values and color identify values out of manufacturer acceptable ranges. As an additional capability, the control shall also have the ability to perform manual combustion calibration. Not having Assisted Combustion Calibration function shall be prohibited.

13. Valve Balancing: To help simplify installation and as part of a boiler plant, the control shall be capable of controlling an electronic modulating motorized valve for each of the boilers using the manager boiler control. It shall have a built-in logic to provide a maximum flow using an adjustable valve opening percentage point for each boiler. The control shall be capable of closing any valve that has an off boiler. If all boilers are off, the control shall keep at minimum one valve open to protect pumps.

14. Building Automation: The control shall be able to communicate to Building Management Systems using BACnet and Modbus without the use of external gateways. The control shall be able to communicate over each of the two protocols using IP as well as RS485. The use of external gateways is not acceptable. The control shall be able to communicate to the building management system using:

    a. BACnet MS/TP and BACnet IP/Ethernet. When communicating over BACnet IP, the control shall offer an additional layer of IP security by mapping all control BACnet IP communication to the BACnet server's IP and MAC addresses. Not having this level of security shall deem the IP communication insecure and shall not be acceptable.
    b. Modbus RTU and Modbus IP.

15. Unit and Plant Status: The control shall provide a quick view of the unit status and plant status.

    a. The unit status screen shall provide temperature setpoint, all water inlet and outlet and supply air and exhaust temperature sensors' values. It shall also provide unit current and target firing rates. Additional screens shall display unit run hours, cycle count and average cycles per hour.
    b. The plant status screens shall provide plant temperature setpoint, plant water supply and return temperatures, outdoor temperature and domestic hot water setpoint and current temperatures. Additionally, a status screen shall show the boiler status of each plant unit, plant firing rate.
    c. Unit and Plant event history: The manager control shall display the last 500 historical events per plant or 200 historical events for single unit installations.

16. Software update: The control shall be capable of field software updates without a need for hardware component(s) replacement. This shall be performed either using software on a USB flash drive or via Internet connection. The software update mechanism shall be performed by a trained technician. The software update menus shall be secured using a password level. After the software update, the control shall retain all of its prior field settings.

17. Copy settings from one boiler to the other: To significantly reduce installation time by reducing long repetitive work, the control shall have the capability of saving its settings to a USB flash drive. In addition, the control shall have the ability of copying new settings from a flash drive.

18. Programmable Inputs and Outputs: The control shall be equipped with multiple relay and analog outputs and dry contact and analog inputs. Each shall be field programmable to meet installation needs. The following I/O options shall be available:

    a. Relay outputs: There shall be two output relays that are programmable. The following relay functions shall be selectable:
        1) Swing Valve 2
        2) System Pump
        3) Summer Pump
        4) Multi-temperature pump
        5) Pump2
        6) Louver

    b. Inputs and interlocks: The following control functions shall be available:
        1) Flow input
        2) Damper end switch input
        3) Louver end switch input

    c. Analog output: There shall be three analog outputs that are programmable. The control shall have configurable analog outputs that can be used as one of the following options:
        1) Boiler pump
        2) Domestic hot water variable speed pump
        3) Valve
        4) Fire rate

    d. Analog input: There shall be three analog inputs that are programmable. The control shall have configurable analog inputs that can be used as one of the following options:
        1) Remote setpoint
        2) Smart Plate valve position
        3) Domestic hot water variable speed pump flow

19. Backup boiler: The control shall be able to operate a lower efficiency back up boiler during peak periods when main plant boilers are at or close to peak load.

20. Communication with SmartPlate: The control shall be capable of controlling and monitoring one or multiple plate heat exchanger(s). It shall be able to:

    a. Change the domestic hot water temperature setpoint and read its current temperatures.
    b. Monitor 3-way valve position.

c. Control the operation of the domestic hot water pump.

21. The controls shall annunciate boiler and sensor status and include extensive self-diagnostic capabilities.

22. The control panel shall incorporate:

    a. Setpoint High Limit: Setpoint high limit allows for a selectable maximum boiler outlet temperature and acts as temperature limiting governor. Setpoint limit is based on a PID function that automatically limits firing rate to maintain outlet temperature within a 0 to 10 degree selectable band from the desired maximum boiler outlet temperature.
    b. Setpoint Low Limit: Allow for a selectable minimum operating temperature.
    c. Failsafe Mode: Failsafe mode allows the boiler to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode, enabling the control can to shut off the unit upon loss of external signal, if so desired.

23. The boiler control system shall incorporate the following additional features for enhanced external system interface:

    a. System start temperature feature
    b. Pump delay timer
    c. Auxiliary start delay timer
    d. Auxiliary temperature sensor
    e. Analog output feature to enable simple monitoring of temperature setpoint, outlet temperature or fire rate
    f. Remote interlock circuit
    g. Delayed interlock circuit
    h. Easy Setup by providing simplified menu quick settings to expedite plant and boiler setup
    i. Delta-T Limiter
    j. Freeze protection
    k. Fault relay for remote fault alarm
    l. Warm-weather shutdown
    m. The control shall offer multi-level user security access using different passwords. For additional security, the passwords shall expire if control display was not touched for an extended period 30 minutes.

24. Each boiler shall include an electric, single-seated combination safety shutoff valve/regulator with proof of closure switch in its gas train. Each boiler shall incorporate dual over-temperature protection with manual reset, in accordance with ASME Section IV and CSD-1.

25. O2-Trim or AERtrim: Each boiler shall be equipped with the patented AERtrim system, an advanced O_2-trim system for condensing boiler applications. The system shall utilize a low cost reliable automotive O_2 sensor that measures and monitors the oxygen content of the exhaust gases. The system shall adjust the blower speed to maintain optimal air-fuel ratios in the event of any site condition changes (air density, gas pressure, BTU content, etc.). The system shall have the following capabilities:

    a. Self-Diagnostics
        1) System Status and Error Messages
        2) When excessive trimming is occurring

3) When O_2 sensor has fallen out of calibration

b. Adjustable parameter settings
   1) O_2 target and range to meet site requirements
   2) Schedule daily or weekly self-diagnostics

Output of O_2 information shall be displayed on the Edge [ii] control panel.

The O_2 sensor shall be installed through the unit's burner plate and measure the oxygen content directly within the unit's combustion chamber.

Boilers without an equivalent O_2 trim will be deemed unacceptable. Due to the moisture content of flue gases from condensing boilers, placing the O_2 sensor in the exhaust manifold or stack will be deemed unacceptable.

26. Each boiler shall be onAER ready with a standard Ethernet port and include a 5 year onAER subscription at no additional charge. AERCO's onAER service grants the user online access to real time operation and status of their system plant from any computer, tablet or mobile device along with the following capabilities:

    a. Efficiency status and trends
    b. O2 levels
    c. Efficiency and performance optimization tips
    d. Preventative Maintenance alerts and scheduling
    e. Predictive Maintenance algorithms.
    f. Warning and error messages
    g. Weekly or monthly performance and status reports
    h. Manage multiple boiler plants or buildings
    i. Customizable dashboard
    j. Add email contacts for alerts and reports, including local AERCO trained technicians
    k. Manage and store startup, maintenance and service documentation

    The boiler manufacturer shall be able to provide a network hub or a network switch to connect up 16 boilers to an online network.

27. Each boiler shall have integrated Boiler Sequencing Technology (BST), capable of multi-unit sequencing with lead-lag functionality and parallel operation. The system will incorporate the following capabilities:

    a. Efficiently sequence 2-to-16 units on the same system to meet load requirement.
    b. Integrated control and wiring for seamless installation of optional modulating motorized valve. When valves are utilized, the system shall operate one motorized valve per unit as an element of load sequencing. Valves shall close with decreased load as units turn off, with all valves open under no-load conditions.
    c. Automatically rotate lead/lag amongst the units on the chain and monitor run hours per unit and balance load in an effort to equalize run hours among active units.
    d. Option to manually designate lead and last boiler
    e. Designated manager control used to display and adjust key system parameters.
    f. Automatic bump-less transfer of master function to next unit on the chain in case of designated master unit failure; master/slave status shall be shown on the individual unit displays.

C. Electrical Power

1. Controllers, Electrical Devices and Wiring: Electrical devices and connections are specified in Division 26 sections.

2. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers and other electrical devices shall provide a single-point field power connection to the boiler.
3. Electrical Characteristics:

Electrical Specifications	**Models**			
	BMK750-2000	BMK2500-3000 & 5000-6000	BMK2500-6000	BMK5000-6000
Voltage	120 V	208 V	460 V	575 V
Phase	1	3	3	3
Frequency	60 Hz	60 Hz	60 Hz	60 Hz
Full Load Current	13-16 Amps	10-30 Amps	5-12Amps	7 Amps

D. Venting

1. The boiler shall be capable of venting in Polypropylene venting material. The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with condensing flue gas service. UL-listed vents of Polypropylene or Al 29-4C stainless steel must be used with boilers.

2. The minimum exhaust vent duct size for each boiler is six inch (BMK750 - 1500), 8 inch (BMK2000 - 3000), 12 inch (BMK4000-5000N) diameter or 12 inch (BMK5000 and 6000) diameter.

3. Combustion-Air Intake: Boilers shall be capable of drawing combustion air from the outdoors via a metal or PVC duct connected between the boiler and the outdoors.

4. The minimum ducted combustion air duct size for each boiler is six inch (BMK750 - 1500), 8 inch (BMK2000 - 3000), 10 inch (BMK4000-5000N) diameter or 12 inch (BMK5000 and 6000) diameter.

5. Common vent and common combustion air must be an available option for boiler installation. To improve system efficiency, multi-boiler system shall utilize sequencing logic with common venting as well as individual boiler venting configuration. Manufacturers not allowing parallel modulation for common shall not be acceptable. Consult manufacturer for common vent and combustion air sizing.

6. Follow guidelines specified in manufacturer’s venting guide.

E. Source Quality Control

1. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions and carbon monoxide in flue gas, and to achieve combustion efficiency. Perform hydrostatic testing.

2. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

    a. If boilers are not factory assembled and fire-tested, the local vendor is responsible for all field assembly and testing.

3. Allow Owner access to source quality-control testing of boilers. Notify Architect fourteen days in advance of testing.

F. Manufacturers

1. This specification is based on the Benchmark Platinum Series boilers that are fitted with Edge [ii] control as manufactured by AERCO International Inc. Equivalent units and manufacturers must meet all performance criteria and will be considered upon prior approval.

2. Basis-of-Design Product: Subject to compliance with requirements, provide AERCO International, Benchmark Platinum Series Boiler with Edge [ii] control:

    a. BMK 750 with 750,000 BTU/hr input

    b. Approved Equals:

        1) Bosch Buderus SB Series
        2) Superior Boiler - Creek Series
        3) Simons Boilers - FTC Titan

2.03 CHIMNEYS: DOUBLE WALL FOR CONDENSING BOILERS

A. The double wall flue system shall be an air-insulated double-wall product designed for commercial applications. It shall be approved for use on individual or common vented ANSI Category I, II, III and IV Gas Burning Appliances, Direct Vent and for Gas and Oil fired appliances listed for Type L-Vent applications as approved by the appliance manufacturer.

B. The double wall flue system shall be tested and Listed by Underwriters Laboratories to UL 1 738/ULC S636 for used with Listed natural gas or propane burning equipment that produce continuous flue-gas temperatures not above 550 F. It shall also be tested and Listed by Underwriters Laboratories to UL 641/ULC S609 for use with Listed oil and gas burning equipment that are suitable for venting with Type L vent which produce continuous flue-gas temperatures not above 570 F. The system shall be installed and sealed per manufacturers' instructions so all joints are gas tight, preventing leakage of products of combustion into a building.

C. The double wall flue system shall be a double-wall product that consists of a flue-gas conduit fabricated from AL 29-4C® stainless steel, which is highly suited for use with high-efficiency gas burning equipment, which produce excessive amounts of condensation in the vent. The outer jacket of the system shall be constructed of type 430 stainless steel with

- 1" of insulation in the annular space.

D. All joints in the double wall flue system shall be fastened with a closure system that combines the features of the manufacturer's tapered ends with a mechanical closure system consisting of tabs and a locking band. The locking band shall be tightened from a single location using a simple hand tool, pulling the two pieces together making a pressure tight assembly. When installed on positive pressure or condensing applications, the joints must be sealed. Diameters 4" through 16"

shall be manufactured with a factory adhered seal. Diameters 18” through 32” shall use an approved sealant on the job site. This closure system shall be tested to be gas tight at two and one-half times the Listed pressure rating of 15” water column.

E. When properly installed the double wall flue system may safely and securely be utilized in either interior or exterior installations. The system shall be capable of withstanding reasonable wind and incidental loads as required by UL standards.

F. When connected to gas-burning appliances with a maximum continuous flue-gas temperature of 550 F, 4” through 24” diameter double wall flue system can be fully enclosed vertically by combustible materials at 1” or greater clearance and 26”–32” diameter by 2” or greater clearance. For Oil fired Type L-Vent with a maximum flue-gas temperature of 570, 4” through 8” diameter a fully enclosed system requires 3” clearance. For horizontal applications refer to the manufacturer’s Clearance Chart.

G. The double wall flue system shall be sized in accordance with appliance manufacturers’ specifications, the most current edition of NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances, the most current edition of NFPA 54 National Fuel Gas Code (ANSI Z223.1), ASHRAE recommendations, and all applicable local and regional codes. This proper sizing, based on information supplied by the consumer, shall be reflected in scale drawings of the system provided by the manufacturer.

H. The double wall flue system is to be installed only in accordance with the manufacturer’s “Installation and Maintenance Instructions” and with all applicable local, regional, and national codes.

I. Submittals shall include detailed plan and elevation drawings of the chimney system, indicating specific components and configuration with respect to the building. Included in the submittals shall be draft calculations performed by the chimney manufacturer to verify that the chimney system will provide adequate draft when the specified equipment is in operation.

J. Model/Manufacturer: Saf-T Vent CI Plus Special Gas Vent by Heatfab Inc.

PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 23 6000
REFRIGERATION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

1.02 REFERENCES

A. Perform the work in accordance with the requirements of section 230000, General Provisions, and with the provisions of all applicable codes and laws.

B. The installation and equipment is to conform to ANSI B 9.l Safety Code for Mechanical Refrigeration.

1.03 SUBMITTALS

A. Procedure: Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Air-Cooled Chiller
2. Refrigeration Accessories
3. Field Performance Tests

C. System maintenance requirements not covered by equipment manufacturers' instructions.

1.04 SYSTEM TESTING

A. Perform operating tests and instruct Owner's personnel as specified in Section 230000. Produce and maintain refrigeration effect under operating criteria determined in advance by agreement with the Architect.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Construct all apparatus of materials suitable for the conditions encountered during operation.

B. Construct all equipment in accordance with the requirements of the local and state codes. Construct all pressure vessels in accordance with the ASME Code for unfired pressure vessels. Pressure vessels shall bear the code stamp.

C. All factory applied acoustical and thermal insulation, including facing and adhesive, to be fire-resistant or non-combustible, and shall conform to the requirements of NFPA and local codes.

D. Mount grease fittings directly on bearings unless the bearings are not visible or inaccessible. Then provide easily accessible extensions to bearing lubrication fittings.

E. Balance all fan wheels and other moving components statically and dynamically. Drill all fan shafts on the center line to receive a tachometer point.

F. Match and balance all system components to achieve compatibility of equipment for satisfactory operation and performance throughout the entire operating temperature and control range.

G. Provide all controls, wiring, piping, valves, tubing, accessories and other components necessary to make a complete operating system.

H. All refrigeration equipment shall comply with the applicable provisions of the ASME Code and American Standard Safety Code for Mechanical Refrigeration ASA-B 9.l, the requirements of all regulating bodies having jurisdiction and the recommendations of the equipment manufacturer.

I. Electrical operating and safety controls shall be 120 volt or less. The control circuit shall have a grounded neutral with all safety controls in the ungrounded leg.

J. All items of refrigeration equipment shall be shipped complete with a holding charge or refrigerant and oil.

K. All piping and components which are part of a manufacturer's standard offering, and are subject to freezing, shall be insulated and heat traced by the manufacturer in accordance with the requirements for outdoor piping as specified in other sections of these specifications. Heat tracing shall be compatible with heat tracing provided under other sections of these specifications and shall terminate in weatherproof junction box. Manufacturer shall coordinate heat tracing voltage and termination point with installing contractor.

2.02 MODULAR AIR-COOLED CHILLER

A. Design Requirements

1. The chiller shall conform to ANSI/AHRI 550/590-2003 Standard for testing and certified rating of Water Chilling Packages using the vapor compression cycle, conducted in accordance with AHRI Standard 550/590-2003 procedures and tolerances.

2. System Description: Chiller shall incorporate Scroll type compressors and consist of multiple independent refrigerant circuits. Each refrigerant circuit shall consist of an individual compressor set, evaporator, thermal expansion valve, liquid line solenoid valve, filter drier, fin and tube condenser, and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical stand-point. The multi-circuit chiller must be able to produce chilled water even in the event of a failure of one or more refrigerant circuits.

3. General

a. Chiller Modules shall be ETL listed in accordance with UL Standard 1995, CSA certified per Standard C22.2#236.

b. Modules shall ship wired and charged with refrigerant. All modules shall be factory run tested prior to shipment.
c. Compressors, heat exchangers, condenser fans, piping and controls shall be mounted on a heavy gauge steel frame. Electrical controls, contactors, and relays for each module shall be mounted within that module. Module shall be provided within a steel enclosure suitable for outdoor use. Exposed steel surfaces shall be provided with a powder coat paint finish.

4. Each module shall include supply and return mains for chilled water. Grooved end connections are provided for interconnection to eight-inch standard piping with Victaulic type couplings. Isolation valves shall also be provided so the heat exchangers may be replaced during operation.

5. Each evaporator shall be a brazed plate heat exchangers constructed of 316 stainless steel. Evaporator heat exchanger shall not be mounted above the compressor, to prevent the effect of migration of refrigerant to the cold evaporator with consequent liquid slugging on start-up.

6. Each module shall contain two hermetic scroll compressors in a tandem piping arrangement mounted to the module with rubber-in-shear isolators. Each system also includes high discharge pressure and low suction pressure safety cut-outs.

7. Each module shall contain dual condenser fans. These fans shall be multi-blade vane-axial type made of plastic composite material for quiet operation. Fans shall be direct drive at a maximum RPM of 1,150. Condenser fans shall be provided with variable frequency drives.

8. Chiller Central Control System.

a. Scheduling of the various compressors shall be performed by a microprocessor-based control system (Master Controller). A new lead compressor is selected every 24 hours to assure even distribution of compressor run time.
b. The Master Controller shall monitor and report the following on each refrigeration system:

1) Discharge Pressure Fault
2) Suction Pressure Fault
3) Compressor Winding Temperature
4) Suction Temperature
5) Evaporator Leaving Chilled Water Temp.

c. The Master Controller shall monitor and report the following system parameters:

1) Chilled Water Entering and Leaving Temperature
2) Discharge Refrigerant Temperature
3) Chilled Water Flow

d. An out of tolerance indication from these controls or sensors shall cause a “fault” indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire chiller will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall. This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller’s LCD. A history of faults shall be maintained

including date and time of day of each fault (up to the last 20 occurrences).

e. Individual monitoring of leaving chilled water temperatures from each refrigeration system shall be programmed to protect against freeze-up.
f. The control system shall monitor entering and leaving chilled water temperatures to determine system load and select the number of compressor circuits required to operate. Response times and set points shall be adjustable. The system shall provide for variable time between compressor sequencing and temperature sensing, so as to fine tune the chiller to different existing building conditions.
g. Chiller shall have external inputs and outputs to be compatible with the plant system controller to include Remote Start/Stop capability and Cooling Alarm output

9. Each refrigerant circuit shall include all refrigerant specialties including a properly sized refrigerant receiver to provide reliable operation down to -20°F Ambient.

10. Chiller shall be provided with the electrical connections as scheduled on project drawings.

11. Chiller shall be mounted by the factory on an integral lifting frame capable of supporting the unit during crane operations so the chiller may be rigged in less number of sections.

12. Butterfly type isolation valves shall incorporate appropriate accessories and controls to allow the chiller to operate efficiently in a variable primary flow system. Motorized valve per module shall operate for variable flow.

13. Provide Free Cooling modules in quantity and capacity as indicated on drawings and schedules. Free Cooling Modules shall interconnect through the common chiller header system and require no additional water connections. Free Cooling Modules shall include glycol cooling coils, temperature controlled fans and an automatic 3-way bypass valve to eliminate the need for mechanical cooling under low ambient conditions. Module shall be completely factory assembled and tested before shipment.

14. BACnet Interface - Chiller shall include a BACnet interface capable of integrating into the factory provided plant controller.

B. Chiller Safeties, Controls and Operation

1. The chiller safety controls shall be provided (minimum) as follows:

a. Low evaporator refrigerant pressure
b. Loss of water flow through the evaporator
c. High condenser refrigerant pressure
d. High compressor motor temperature
e. Low suction gas temperature
f. Low leaving evaporator water temperature

2. Failure of chiller to start or chiller shutdown due to any of the above safety cutouts shall be enunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English. Alphanumeric codes shall be unacceptable.

3. The chiller shall be furnished with a Master Controller as an integral portion of the chiller control circuitry to provide the following functions:

a. Provide automatic chiller shutdown during periods when the load level decreases below the normal operating requirements of the chiller. Upon an increase in load, the chiller shall automatically restart.

b. Provisions for connection to automatically enable the chiller from a factory provided plant management system.
c. The control panel shall provide alphanumeric display showing all system parameters in the English language with numeric data in English units.

4. Normal Chiller Operation

a. When chiller is enabled, the factory supplied Master Controller modulates the chiller capacity from minimum to maximum as required by building load.
b. The Chiller control system shall respond to Entering Water Temperature and will have an integral reset based on entering water temperature to provide for efficient operation at part-load conditions.
c. The unit control system shall provide automatic changeover between Mechanical Cooling, Pre-Cooling, and Free-Cooling modes with the following field adjustable set points:

1) Changeover Set Point (Ambient Air Temperature): Below this set point chiller will be in free cooling mode. If adequate cooling cannot be accomplished through free cooling coils, mechanical cooling will be staged up to meet building load requirements.
2) Leaving Glycol Temperature Set Point: This setting will provide two-stage thermostatic control of the unit fans to meet indicated setting for chiller leaving glycol temperature.
3) Leaving Glycol Low Temperature Lock-out: At any time if the leaving glycol drops below this field adjustable setting, free cooling will be suspended and system glycol will be diverted around the glycol cooling coils. This will prevent over cooling of the chilled water system due to ambient wind blowing through the glycol coils under cold winter conditions.

C. Piping System Flushing Procedure

1. Prior to connecting the chiller to the building chilled water loop, the piping shall be flushed with a detergent and hot water (110-130° F) mixture to remove previously accumulated dirt and other organic residue. In old piping systems with heavy encrustation of inorganic materials consult a water treatment specialist for proper passivation and/or removal of these contaminants.

2. During the flushing a 30 mesh (max.) Y-strainers (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The flushing process shall take no less than 6 hours or until the strainers, when examined after each flushing, are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take as long as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions. After flushing with detergent and/or dilute acid concentrations the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.

3. Prior to supplying water to the chiller the Water Treatment Specification shall be consulted for requirements regarding the water quality during chiller operation. The appropriate chiller manufacturer's service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

D. Water Treatment Requirements

1. Supply water for the chilled water circuit shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the chiller's heat exchangers, headers and associated piping. Cycles of concentration shall be controlled such that recirculated water quality for modular chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

a.	pH	Greater than 7 and less than 9
b.	Total Dissolved Solids (TDS)	Less than 1000 ppm
c.	Hardness as CaCO3	30 to 500 ppm
d.	Alkalinity as Ca CO3	30 to 500 ppm
e.	Chlorides	Less than 200 ppm
f.	Sulfates	Less than 200 ppm

E. Chiller Installation and Start-Up

1. Chiller must be installed per all of the manufacturer's documentation. This includes: IOM Manual, Submittal documentation, CAD Drawings, other.

2. All local structural codes must be observed. Chiller to mounted and aligned as specified on drawings.

3. All local plumbing codes must be observed. Piping must be run in such a way that the proper required clearances for head removal for tube cleaning are observed.

4. All National and Local Electrical codes must be observed. Installation of the electrical on the chiller must follow the associated documentation from the chiller manufacturer. Electrical installation shall be coordinated with electrical contractor. Controls installation shall be coordinated with the control's contractor.

5. Provide all material required for a fully operational and functional chiller.

6. Factory Start-Up Services: An authorized factory start agent is required. At minimum, (2) two days shall be spent on-site to ensure proper unit operation.

7. During the startup period, the factory authorized agent will instruct the owner's representative on proper care and operation of the chiller.

F. Manufacturer: Multistack Airstack or approved equal.

2.03 RECEIVERS

A. For each refrigerant circuit provide a welded steel receiver with shut-off valves, safety valves, sight glasses and cast iron mounting cradles.

B. Capacity: Adequate to store 120% of the total refrigerant charge of the system.

2.04 REFRIGERATION VALVES AND ACCESSORIES

A. Provide all necessary valves and accessories of adequate capacity and pressure rating to make a complete operable system. Connection shall be at least the full size of the connecting piping.

B. Charging valves: Henry Valve Co., Type 623 or 643.

C. Magnetic Stop Valve: Alco Valve Co., Series S, M, and R.

D. Relief Valves: Henry Valve Co. No. 52 or 54.

E. Sight Glasses: Henry Valve Co. Type L1-35.

F. Strainers: Alco Valve Co. No. 922.

G. Dehydrator: Henry Valve Co. Type 7-C.

H. Stop Valves: Henry Valve Co. Type 203.

I. Thermal Expansion Valves: with external bulb and equalizer, Alco Valve Co. - T Series.

PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in conformance with manufacturer's recommendations.

3.02 FIELD TESTS - PERFORMANCE

A. The manufacturer of the equipment shall perform all field testing and final adjustment of the refrigeration apparatus in accordance with provisions of the applicable ASHRAE Standards.

B. Compile and certify the following data as applicable to the equipment being tested.

Outdoor air temperature
Temperature of chilled water - in and out
Temperature of condenser water (or glycol) - in and out
Chilled water flow - GPM
Condenser water (or glycol) flow - GPM
Pressure drop through chillers
Pressure drop through condensers
Condensing temperature
Operating kilowatts from measured voltage, amperes, power factor.

C. Should any part of the apparatus or system fail to meet the contract requirements, adjust, repair or replace any and all defective or inoperative parts and, on completion, again conduct the complete performance tests.

3.03 INSTALLATION, SUPERVISION AND INSTRUCTION

A. The manufacturer shall provide a competent engineer for a total of three eight-hour days, (straight time basis) not necessarily consecutive, for the instruction of the Owner's personnel. The instruction period shall start after the test period.

B. Provide three charts of equipment lubrication and maintenance schedules mounted on 1/4" masonite and covered with heat bonded clear plastic laminate.

C. Provide a set of start and stop instruction mounted on 1/4" masonite and covered with heat bonded clear plastic laminate at each machine.

3.04 GLYCOL – CHILLED WATER SYSTEM

A. The mechanical contractor shall fill the chilled water system with a propylene glycol (phosphate-based) solution to the specified concentration.

1. The fluid must be easily analyzed for glycol concentration and inhibitor level, and easily reinhibited using inhibitors readily available from the fluid manufacturer.

2. The fluid must pass ASTM D1384 (less than 0.5 mils penetration per year for all system metals).

B. Installation of fluid

1. Clean systems with a 1% to 2% solution of trisodium phosphate in water prior to the installation of industrially inhibited propylene glycol fluid. Extensively corroded systems should be cleaned by an industrial cleaning company and all necessary replacements and repairs should be made to the system as required.

2. Use only good quality water in solution with the propylene glycol fluid. Use only water with low levels (less than 50 ppm of chloride, sulfate, and hard water ions (Ca, Mg). Distilled or deionized water is recommended. If good quality water is unavailable, purchase pre-diluted solutions of industrially inhibited propylene glycol fluid from the fluid manufacturer.

C. Testing

1. Provide all necessary field testing equipment for maintaining control of treatment standards and cycles of concentration specified above. Test kits shall be supplied by the glycol manufacturer and remain the property of the Owner.

END OF SECTION

SECTION 23 7000
AIR HANDLING AND TREATMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and applicable provisions of the Contract, including General and Supplementary Conditions, Division 1 - General Requirements, and the General Provisions, Section 230000, govern the work of this Division.

B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.

C. Perform the work in accordance with the requirements of and with the provisions of all applicable codes and laws.

D. The installation and equipment is to conform to ANSI B9.1 Safety Code for Mechanical Refrigeration.

E. Air Moving and Conditioning Association (AMCA) Standards - Air performance of all air moving devices, shall be rated in accordance with AMCA Standard Test Code 2l0 and shall be licensed to bear the AMCA certified rating. Sound ratings specified in Section 230000 shall be obtained in accordance with the AMCA Standard 300. They shall be published in accordance with AMCA Standard 30l, and the products should bear the AMCA sound certified ratings seal.

F. The quantity and performance criteria for each type of equipment is listed in the equipment schedules.

1.02 SUBMITTALS

A. Procedure

1. Prepare and make the submissions listed below and in Section 230000 in accordance with the procedure specified in Section 230000.

B. Shop Drawings

1. Air Handling Equipment and all Related Equipment
2. Fans
3. Fan Performance Curves
4. Filters
5. Variable volume, constant volume, fan terminal units
6. Fan coil units
7. Humidifier
8. Cabinet and Unit Heaters

C. System Testing

1. Perform operating tests and instruct Owner's personnel as specified in Section 230000. Produce and maintain ventilation and air conditioning under operating criteria determined in advance by agreement with the Architect.

PART 2 EQUIPMENT

2.01 GENERAL REQUIREMENTS

A. Construct all apparatus of materials suitable for the conditions encountered during operation.

B. All factory applied acoustical and thermal insulation, including facing and adhesives, sealants and paint, to be fire-resistant or non-combustible, and shall conform to the requirements of NFPA and local codes.

C. Construct all equipment in accordance with requirements of the local and state codes. Construct all pressure vessels that fall within the scope of ASME Code for unfired pressure vessels to conform to the code and bear the code stamp. Furnish three copies of National Board Inspection and Test Report.

D. Match and balance all system components to achieve compatibility of equipment for satisfactory operation and performance throughout the entire operating temperature and control range.

E. Provide all controls, wiring, piping, valves, tubing, accessories and other components necessary to make a complete operating assembly.

F. Test and rate all fans in accordance with the standards of AMCA. All fans must bear the AMCA rating seal.

G. Mount grease fittings directly on bearings unless the bearings are not visible or inaccessible. Then provide easily accessible extensions to bearing lubrication fittings.

H. Balance all fan wheels and other moving components statically and dynamically. Drill all fan shafts on the center line to receive a tachometer point.

I. Submit to the Engineer for approval complete curves of fan performance at the operating speed.

J. Provide coil covers on all coil headers which are installed outside of the air stream.

K. All filters shall be U.L. Class I.

L. Certify unit performance in accordance with ARI standard 410-72.

M. Submit to the Engineer for approval complete sound power data at the operating speed.

N. Motors to be premium high efficiency type with guaranteed minimum efficiency rated in accordance with IEEE standard 112, method B. Refer to Specification Section 230513 for required motor efficiencies and acceptable manufacturers.

O. Fans scheduled for variable speed duty shall be equipped with motors compatible with and specifically designed for variable speed operation. Coordinate with the manufacturer of the variable speed drive as specified in Section 230513.

P. Bearing Protection Ring: Whenever variable frequency drives are installed to control motor driven equipment, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor to discharge shaft currents to ground. Refer to Specification Section 230513.

2.02 AIR HANDLING UNIT

A. General

1. Unit layout and configuration shall be as defined in project plans and schedule.
2. Manufacturer to provide a full perimeter integral base frame for either ceiling suspension of units or to support and raise all sections of the unit for proper trapping. Base frame will either be bolted construction or welded construction. Refer to schedule for base height and construction type. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.

B. Unit Casing

1. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 125-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.
2. Casing performance - Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.
3. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.
4. Under 55F supply air temperature and design conditions on the exterior of the unit, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.
5. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).
6. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.
7. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.
8. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*ºF/BTU.
9. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

10. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.
11. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.
12. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

C. Access Doors

1. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.
2. All doors shall be provided with a thermal break construction of door panel and door frame.
3. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.
4. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.
5. Handle hardware shall be designed to prevent unintended closure.
6. Access doors shall be hinged and removable without the use of specialized tools.
7. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.
8. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.
9. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.
10. Multiple door handles shall be provided for each latching point of the door necessary to maintain the specified air leakage integrity of the unit.
11. An optional shatterproof window shall be provided in access doors where indicated on the plans. Window shall either be single pane, or thermal dual pane, as defined on schedule. Window shall be capable of withstanding unit operating pressures and shall be safe for viewing UV-C lamps.

D. Primary Drain Pans

1. All cooling coil sections shall be provided with an insulated, double-wall, stainless steel drain pan.
2. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements.
3. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.
4. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.
5. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.
6. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.
7. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

E. Fans

1. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components.
2. Provide fans of type and class as specified on the schedule. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free grounding assembly installed on the fan motor to discharge both static and induced shaft currents to ground.
3. Direct drive plenum fans with integral frame motors, shall be mounted on isolation bases. Fan shall be dynamically balanced throughout the operating range to a BV-3 (0.20 in/s) per AMCA 204 test standard. Fan and motor shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.
4. Fan airflow measurement systems shall be provided as indicated on the schedule and drawings to measure fan airflow directly or to measure differential pressure that can be used to calculate airflow. The accuracy of the devices shall be no worse than +/- 5 percent when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with selectable 4-20 mA or 2-10 VDC output. Signal shall be proportional to air velocity.

F. Motors And Drives

1. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.
2. Fan Motors shall be heavy duty, open drip-proof operable at scheduled voltage. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.
3. Direct driven fans utilizing integral frame motors shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.
4. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

G. Coils

1. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.
2. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the

coil.

3. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.
4. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.
5. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

H. Hydronic Coils

1. Supply and return header connections shall be clearly labeled on unit exterior such that direction of coil water-flow is counter to direction of unit air-flow.
2. Coils shall be proof-tested to 300 psig and leak-tested to 200 psig air pressure under water.
3. Headers shall be constructed of round copper pipe or cast iron.
4. Tubes shall be 5/8-inch .020 copper, with aluminum fins.
5. Hydronic coils shall be supplied with factory installed drain and vent piping to the unit exterior.

I. Filters

1. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.

2. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule.

J. Dampers

1. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

K. Access Sections

1. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer's maintenance manual.

L. Steam Dispersion Humidification Section

1. Humidifier sections shall be provided within the air handling unit with the appropriate humidifier type and performance as indicated on the schedule and drawings.
2. Humidifiers shall consist of a dispersion panel with a steam supply header/separator and a bank of steam dispersion tubes. Each active tube shall be fitted with a series of nozzles which extend from the center of the tube. The nozzles shall be sized and spaced to accept steam from the separator/header and provide a dry and uniform discharge of steam. All wetted tubes and headers shall be stainless steel.
3. No component shall be located upstream of the humidifier within 8 inches or downstream of the humidifier within an absorption distance of 18 inches.
4. All pipe connections shall be made from one side of the air handler as indicated on the schedule and drawings.
5. For direct steam applications, the control valve shall be protected by a steam supply strainer and inverted bucket trap. Steam separators, control valves, traps, and strainers shall be provided by the AHU Manufacturer and shipped loosed for field installation.

M. Total Energy Recovery Wheel Section (OAU-1)

1. Total energy recovery wheels shall be provided as indicated on the schedule and drawings. Wheels shall be integral parts of the AHUs and shall be sized per the ventilation requirement of the units. Additional outside air units, or other field assembled and ducted energy recovery devices, are not acceptable. Mixed air units with economizing shall be constructed with internal bypass dampers such that the pressure drop across the wheel does not increase during economizing. External bypass and multiple duct connections are not acceptable.
2. The air handling unit shall be certified by AHRI to contain a rotary energy recovery wheel certified to ANSI/AHRI Standard 1060 and bears the AHRI 1060 label. Performance characteristics of the energy wheel shall be provided as defined by AHRI 1060 definitions. The energy wheel shall be a total energy wheel, with the sensible and latent effectiveness reported and within 5% of each other. The calculated total net effectiveness of the recovery wheel shall not be less than 70% when the specified ventilation flow rate equals the exhaust flow rate. The energy wheel EATR shall be less than the value indicated in the schedule and drawings. Wheel face velocity and pressure drop shall not exceed performance as defined on schedule. The energy recovery cassette shall be an Underwriters Laboratories (UL) Recognized Component certified for mechanical, electrical, and fire safety in accordance with UL Standard 1812.
3. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belts. The total energy recovery wheel shall incorporate a desiccant without the use of binders or adhesives, which may plug the desiccant aperture. The adsorbent shall not be applied as a glued on surface coating and not susceptible to erosion, abrasion, or delamination. Coated segments shall be washable using standard detergent or alkaline-based coil cleaners. The adsorbent shall be selected for its high affinity for water vapor and shall not dissolve or deliquesce in the presence of water or high humidity. The rim shall be continuous rolled stainless steel to form an even concentric circle to prevent leakage around the rim and to minimize wear of components. All diameter and perimeter seals shall be provided as part of the cassette assembly. Perimeter seals shall

be self-adjusting; diameter seals shall be adjustable.

4. Wheel drive motor shall be provided mounted in the cassette frame. Wheel drive motor shall be thermally protected and UL Component Recognized. Drive belts shall not require belt tensioner. On units that require drive belt tensioner for the wheel belt/motor assembly, the unit manufacturer shall provide at no additional charge to the customer a visual inspection every four months, and adjustment if necessary, of the recommended belt tension during the unit warranty period. Wheel motors shall be of the voltage, phase, frequency, and Hp indicated on the schedule and drawings.
5. Wheel bearings shall be permanently sealed and lubricated and have a minimum L-10 life of 400,000 hours.
6. Access doors shall be provided for the removal of wheel segments. Doors shall be located to allow access to the entire upstream and downstream face of each wheel. Adequate space and access shall be provided for energy wheel motor, bearing and belt removal.
7. Energy recovery wheels shall be designed with variable effectiveness control, to vary the wheel recovery capacity. Variable effective control shall be done by an internal bypass damper provided by the AHU Manufacturer. The wheel variable effectiveness control shall have the ability to modulate the total energy recovery ability down to at least 40% of the initial recovery capacity. Variable frequency speed control is not an acceptable method for controlling variable effectiveness.
8. Frost prevention shall be achieved by outside air bypass, return air preheat, or outside air preheat, depending upon design conditions. Frost set point temperatures based on the scheduled design air conditions shall be provided by the AHU Manufacturer. Variable frequency speed control is not an acceptable method of frost control. Winter design supply and exhaust air conditions leaving the energy wheel shall be provided by the AHU Manufacturer and shall include any de-rate in performance due to frost prevention measures.
9. Control of energy wheels shall be incorporated and an integral part of the AHU control systems and shall be as described under the AHU control specifications. Secondary independent wheel controllers are not acceptable.
10. Access doors shall be provided on all air entering and air leaving sides of wheel to allow for wheel maintenance, belt or motor removal. Access doors shall be constructed per Section 2.04.

N. Variable Frequency Drives (VFDs)

1. Variable frequency drives shall be provided, mounted and wired by the AHU manufacturer as indicated on the schedule and drawings. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFDs shall be UL listed. The listing shall allow mounting in plenum or other air handling compartments.
2. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.
3. With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
4. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
5. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL 508 certified for the building and assembly of option panels. Assembly of separate panels with options by a third-party is not acceptable. The appropriate UL stickers shall be applied to both the VFD

and option panel, in the case where these are not contained in one panel.

6. The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.
7. The VFDs full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
8. The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.
9. An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
10. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
11. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.
12. Galvanic and/or optical isolation shall be provided between the VFDs power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.
13. The VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
14. Protective Features

    a. Protection shall be provided against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VFD overtemperature and motor overtemperature. The VFD shall display all faults as words. Codes are not acceptable.
    b. The VFD shall be protected from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD shall continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, 313 V AC for 460 volt units, and 394 volts for 600 volts units.
    c. The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
    d. The VFD package shall include semi-conductor rated input fuses to protect power components.
    e. To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Otherwise the AHU manufacturer shall ensure that inverter rated motors are supplied.
    f. The VFD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
    g. The VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
    h. The VFD shall catch a rotating motor operating forward or reverse up to full speed.
    i. The VFD shall be rated for 100,000 amp interrupting capacity (AIC).
    j. The VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD shall identify which of the output phases is low or lost.

k. The VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt units, 539 V AC on 460 volt units, and 690 volts on 600 volt units.

15. Interface Features

1) Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference. On units with bypass, a VFD/Off/Bypass selector switch shall be provided.
2) The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.
3) The VFD shall provide digital manual speed control. Potentiometers are not acceptable.
4) A lockable, alphanumeric backlit display keypad shall be provided. The keypad shall be remotely mountable up to 10 feet away using standard 9-pin cable.
5) The keypads for all sizes of VFDs shall be identical and interchangeable.
6) To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFDs keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.
7) The display shall be programmable to display in English, Spanish and French at a minimum.
8) A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
9) A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.
10) The VFD shall include a standard EIA-485 communications port and capabilities to be connected at a future date to a Johnson Controls N2 Metasys or Siemens FLN system at no additional cost to the owner. The connection shall be software selectable by the user.
11) At a minimum, the following points shall be controlled and/or accessible:

a) VFD Start/Stop
b) Speed reference
c) Fault diagnostics
d) Meter points

12) Four additional Form C 230 volt programmable relays shall be available for field installation within the VFD.
13) LonWorks® communication shall be available for factory or field installation within the VFD.
14) Two set-point control interfaces (PID control) shall be standard in the unit. The VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
15) Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
16) Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFDs unable to show these four displays simultaneously shall provide panel meters.
17) Sleep mode shall be provided to automatically stop the VFD when its speed drops below set sleep level for a specified time. The VFD shall automatically restart when the speed command exceeds the set wake level.
18) The sleep mode shall be functional in both follower mode and PID mode.

19) A run permissive circuit shall be provided to accept a system ready signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
20) The following displays shall be accessible from the control panel in actual units: Reference Signal Value, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and unit CFM.
21) The display shall be programmed to read in inches of water column (in-wg).
22) The VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
23) If the temperature of the VFDs heat sink rises to 80ºC, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFDs heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
24) The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses.
25) The VFD shall store in memory the last 10 faults and related operational data.
26) Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
27) Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.
28) Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.
29) Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24V DC status indication.
30) Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed.

16. Adjustments

1) The VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.
2) A minimum of sixteen preset speeds shall be provided.
3) Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
4) Four current limit settings shall be provided.
5) If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: undervoltage, overvoltage, current limit and inverter overload.
6) The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
7) An automatic on delay shall be selectable from 0 to 120 seconds.

17. Service Conditions

    1) VFDs shall provide full output in an ambient temperature from -10 to 50ºC (14 to 104ºF).
    2) VFDs shall provide full output in a relative humidity from 0 to 95%, non-condensing.
    3) VFDs shall provide full output up to 3,300 feet elevation without derating.
    4) VFDs shall provide full output with an AC line voltage variation from -10 to +10% of nominal voltage.
    5) No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

18. Warranty

    1) The VFD shall be warranted by the manufacturer for a period of 42 months from date of shipment, or 36 months from start-up, which ever occurs first. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

19. Factory-Installed Motor Wire Termination, Vfd, And Combination Starter/Disconnect Enclosures

    1) VFDs shall be factory mounted on the drive side of the fan section. VFD may be mounted on the interior of the unit, accessible from the unit exterior through an access door, or on the casing exterior in a NEMA Type 1 enclosure for indoor units. If not mounted on the fan section due to NEC disconnect height limitations or serviceability constraints in the mechanical equipment room, VFD may be mounted in another location other than the fan.
    2) Any welds shall be properly finished with no rough edges. Enclosures shall house circuit breaker disconnects, bypass circuitry, Drive-OFF-Bypass switches, manual speed controls, and control transformers. VFDs and starter/disconnects shall have an external disconnect located on the outside of the access door.

O. Factory Wiring of Lights, VFDs, Motorized Impeller Control Panels, and Combination Starters/Disconnects

1. VFDs shall be wired per NEC, UL, and NFPA 90A requirements. Units with factory-mounted controls shall also include power wiring from the VFD or starter/disconnect control transformer to the control system transformers. Units with VFDs and factory-mounted controls shall have a binary start-stop signal and an analog speed signal wired from the direct digital controller to the VFD.
2. All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6-inch in length may be contained in FMC.
3. After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout the usable range of the drive and that the fan rotation is correct. Each VFD with bypass shall also be tested in the bypass position to ensure the bypass is operational.

P. Manufacturer: Trane or approved equal.

2.03 FAN: CENTRIFUGAL - ROOF MOUNTED - ROUND DOME - ALUMINUM

A. Motor driven centrifugal fan unit built into removable all aluminum weather tight housing; belt drive, designed for roof curb mounting.

B. Fan motor - drip-proof, with disconnect switch. Mount motor driven on vibration isolators.

C. Screen air discharge with removable aluminum (.047") bird screen.

D. Mount fans on prefabricated, double wall aluminum acoustically lined base, with integral sound baffles, minimum 12 inches above the roof.

E. Provide anti-condensate coating or baked epoxy coating on housing.

F. Accessories

1. Unit mounted disconnect switch
2. Anti condensate coating
3. UL listing
4. Totally enclosed motor

G.

Manufacturer:	Model/Series
Acme Engineering Co.	PR,PN
Greenheck Fan Corp.	G,GB
Loren Cook	ACEB,ACED
Penn Ventilator Co.	DOMEX

2.04 FILTERS – MUSEUM SYSTEMS (BUILT-UP OR CUSTOM)

A. Pre-Filters

1. Air filters shall be medium efficiency ASHRAE pleated panels consisting of the media, media support grid, and enclosing frame. Filter media shall be a cotton and synthetic blend, lofted to a uniform depth of 0.18”, and formed into a uniform radial pleats.

2. A welded wire grid, spot-welded on one-inch centers, treated for corrosion resistance, shall be bonded to the downstream side of the media to maintain the radial pleat and prevent media oscillation.

3. An enclosing frame, of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media to prevent air bypass, and include integral diagonal support members on the air entering and air existing side to maintain uniform pleat spacing in varying airflows.

4. The filter shall have a Minimum Efficiency Reporting Value of MERV 7 when evaluated under the guidelines of ASHRAE Standard 52.2-1999. It shall have an average dust spot efficiency of 25-30% and a minimum arrestance of 91% when evaluated under ASHRAE Standard 52.1-1992. The media shall maintain or increase in efficiency over the life of the filter.

5. Initial resistance to airflow shall not exceed 0.28” w.g. at an airflow of 500 fpm.

6. The filter shall be classified by Underwriters Laboratories as UL Class2. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

7. Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.1 and 52.2.

8. Filter shall be Camfil Farr 30/30 or approved equal.

B. High Efficiency Filters

1. Air filters shall be high-efficiency ASHRAE pleat-in-pleat V-bank disposable type assembled in a compact and secure enclosing frame.

2. Filter media shall be of microfine glass formed into uniformly spaced pleats separated by fiberglass thread separators and formed into a minipleat pack design.

3. Each minipleat pack shall be assembled into a V-bank configuration with an appropriate number of packs to obtain specified pressure drop.

4. The media packs shall be bonded to the inside periphery of the enclosing frame with a fire-retardant phosphorus-free sealant. The enclosing frame shall include galvanized steel channels bonded to the media pack to prevent air bypass. Extruded aluminum supports shall be placed on the air entering and air exiting sides to promote uniform airflow and assist in structural support.

5. Rigid plastic end caps shall be mechanically fastened to the top and bottom of the enclosing structure to ensure a rigid and durable filter.

6. The filter shall have a Minimum Efficiency Reporting Value of MERV 14 when evaluated under the guidelines of ASHRAE Standard 52.2-1999. Filters shall have an average dust spot efficiency of 90-95% when evaluated under ASHRAE Standard 52.1-1992.

7. Initial resistance to airflow shall be 0.30” w.g at an airflow of 500 fpm. Filter shall be rated by Underwriters Laboratories as UL Class 2. The filter shall be capable of withstanding 10” w.g. without failure of the media pack. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

8. Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.1 and 52.2.

9. Filters shall be Camfil Farr Durafil or approved equal.

C. Carbon Filters

1. Air filters shall be compact 12” deep adsorber type with multiple panels of 1” deep sorbent media, impact-resistant plastic end caps, galvanized steel vertical support channels, and a 1” nominal size header for side-access or built-up bank application.

2. Media shall be Activated Carbon, single-pass bed with module contains of 30 lbs each of activated charcoal media specifically manufactured for the removal of molecular contaminants. The media shall be formed in one-inch panels, enclosed in 26-gauge galvanized steel frame and supported and protected by a combination of corrugated Kraft honeycomb and nylon mesh.

3. The media packs shall be formed into a V-bank configuration with an appropriate number of panels to meet pressure drop requirements. The panels shall be secured in impact-resistant plastic enclosure caps. Galvanized steel channel supports shall be installed on the vertical axis on the air-entering and the air-exiting sides to affect a rigid and durable enclosure.

4. Resistance to airflow shall not exceed 0.38 inches w.g. at 500 feet per minute velocity.

5. Media volume shall be appropriate to provide a minimum residence time of 0.026 seconds when operated at a velocity of 500 feet per minute. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

6. Filters shall be Camfil Farr Camsorb CH Loose-fill V-cell Adsorbers or approved equal.

D. Gaseous Filters

1. Gaseous and particulate contamination control levels not to exceed:

   a. 1 $\mu G/M^3$ of SO_2
   b. 5 $\mu G/M^3$ of NO_2
   c. 25 $\mu G/M^3$ of O_3 and control for HC1, HCHO and acetic acid

2. Air filters shall be compact 12” deep adsorber type with multiple panels of 1” deep sorbent media, impact-resistant plastic end caps, galvanized steel vertical support channels, and a 1” nominal size header for side-access or built-up bank application.

3. Media shall be Odoroxidant Media, single-pass bed with module contains of 30 LB. Each of permanganate media specifically manufactured for the removal of molecular contaminants. The media shall be formed in one-inch panels, enclosed in 26-gauge galvanized steel frame and supported and protected by a combination of corrugated Kraft honeycomb and nylon mesh.

4. The media packs shall be formed into a V-bank configuration with an appropriate number of panels to meet pressure drop requirements. The panels shall be secured in impact-resistant plastic enclosure caps. Galvanized steel channel supports shall be installed on the vertical axis on the air-entering and the air-exiting sides to affect a rigid and durable enclosure.

5. Resistance to airflow shall not exceed 0.38 inches w.g. at 500 feet per minute velocity.

6. Media volume shall be appropriate to provide a minimum residence time of 0.026 seconds when operated at a velocity of 500 feet per minute. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

7. Filters shall be Camfil Farr Camsorb CH Loose-fill V-cell Adsorbers or approved equal.

E. After-Filters

1. Same as “Prefilters” in paragraph above.

F. Extra Equipment - Provide all filters during operation of fans until acceptance. Provide two complete unused replacement sets of pre-filters, high efficiency filters, carbon, gaseous and after-filters for each air system. Install one set at a time of acceptance of the systems and turn one set over to the owner.

G. Housings

1. Filter housing shall be two-stage filter system consisting of 16-gauge galvanized steel enclosure, aluminum filter mounting track, universal filter holding frame, dual-access doors, static pressure tap, filter gaskets and seals.

2. The housing shall be constructed of 16-gauge galvanized steel with pre-drilled standing flanges to facilitate attachment to other system components. Corner posts of Z-channel construction shall ensure dimensional adherence.

3. The housing shall incorporate the capability of two stages of filtration without modification to the housing. A filter track, of aluminum construction shall be an integral component of housing construction. The track shall accommodate the specified filter media.

4. Dual access doors, swing-open type, shall include high-memory sponge neoprene gasket to facilitate a door-to-filter seal. Each door shall be equipped with adjustable and replaceable positive sealing UV-resistant star-style knobs and replaceable door hinges.

5. A universal holding frame constructed of 18-gauge galvanized steel, equipped with centering dimples, multiple fastener lances, and polyurethane filter sealing gasket, shall be included to facilitate installation of high-efficiency filters.

6. The housing shall include a fitting to allow the installation of a static pressure gauge to evaluate pressure drop across a single filter or any combination of installed filters.

7. Leakage at rated airflow, upstream to downstream of filter, holding frame, and slide mechanism shall be less than 1% at 3.0” w.g. Leakage in to or out of the housing shall be less than one half of 1% at 3.0” w.g. Accuracy of pneumatic pressure fitting, when to evaluate a single-stage, or multiple filter stages, shall be accurate within ± 3% at 0.6” w.g.

8. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

9. Housings shall be Camfil Farr 3P or 6P Glide/Pack or approved equal.

2.05 VAV UNIT: LOW PRESSURE

A. Cabinet shall be constructed of zinc coated steel with 1" internal insulation. Insulation shall meet standards of specification section 230700.

B. Air volume damper shall be constructed of extruded aluminum components with nylon fitted bearings. Air leakage shall not exceed 2% at 1" W.G. inlet pressure.

C. Damper operator shall be factory mounted and compatible with space thermostats specified in specification section 230923. Units shall be of the pressure independent type capable of operating with inlet pressures between 1.0 and 3.0 inches of water.

D. Unit shall be factory tested prior to shipment.

E. Manufacturer: Model/Series:
Titus
Price
Trane
Anemostat.

2.06 VAV UNIT: LOW PRESSURE - HOT WATER REHEAT

A. Cabinet shall be constructed of zinc coated steel with 1" internal insulation. Insulation shall meet standards of specification section 230700.

B. Air volume damper shall be constructed of extruded aluminum components with nylon fitted bearings. Air leakage shall not exceed 2% at 1" W.G. inlet pressure.

C. Damper operator shall be factory mounted and compatible with space thermostats specified in specification section 230923. Units shall be of the pressure independent type capable of operating with inlet pressures between 1.0 and 3.0 inches of water.

D. Unit shall be factory tested prior to shipment.

E. Heating Coil:

1. Seamless copper tubes with brazed copper return bends and without internal turbulence inducers. Aluminum plate or helical fins. Red brass headers each with drains and vents.

2. Flanged minimum 16 gauge galvanized steel casings with mounting holes.

3. Mount and arrange components to permit expansion without strain on tubes, headers or casing and with all guides and supports necessary to assure proper alignment and drainage.

F. Support - All units shall be independently suspended from the building structure. Provide auxiliary steel for hanging where required. Resting the units on ceiling structure will not be permitted.

G. Manufacturer: Model/Series:

Tuttle and Bailey
Price
Enviro Tech
Tempmaster
Carrier
Trane.

2.07 FAN COIL UNIT: CABINET - 2/4 PIPES

A. Vertical cabinet centrifugal type.

B. Cabinet: 18 gauge, nominal with 16 gauge front panels; channel formed edges around entire perimeter.

C. Chassis: Minimum 18 gauge galvanized steel, reinforced with flanged edges lined with 1/2" thick, 1 lb. density neoprene faced fiberglass. Galvanized steel drain pan with insulating liner.

D. Fan: Double inlet, double width, forward curved, galvanized steel wheel and scroll. Fan, motor and drain pan assembly shall be removable as a unit.

E. Coils:

1. Cooling/heating coil: 5/8" O.D. seamless copper tubes, with aluminum fins, mechanically bonded.

2. Test coils at the factory for maximum working pressures of up to 300 PSI.

F. Motors: Multispeed permanent split capacitor type directly connected to an extension of fan shaft. Maximum fan motor speed 1100 RPM. Provide integral thermal overload protection. Unit mounted fan speed switch. Provide special motors for all units scheduled with external static pressures of 0.10 inches or greater. Motors shall be capable of delivering scheduled CFM at static pressures indicated.

G. Filter: 1" disposable woven glass.

H. Accessories:

1. Two-pipe valve package with automatic summer/winter changeover (Trane H-37).

2. Four pipe valve package, including two way control valves for hot and chilled water, two stop valves for each service and an air vent on each service. Provide three way chilled water control valves where indicated on plans or in equipment schedules. Control valves shall be provided in conformance with Specification Section 230923.

3. Tamper proof panel

4. Unit sub-base.

5. Extended motor oiler lines.

I. Manufacturer: Model/Series:
Trane Unitrane
Carrier
International

2.08 HUMIDIFIER: ELECTRONIC

A. Incoloy based resistive heating element for steam production.

B. Heating elements shall be designed to promote calcium scale to break during contration of heating element.

C. Heating element installed in stainless steel water tank. Bottom of stainless steel tank must be open to allow for scale to fall away from the heating elements and avoid build-up of scale.

D. Modulating output between 4% and 100% of rated capacity. Capacity must be increased or decreased by varying the amperage draw of the electric heat elements.

E. Control accuracy of up to +/-1%RH by using SSR control precision solid state relay control and high precision sensor. SSR control must be capable of continuously and rapidly changing the output throughout the operating range.

F. Furnish fault relay module for hard wired fault capability.

G. Scale collection chamber integrally mounted under the electric heating elements to collect calcium scale that falls from the heating elements during normal rapid temperature changes. Scale tank shall extend the life of the humidified by keeping build-up of scale from insulating electric heating elements to the point where they burn themselves up. Scale tank shall also ease normal maintenance of humidifier by being easily serviceable for removal of scale and reducing the maintenance required from cleaning compacted scale from heating elements. Scale tank shall be cooler than the stainless steel steam tank, Scale tank to include a hand drain valve for maintenance.

H. Dual magnetic electronic float system, located outside of the boiling water to ensure accurate water level control and reduced maintenance. Systems using conductivity probes or floats located within hot reservoir are not acceptable.

I. Self-diagnostics during start-up of system to prevent unsafe operation of the unit(s):

1. Fill valve check.
2. Float level check.
3. Drain pump check.

J. Durable powder coated steel cabinet with zero side clearance requirement for minimal footprint.

K. Insulating air gap between plumbing and electrical compartment for increased electronic reliability.

L. Standard internal drain water tempering to ensure maximum 140°F drain water. External drain water cooler not acceptable.

M. Integral fill cup with minimum 1-inch air gap to prevent back siphoning.

N. Automatic off-season shut-down after 3 days of "no call" will completely drain the boiling tank and automatically restart on call for humidity.

O. Programmable drain settings to dilute calcium during humidification by allow draining small water quantities during operation without interrupting steam production. Units shall have multiple drain rates that are programmable based upon tested or historical maintenance trends. Drain water shall be maintained below 140 degrees by bleeding potable water into drain water.

P. Furnish a duct mounted temperature sensor to be wired to channel 2. Channel 2 shall act as a modulating high limit. Should duct humidity exceed the safe humidity to avoid duct condensation, channel 2 control shall override the wall humidity sensor (channel 1) and reduce the capacity to just under the safe duct humidity set point. c- Furnish airflow switch.

Q. Self actuated drain cooler. For this project a drain cooler is to be installed inside the AHU, so down sloping steam piping condensate and steam distributor condensate can be cooled to less than 140 degrees.

R. Sam-e short absorption steam distributors designed for atmospheric steam humidifiers to directly inject the steam into ducted air for humidification. For this project steam distributors are mounted inside pad mounted AHU's. Because condensate is to be sent to drain coolers, steam distributors are to be sized for a height less than AHU internal height. Height of steam distributor will be a function of required condensate elevation to drain cooler inlet.

1. Absorption distance characteristic shall prevent water accumulation on any induct surfaces as specified.
2. Steam dispersion panel consisting of a horizontal stainless steel header supplying steam to a bank of closely spaced 3" or 9" or 12" vertical tubes as necessary to meet absorption distance requirements, and to reduce condensation losses.
3. Single horizontal stainless steel header to provide steam to vertical distributor tubes and to reduce condensation losses. Dual header systems creating unnecessary condensation, or systems needing to be installed on a partition or requiring blank off plates are not acceptable.
4. Header design is primarily round tube to minimize pressure drop. Square headers are not acceptable.
5. Steam inlet and condensate return located on the same side and at the bottom of the header to allow single point entry and floor mounting.
6. Headers are 304 stainless steel construction.
7. Vertical stainless steel distribution tubes to promote condensate evacuation. Horizontal distributor tubes are not accepted.
8. Distribution tubes shall include threaded standoffs for trouble free attachment to factory-supplied support bracket.
9. Stainless steel nozzle inserts ensure condensate free steam is discharged from the center of the distribution tubes. Systems without nozzle inserts, or other than stainless steel, are not acceptable.
10. Stainless steel nozzle inserts shall have metered orifices, sized to provide even distribution of the discharged steam, spaced for optimum steam absorption.
11. Tube and header shall be insulated to reduce condensate and temperature rise. Insulation constructed from 304 stainless steel shielding for increased energy efficiency and reduced airstream heat gain. Stainless steel shields to be isolated from distributor using plenum rated synthetic foam strips. Insulation to provide air-gap to minimize conduction and convection, as well provide reflective surface to minimize radiating heat transfer. Uninsulated headers, or simple foam insulation not accepted.

S. Adjustable mounting frame available for quick and easy installation. Mounting frame shall be constructed of 304 stainless steel. Galvanized frames shall not be acceptable.

T.

Manufacturer:	Model/Series:
Condair	RS
Neptronic	SKS4
Armstrong	ERS

2.09 UNIT HEATER: HOT WATER

A. Vertical or horizontal mounted with propeller fan direct connected to electric motor.

B. Coil: Copper tubes with aluminum fins mechanically bonded to the tubes.

C. Casing: Minimum 18 gauge steel with steel fan guard and horizontal deflection or outlet cone louvers. Finish in baked enamel.

D. Motor: Permanent split capacitor with built-in thermal overload protection.

E.

Manufacturer:	Model/Series:
Modine	HS
Carrier	
Trane.	

2.10 UNIT HEATER: ELECTRIC

A. Casing: 18 gauge die formed steel, phosphate coated and finished with two coats of baked enamel. Adjustable discharge louvers and protective inlet louvers. Furnish mounting brackets for ceiling mounting.

B. Heating elements of alloy resistance wire, fully enclosed in refractory, sheathed with copper coated steel; aluminum fins.

C. Motors: Totally enclosed, continuous duty, direct connected to an all aluminum fan. Maximum RPM - 1750.

D. Controls:

1. Automatic reset thermal overload protection.
2. Manual reset thermal overload
3. Low voltage thermostat for field mounting
4. Fin delay relay for field wiring
5. 24-volt control transformer
6. Prewired control kit
7. Factory installed heat recovery thermostat
8. Factory installed power disconnect switch

E.

Manufacturer:	Model/Series:
Chromolox	MUH
Indeeco	
Brasch.	

2.11 CABINET UNIT HEATER: HOT WATER

A. Vertical or horizontal centrifugal cabinet type.

B. Cabinet: 16 gauge removable front with 18 gauge side and back panels. Bonderize metal surfaces, and apply one coat of baked on primer. Finish with baked on enamel. Finish color to match samples to be provided by the Architect.

C. Fan: Forward curved centrifugal type, constructed of fiberglass reinforced thermoplastic.

D. Coil: 5/8" O.D. copper tubes with mechanically bonded aluminum fins.

E. Motor: Multispeed permanent split capacity type, connected to an extension of the fan shaft.

F. Filter: 1" disposable woven glass.

G. Manufacturer: Model/Series
Trane
ITT Nesbit
McQuay.
Sterling
Ted Reed

2.12 ADJUSTABLE V-BELT DRIVES

A. For all belt-driven equipment: A complete matched set to transmit the power to the driven equipment; not less than two belts per drive.

B. Sheaves: Adjustable plus or minus l0%. When motor is l5 HP or over, use, companion type sheaves.

C. Belts: Reinforced rubber or neoprene.

D. Service Rating: Not less than 200% of the maximum estimated load; greater if specified for particular apparatus.

E. Minimum efficiency: 95%.

F. Manufacturer:
Browning Mfg. Co.
T.B. Wood's Sons Co.

2.13 MACHINERY GUARDS

A. Guard all visible moving parts of machinery, including fan belt drives, by barriers constructed of properly supported and easily removed 1-1/4" x 1-1/4" x 1/8" galvanized angle iron frames and 3/4" No. 16 galvanized expanded metal mesh. Round and finish all guard edges.

B. Provide openings equal to twice the diameter of the shaft for the insertion of a tachometer in all machinery guards covering the ends of motor or equipment to allow adjustment of belt tension.

2.14 FILTER GAUGES

A. At each filter bank, provide a mounted 4-l/2" diameter dial gauge with brass valved connection tubing to brass static pressure sensing tips upstream and downstream of the filter bank.

B. Scale: Clean filter drop at mid scale
1) Graduated in 0.2" W.G. increments.

C. Manufacturer: Model/Series:
F.W. Dwyer Mfg. Co. Magnehelic Series 2000.

PART 3 EXECUTION

3.01 **GENERAL**

A. Install equipment in conformance with manufacturer's recommendations.

END OF SECTION

SECTION 260000
GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Division shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this Division as shown on the drawings, as specified herein, and/or as required by job conditions.

B. This Section 260000 governs general procedures, materials, and workmanship as applicable to the electrical work specified in the other Division 01 sections. Refer to Division 01 sections for additional general requirements.

C. Perform the work in accordance with the requirements and provisions of applicable codes and laws.

D. Equipment, materials, and installation shall conform to applicable standards and requirements of the following organizations and documents:

ANSI	-	American National Standards Institute
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
CBM	-	Certified Ballast Manufacturers Association
CSA	-	Canadian Standards Association
ETL	-	ETL Testing Laboratories
FCC	-	Federal Communications Commission
FM	-	Factory Mutual
FS	-	Federal Specifications
ICEA	-	Insulated Cable Engineers Association
IEEE	-	Institute of Electrical and Electronic Engineers
IESNA	-	Illuminating Engineering Society of North America
NEC	-	National Electrical Code
NECA	-	National Electrical Contractors Association
NEMA	-	National Electrical Manufacturers Association
NESC	-	National Electric Safety Code
NETA	-	International Electrical Testing Association
NFPA	-	National Fire Protection Association
OSHA	-	Occupational Safety and Health Administration

1.2 INTENT

A. It is the intention of the specifications and drawings to obtain finished work, clean, tested, and ready for operation.

B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, or items and services necessary to render the work complete and ready for operation, even if not specified, shall be provided without additional cost.

C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

1.3 DEFINITIONS

- Homerun: The installation of cable(s), conduit(s) or tubing(s) between the panelboard and the first wiring device or lighting outlet fed from the branch circuit.

1.4 WORK INCLUDED

A. The work under this Division shall include labor, material, equipment, services, and administrative tasks required to complete and make operable the electrical work shown on the drawings and specified herein, and including, but not limited to, the following:

1. Preparation and submission of shop drawings, diagrams, and illustrations.
2. Procuring necessary permits and approvals and paying required fees and charges in connection with the work of this Division.
3. Coordinating with, and complying with requirements of, the local electric utility, telecommunications service provider, and other franchised utility and service companies as applicable to the scope of this work.
4. Record drawings.
5. Operating and maintenance instructions and manuals.
6. Identification labels, tags, charts, and diagrams.
7. Final connections to electrical equipment and devices.
8. Cutting, drilling, and patching required for the work of this Division.
9. Excavation and backfill for underground electrical work.
10. Concrete housekeeping pads for floor-mounted electrical equipment.
11. Temporary light and power for construction purposes.
12. Testing and adjustment of systems and equipment furnished, installed, and/or connected under this Division.
13. Independent commissioning of new systems and all associated components as described herein.

1.5 2D AND/OR 3D ELECTRONIC DATA FILES

A. The data contained within these electronic files represents part of AltieriSeborWieberLLC's instruments of service and shall not be used for any purpose other than as a convenience in the preparation of shop drawings and/or coordination drawings for the project.

1. If the data contained within these electronic files is used and/or reused in an unauthorized manner, AltieriSeborWieberLLC, its members and employees shall be defended and held harmless from any claims, loss, or damage, including reasonable attorney's fees and defense costs, in connection with such unauthorized use and/or reuse.

B. These electronic files are not part of the Contract Documents, and differences may exist between these electronic files and the corresponding hard copy Contract Documents. We make no representation regarding the accuracy, completeness, or usefulness of electronic files you receive, and have no obligation beyond the electronic transmission of these files to an address you designate. If a conflict arises between the electronic files and the signed and sealed hard copy prints of the Contract Documents, the signed and sealed hard copy prints of the Contract Documents shall govern. The Contractors acknowledge that it is their responsibility to verify the completeness and correctness of the above referenced electronically transmitted data against the issued contract documents, and that they are not relieved of their responsibilities under the Contract, including but not limited to checking, confirming and coordinating all dimensions and details, taking field measurements, verifying field conditions and coordinating the work with the work of all other trades for the project.

1. If a conflict arises between the electronic files and the signed and sealed hard copy prints of the Contract Documents, AltieriSeborWieberLLC, its members and employees shall be defended and held harmless from any claims, loss, or damage, including reasonable attorney's fees and defense costs, resulting from omissions, variations or deletions pertaining to the completeness and usefulness of these files.

1.6 REFERENCES

A. Section 013300 – Submittals

B. Section 018113 "Sustainable Design Requirements."

C. Section 018119 "Indoor Air Quality Requirements."

D. Section 018115 "Construction Waste Management."

E. Section 018114 "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints & Coatings."

F. Section 019113 "General Commissioning Requirements."

1.7 APPROVALS

A. See General Conditions and Division 01 sections, in addition to the following requirements.

B. Submit for approval a list of manufacturers of equipment proposed for the work. Contractor's intent to use exact make specified does not relieve him of responsibility for submitting such a list.

C. Where any specific material, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. The Contractor shall verify the duty specified with the specific characteristics of the equipment offered for approval.

D. If material or equipment is installed before it is approved, the Contractor shall be liable for its removal and replacement with no additional cost.

1.8 COORDINATION WITH OTHER TRADES

A. Prepare complete set of drawings showing necessary slab openings, cuts or holes in structural members and structural supports that require structural framing. Drawings shall clearly indicate sizes and location relative to established column lines. Drawings shall be made using the latest backgrounds available from the architect. Drawings shall be completed in sufficient time to allow for structural steel fabrication so as not to delay project schedule.

B. Shop drawing submissions shall demonstrate knowledge of the work of other trades and shall show the locations of the work of other trades that affect the work of this contract.

1.9 COORDINATION DRAWINGS

A. Coordination drawings shall be completed as required in Division 01. Refer to Section 230000 for requirements and sequence of drawing development.

B. The electrical contractor shall add electrical work on the coordination drawings. Electrical work to be shown on the coordination drawings shall include, but not be limited to, panelboards, switchgear, transformers, variable frequency drives, and cable tray and conduit 2" and larger. Additional electrical work shall be shown on coordination drawings where close coordination is required. Access requirements shall be shown for equipment.

C. After other trades have included their work on the coordination drawings and noted conflicts, the trades shall meet to resolve conflicts and agree to acceptable solutions. Each trade shall sign coordination drawings. Items not shown on the coordination drawings are the responsibility of the omitting contractor and the contractor is subject to additional costs incurred by other trades.

D. The Architect and Engineer are not part of the coordination drawing process. The Engineer will aid relative to acceptability of installations.

E. Submit final signed coordination drawing to engineer. Only submit items that are different from previously approved shop drawings. Revisions shall be clearly indicated.

F. Any work fabricated or installed prior to sign off by the applicable trades shall be removed and re-installed in conformance with coordination drawings.

G. Each contractor (mentioned above) is responsible for the coordination of his sub-contractors.

H. The overall coordination of the coordination process is the responsibility of the general contractor.

1.10 SUBMITTALS

A. Shop Drawing Schedule

1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of proposed shop drawing submissions.

2. The schedule shall include the following information.

    a. Item to be submitted.
    b. Date of submission
    c. Latest date for approval
    d. Manufacturers of the specified item.

3. Items not specifically listed as "approved equal" should be listed for consideration at this time.

B. See Division 26, 27 and 28 equipment sections for specific submittals required. Unless otherwise indicated, submittals are required for electrical devices, equipment, and systems including basic construction materials such as conduit, 600 volt building wire, and standard fittings and boxes. Submit only data which are pertinent. Mark each copy of manufacturer's standard printed data to identify products, models, options, and other data pertinent to project. Common submissions including different equipment and/or components are not acceptable and will be summarily rejected.

C. Manufacturers' Data

1. If catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features that the Contractor proposes to furnish shall be clearly identified. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.

D. Shop Drawings

1. Coordinate and submit components, necessary for Architect/Engineer to adequately review submittal for each system or like materials, as complete package. Reproduction of design drawings for use of shop drawings is not permitted.

2. Shop drawings shall clearly indicate details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include information required for making connections to other work.

3. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that such units may be checked both individually and as an assembly.

4. Shop drawings shall include a listing and labeling statement indicating products are listed and labeled by a certified testing laboratory or agency for all electrical materials, devices, appliances, and equipment.

5. Contractor shall keep on the site, in good order, a complete up-to-date set of approved shop drawings. Shop drawings shall be made available for inspection by the Architect.

6. The approval of shop drawings will be for general conformance to drawings and specifications and shall not be construed as permitting any departure from the contract requirements. If the shop drawings show any variations from contract requirements because of standard shop practices or other reasons, such variations shall be clearly identified on the drawings or specifically noted in the letter of transmittal, in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby. If the Contractor fails to so identify such variations, he will not be relieved of responsibility for executing the work in accordance with the contract, even though such shop drawings have been approved and the work installed. Approval shall not relieve the Contractor of responsibility for any error in details, dimensions, etc. shown on shop drawings, nor for the furnishing of materials or work required by the contract and not indicated on the shop drawings. Approval shall not be construed as approved departure from details or instructions previously furnished by the Architect.

7. No work for which shop drawings are required shall be executed until the Architect's approval is obtained.

E. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken.

1. NO EXCEPTION - Submittal appears to comply with the contract drawings and specifications. Contractor is not relieved of responsibility to meet the requirements of the contract drawings and specifications due to errors, omissions, or conflicts with other equipment or trades.

2. EXCEPTIONS AS NOTED - Submittal appears to comply with the contract drawings and specifications except for the items noted by the engineer. Contractor is not relieved of responsibility to meet the requirements of the contract drawings and specifications due to errors, omissions, or conflicts with other equipment or trades.

3. REVISE AND RESUBMIT - In the opinion of the engineer the nature and/or quantity of exceptions is sufficient to require resubmission to demonstrate compliance. Submittals must be returned within 30 days for contingent acceptance to remain valid. Submittals will become rejected if not returned within 30 days.

4. REJECTED - Submittal does not comply with contract drawings and specifications.

1.11 RECORD DRAWINGS

A. Provide "Record Drawings" in accordance with Article 4 of the General Conditions Governing all Contracts, indicating in a neat and accurate manner a complete record of all revisions of the original design of the work. Include all changes and accurately record, on reproductions of the contract drawings or appropriate shop drawings and in digital format (on memory stick in Adobe Acrobat PDF and AutoCAD 2018 (minimum) “.dwg” and “.dxf” format), all deviations between the work shown on the contract documents and the work installed.

B. Submit for approval bound sets of the required drawings, manuals, and operating instructions.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Furnish manufacturers operating and maintenance instructions, parts lists, and sources of supply for replacements in accordance with Division 01 - General Requirements.

B. Provide the following:

1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.

2. Bind each set within a common binder. Index and organize with a table of contents, to permit quick and convenient reference.

3. One day of instruction in operation and maintenance of equipment to Owner's maintenance force. Schedule a 2-week period, convenient to Owner, during which qualified personnel, including manufacturers' technicians and engineers will be available for Owner's instruction.

4. Master Operating Manual (submit in quadruplicate) with PDF file to recreate manual on memory stick. Provide a copy of the information to the engineer of record in PDF format.

5. Manufacturer's mechanical and electrical equipment parts list of components of the systems listed on the equipment schedules, control diagrams and wiring diagrams of controllers.

6. List shall give system number, unit number, manufacturer's model number, and manufacturer's drawing numbers.

7. Step by step operating instructions for each system including preparation for starting, re-starting after power failure, or re-setting after overcurrent or short-circuit operation.

8. Maintenance instructions for each type of equipment.

9. Possible breakdowns and repairs for each type of equipment.

10. List of nearest local suppliers for equipment.

11. Manufacturer's literature describing each piece of equipment listed on the fixture, panel and equipment schedules and in the specifications including wiring diagrams and a copy of any applicable test reports.

12. As-installed control diagrams by the control manufacturer.

13. Recommended trouble shooting procedures in the event of foreseeable electrical system failure.

14. Complete "As-Installed" color coded wiring diagrams of systems and electrical motor controller connections.

15. Copies of the following test reports or study reports:

    a. Building wire insulation resistance.
    b. Emergency power system.
    c. Dry type transformer.
    d. AV / Computer grade isolation transformer.
    e. Pad mounted distribution transformer.
    f. Architectural lighting control system.
    g. Lightning protection system.
    h. Fire alarm system.
    i. Short circuit, arc flash and coordination study with final settings.

1.13 GUARANTEES AND SERVICES

A. All workmanship, installation materials and equipment shall be maintained and serviced for the guarantee period at no additional cost to the Owner.

B. Leave entire system installed under this Contract in perfect working order, and, without additional charge, replace any work or material which develops defects within the guarantee period, including all other work damaged because of such defects.

1.14 SYSTEM MAINTENANCE

A. Contractor shall provide routine and preventive maintenance during the warranty period.

B. Contractor shall submit to Engineer for approval a comprehensive plan covering items to be maintained and service to be performed. Plan shall include checklist for use by maintenance personnel.

C. Owner's representative(s) shall accompany contractors' maintenance personnel and receive instructions on proper maintenance of equipment.

D. Maintenance performed shall include a complete check out of each piece of equipment at least twice during warranty period. The first shall occur approximately halfway through the warranty period (change of season) and the second shall occur at the conclusion of the warranty period and prior to commencement of the owner's maintenance. Each system and/or piece of equipment shall be inspected, operated through its complete range of operation, and adjusted as required. This inspection shall be the same as performed at the initial start-up of the item or system. In addition, there shall be monthly maintenance inspections of each piece of equipment. During the monthly inspections, equipment shall be checked for items such as dirty filters, belt wear, lubrication, unusual sounds, or unusual operating conditions. Monthly inspections shall also include recording of system operating temperatures and pressures.

E. Contractor shall include all labor and material to perform the maintenance, including replaceable items such as batteries, drivers, power supplies, lamps, ballasts, fuses, and air and oil filters.

F. Maintenance on the following items shall be included:

1. Lighting fixtures
2. Generators
3. Fire alarms

1.15 PERMITS AND CERTIFICATES

A. Prior to proceeding with any installation, the Contractor shall prepare and submit to the proper authorities for their approval working drawings required by them, and shall give necessary notices, obtain permits, and pay local, state, and federal taxes, fees and other costs in connection with this work.

1.16 SHORT CIRCUIT, ARC FLASH AND OVERCURRENT PROTECTION COORDINATION STUDY

A. A short circuit, arc flash and overcurrent protection coordination study has been performed by the project engineer to establish a code-compliant solution. The Basis of Design uses equipment manufactured by Cutler-Hammer circuit breakers and devices indicated on the single line diagram(s). The contractor or equipment manufacturer shall provide a short circuit, selective coordination, and arc-flash study to document that a solution has been implemented based on proposed equipment and conductor distances.

B. Equipment and overcurrent devices indicated on the documents reflects the named manufacturer as the basis of design for this project. Proposed overcurrent devices were specifically selected to achieve selective coordination. Substituted (if applicable in project) equipment or products will be considered from approved manufacturers. Contractor assumes full responsibility for equivalent performance and footprint of substituted equipment or products. Contractor also assumes full responsibility for selective coordination of all substituted equipment and products.

C. Equipment furnished as part of specification sections listed below will not be reviewed or approved without a submission of a complete short circuit, arc flash and overcurrent protection coordination study:

1. 210000 - Fire Pump Transfer Switch
2. 260943 - Digital Lighting/Architectural Dimming Control System
3. 262200 – Dry Type Transformers
4. 262212 – Computer-Grade Isolation Transformers
5. 262413 – Switchboards
6. 262416 – Panelboards
7. 262700 – Electric Service
8. 262800 – Low Voltage Circuit Protective Devices
9. 263200 – Emergency Power System
10. 263623 – Automatic Transfer Switch

D. The contractor or equipment manufacturer shall perform and submit for review and approval (1) a short circuit study and (2) an overcurrent protection coordination study in accordance with IEEE "Red Book" Standard 141 for the actual service and distribution equipment supplied, including (3) arc flash hazard calculations per IEEE 1584, and complying with NFPA 70E. The study shall include equipment shown on the single line diagram and specified in each Section identified in paragraph C above. Include all portions of the existing and proposed electrical distribution system from the normal power incoming primary source down to and including all panels and distribution equipment shown on the drawings. Provide a computer-generated format like SKM Systems Power Tools, ETAP (Electrical Transient and Analysis Program) Power System Analysis software Power or approved equivalent. Study reports shall be reviewed and sealed by a professional engineer registered in the State of North Carolina with the appropriate seal annotated on the title page.

E. Reports shall include as minimum:

1. Single-line diagram(s) of service & distribution to include:
   a. Complete component identification to match project labels.
   b. Transformer KVA and temperature rise
   c. Circuit breaker & fuse type, frame & trip
   d. Conductor quantity, type, size, and length
   e. UL listed component AIC rating, including rating with upstream fuse, if applicable
   f. Calculated fault current at each node and labeled on the single-line diagram.

2. Short circuit summary & analysis shall include complete fault calculations as specified herein for each proposed and ultimate source combination including utility, generator and parallel or closed transition with motor contribution, as applicable. Include fault contribution of all motors in the study. Motors with variable frequency drive controllers are equipped with bypass and shall be included.

3. Selective coordination summary & analysis as required by Code including:
   a. Coordination required for 0.01 second and longer.
   b. Fire pump emergency and legally required standby distribution.

4. Arc flash hazard analysis shall calculate:
   a. Listing of assumptions.
   b. Incident energies at each equipment, protective device, bus, and feeder including all transformers and where work could be performed on energized parts.
   c. Incident energies at defined working distances.
   d. Arc-flash protection boundary.
   e. Required protective flame-resistant clothing class for arc flash areas.
   f. Recommendations for arc flash mitigation and reduction of personal protective equipment categories.

5. Short circuit computer program results.

6. Analysis of short circuit results including discussion of any problem areas.

7. Recommended solutions for any identified problem areas.

8. Branch & feeder composite computer-generated time current curves (TCC) for equipment and protective devices in system.

9. Time current curves including analysis of selective coordination results including discussion of any problem areas. TCC's shall include:
   a. Individual devices in color with information labels to match single line diagram descriptions.
   b. Inset containing single line diagram of components described in TCC.
   c. Component damage curves & inrush points for conductors, motors & transformers.
   d. Truncate curves at maximum available fault current.
   e. Trip settings.

10. When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

11. Table of recommended settings of protective devices.

12. Appendices with time current curves in color, UL listings, manufacturer's data, and supporting information used in study.

F. Manufacturer shall document that overcurrent protection devices will perform in accordance with their U.L. listings and ANSI/IEEE Standard 242.

G. The short circuit, arc flash and coordination study shall be included with the submittals for equipment included in the study and as listed above. Failure to include the study with the equipment submittals will cause the equipment submittals to be rejected.

H. The contractor shall modify distribution equipment based on the results of the study.

I. The contractor shall be responsible for final field adjustment of ground fault, overload and short circuit settings of adjustable circuit breakers and replacement of fused devices in compliance with the short circuit and coordination study recommendations.

J. Provide labeling of equipment requiring clear workspace as described in NEC 110.26(A) and likely to require examination, adjustment, servicing, or maintenance while energized to warn qualified persons of potential electric arc flash hazards in accordance with the results of the study and per NEC 110.16 meeting the requirements of NEC 110.21.B. As a minimum include arc flash labels for:

1. Meter socket enclosures, switchboards, panelboards, motor control centers, lighting control & dimming panels, control panels, variable frequency drives, and disconnect switches.

K. Provide labeling of equipment requiring clear workspace as described in NEC 110.26(A) and likely to require examination, adjustment, servicing, or maintenance while energized to warn qualified persons of potential electric fault current hazards in accordance with the results of the study and per NEC 110.24. As a minimum include fault current labels for all service equipment.

1.17 EQUIPMENT AND SYSTEMS CRITERIA

A. The criteria of design and performance to produce the required operation are based on equipment shown or scheduled.

B. The equipment must conform to the structural design provisions for loads applied to the structure, to the dimensions established by drawings for equipment spaces and other clearances.

C. The descriptions cover basic equipment and operation but not all the details of design and construction.

D. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish equipment required to produce specified performance under installed conditions.

E. Factory wiring, interconnections, raceways, and connections shall conform to these specifications for the field work.

F. Provide trim, enclosures and accessories required to make a complete installation.

G. Finish equipment, motors, controls and similar apparatus with machinery enamel, prime coat, and finish coat. Provide prime coat suitable for field painting and other protective treatments and coatings as specified.

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT AND SYSTEMS

A. Materials and equipment and systems shall be new, bear manufacturer's name and trademark, and comply with applicable standards specified.

B. The UL label shall be borne on each piece of applicable material or equipment.

C. Equipment shall be provided with required hardware for proper installation, assembly, and operation.

D. The descriptions cover basic equipment and operation but not complete details of design and construction. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish equipment required to produce specified performance under installed conditions. Provide trim, enclosures and accessories required to make a complete installation.

E. Follow manufacturers' directions in delivery, storage, protection and installation of equipment and materials. Notify Architect promptly, in writing, of any conflict between requirements of the contract documents and manufacturers' directions and obtain Architect's written instructions before proceeding with work. Bear any costs to correct deficiencies arising from failure to comply with the manufacturers' directions and instructions.

F. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements. Store items subject to moisture damage in dry, heated spaces. Tightly cover and protect equipment against dirt, water, chemical, and mechanical injury, and against theft.

G. Equipment and materials of the same general type shall be of the same manufacturer, make and model throughout the work to provide uniform appearance, operation, and maintenance.

2.2 EQUIPMENT DEVIATIONS

A. Contractor shall use the specified manufacturers. Any requests for substitutions, including 'or equals', must be submitted in writing ten (10) working days prior to the bid due date. Substitutions shall be justified based on need, cost, or both, as long as there is no identified reduction in quality and that design parameters are met. Acceptance or rejection of a substitution will be issued to bidders as an addendum. Substitutions will not be accepted after the Bid Date unless requested by the Architect and reviewed by the Engineer. Note: Considering a manufacturer as an 'or equal' is considered a substitution.

B. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, and which requires any additional utilities or redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical or electrical layouts, such redesign and new drawings required thereby, with approval of the Architect, shall be prepared by the Contractor without additional cost. Any changes in the project required to support alternates or substitutions shall be fully identified and submitted on the shop drawings for the substitute or alternate product. Such changes shall be reflected in the coordination drawings and shall be approved by the affected trades.

C. Where such approved deviation requires a different quantity or arrangement of equipment from that specified or indicated on the drawings, the Contractor shall provide any structural supports, controllers, motors, starters, wiring, conduit, and any other additional equipment required by the deviation, at no additional cost.

D. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, a substituted item must conform to the specified item. Consideration will not be given to claims that a substituted item meets performance requirements with lesser construction. Performance as indicated in schedules and in specifications shall be interpreted as minimum acceptable performance.

2.3 ACCESS DOORS IN WALLS AND CEILINGS

A. At each electrical component requiring access when located above ceiling or inside the wall not accessible by removal of grille, ceiling tile or from the air shafts, furnish access panels for installation by trades responsible for wall and ceiling construction as specified under Division 08 – Access Doors and Panels. Size panels sufficiently to access products requiring inspection, maintenance, and adjustment, including but not limited to electrically operated valves, in-line controls, fire dampers, instruments and smoke or heat detectors.

1. Minimum size for panels: 16 by 16 inches.

2. Size panels located in masonry walls to match masonry coursing.

B. Locations: Locate panels in walls and non-accessible ceilings of closets, storage rooms and other non-public spaces to the greatest extent possible. When access panels are required in corridors and public spaces, locate panels as directed by Architect.

C.

Manufacturer:	Model:
1. Cesco	WB-AP
2. J L Industries	CT
3. Karp	RDW
4. Milcor	AP

PART 3 - EXECUTION

3.1 SITE INVESTIGATION

A. Examine drawings, specifications, and site, and be responsible for the nature and location of work and the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, electric power, roads, etc.

3.2 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the drawings. Consult the Mechanical and Architectural drawings and details for exact locations of equipment.

B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which work will be installed and maintain maximum headroom and space conditions. Where headroom, working clearance or space conditions appear inadequate, Architect shall be notified before proceeding with installation.

C. If directed by the Architect, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

3.3 COORDINATION WITH OTHER TRADES

A. Closely schedule the work so that the work will be installed at the proper time and without delaying the project's completion.

B. Where the work of this Division is to be installed near the work of other trades, or where there is evidence that the work will interfere with the work of other trades, assist in working out space conditions to make a satisfactory arrangement. If the work is installed before such coordination with other trades, make necessary changes in the work as directed by the Architect to correct any conflicts or interferences, without additional cost to the Owner.

3.4 COORDINATION AND LAYOUT

A. Study drawings and specifications to ensure completeness of work required. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete the work, even if not explicitly shown or specified.

B. Verify measurements and conditions in field before starting work.

C. Examine materials, surfaces, and structures to which work is to be applied and notify the Architect, in writing, of any conditions that are detrimental to proper and expeditious installation of work. Starting of work shall be construed as acceptance of conditions.

D. Confer with other trades to install work to avoid interference with other trades. The necessary adjustments to conform to structural conditions and work of other trades, particularly ductwork and piping layouts, is included under this section. Assist other trades in the preparation of coordinated layout drawings.

3.5 CONNECTIONS TO EQUIPMENT FURNISHED UNDER OTHER DIVISIONS OR BY OWNER

A. Provide electrical connections to equipment and fixtures requiring such connections which are

supplied by Owner or under other Divisions.

B. Provide conduit, wire, lugs, fittings, accessories, and trim for final connection of each item of equipment as required for complete assembly and specified operation.

3.6 WORKMANSHIP

A. Perform work in practical, neat, and workmanlike manner, with electricians skilled in the work they are performing, and using the best generally recognized trade practices.

B. No work shall be covered or hidden from view until it has been inspected and approved by the required Building Department personnel and the Architect.

C. Workmanship or materials not meeting with requirements of the specifications or drawings, or the satisfaction of the Architect, shall be rejected and shall be immediately replaced in an acceptable manner without additional cost.

3.7 TESTS

A. Testing on incoming services shall be in accordance with Local Power Company requirements. Tests shall be performed by an electrical contractor or an approved independent testing Company in the presence of the Architect, Owner, and the local Utility. All tests to be documented and submitted for approval and included in the O&M Manuals.

B. Notify Architect, in writing, at least one week prior to tests, of the proposed testing timetables. Perform tests with the approval of and in the presence of the Architect or his representative.

C. Provide temporary connections, necessary testing equipment, labor, and materials, required for the testing of the systems and equipment. Systems shall be prepared for testing and protected from damage. Measuring instruments shall be properly calibrated. The cost of tests shall be included in the contract price.

D. Verify and correct as necessary the following: voltages, tap settings, trip settings, and phasing on equipment and devices furnished or installed. Secondary voltages shall be tested at the bus in the main switchboard, at panelboards, and at such other locations on the distribution systems as necessary. Secondary voltages shall be tested under no-load and full-load conditions.

E. Prior to testing, set GFI trip settings as required by the short circuit and protective device coordination study or as directed by the Architect. Initially, prior to final trip settings, set up as follows upon installation:

1. Main GFI (no downstream GFI CB): Time at minimum and maximum amp.
2. Main GFI (with downstream GFI CB): Time at maximum amp.
3. Downstream GFI:Time at twenty five percent of maximum and amp at twenty five percent of maximum.

F. Electronic solid state trip units shall be set by a manufacturer's trained technician as follows:

1. Circuit breakers with solid state trip units shall be initially pre-set to the equivalent LT, LTD, ST, STD setting of the thermal magnetic version of the same ampere rated circuit breaker.
2. Instantaneous setting shall be not less than 4X.
3. Circuit breaker final settings and configurations shall be adjusted per the approved short circuit, selective coordination, and arc flash studies.

G. The ground grid systems shall be tested using the three-terminal fall in potential method. A minimum of eight test points for each ground grid system shall be submitted for review by the Architect. The test points shall be made along a straight line from the grid system to the reference terminal. The distance between the grid system and the reference terminal shall be consistent with normal practices for ground testing. Grounding tests shall be performed during the dry season. Tests shall be performed before loaming and seeding or paving work has been performed.

H. Provide a written report on testing and device settings. Include a copy in the Operation and Maintenance Manual.

I. Adjust occupancy sensors for proper operation including time delay, field of view (masking), typed sensing and parallel operation.

J. Test wiring, outlets, lighting fixtures, switches, controllers, starters, motors, etc., wired under this Division. Leave free from grounds, crosses, shorts, opens, etc., and leave materials and apparatus in proper and satisfactory working condition. Perform additional tests as listed in the other Division 26 specification sections.

K. Lighting fixtures shall be tested in place verifying for operation, color, no flickering under dimming applications.

L. Test for proper operation of emergency lighting equipment under simulated building wide power outage conditions. Coordinate with owner and IT department for scheduling of test.

M. Test distribution equipment, motors, and three phase receptacles for proper phase connections and phase rotation.

N. Test service entrance, switchboards, panelboards, feeders, branch circuits and receptacles for proper neutral and grounding connections.

O. Prior to energizing, test insulation resistance of conductors and distribution equipment rated 80A and above with a 500-1000VDC megger (as required per manufacturer recommendations and existing conditions), both phase-to-phase and phase-to-ground. Do not energize any circuits with a reading of less than one megohm (1 million ohms) for #6 AWG wire and smaller or 250,000 ohms for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor. Circuits under megger insulation test shall be connected to respective final terminals but with switches and breakers in the "OFF" position.

P. After fixtures, devices, and equipment are installed and connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and the grounded enclosure and test insulation resistance. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from the neutral bar. He shall then test each branch circuit separately to the panel until the low readings are found. The contractor shall correct troubles, reconnect, and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

Q. Prior to energizing, test for continuity and identification of each conductor. Identify both ends of each conductor.

R. Perform additional tests required by Owner, Architect or any other authorities having jurisdiction.

S. Correct or replace any circuit, material or equipment that is found to be defective by these tests. Correct defects, whether due to faulty workmanship or material furnished, in a manner acceptable to Architect without additional cost.

3.8 IDENTIFICATION

A. Equipment

1. Identify each item and the system or area it serves. Provide an engraved lamicoid nameplate in a visible location on each switchboard, panelboard, disconnect, switch, inverter, automatic transfer switch, annunciator, dimmer panel, lighting control panel, and similar equipment. Provide stencils on major equipment and as follows:

   a. Normal equipment: Black background with white lettering.
   b. Emergency equipment: red background with white lettering.

2. Switchboards, panelboards, dimmer and lighting control panels, cabinets, junction boxes, switches, controllers, motors, etc., shall be identified as to systems, voltage, phases, horsepower, fuse size, circuit breaker size, heater size, magnetic size, and feed location on their exteriors.

3. Identify the source supplying each circuit disconnecting means as required by NEC Section 110.22.

4. Provide panel-specific printed labels as required by the Short Circuit, Arc Flash and Overcurrent Protection Coordination Study paragraphs above for all equipment in the system from the project short circuit, coordination & arc flash study file. Assume three (3) labels per equipment/bus in your estimate using 4” x 6” labels or one (1) 6” x 8” label per equipment bus. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z535. The labels shall be printable directly from the power system software utilized for the study with a Duralabel, Brady PowerMark or GlobalMark printer.

B. Wiring

1. Provide vinyl cloth self-adhering labels for feeders and branch circuits in pull boxes, junction boxes, cabinets, and outlets to identify each feeder and circuit. Manufacturer: Panduit Pan-Code, Brady or approved equal.

2. Cables and branch wiring shall be identified showing phasing, system designations, and items served. Identity is required in switchboards, panels, junction boxes, switches, controllers, cabinets, etc.

C. Provide complete, accurate, typewritten circuit directories mounted securely to panelboard doors, switchboard faces, and dimming / lighting control panels. Directories to include for each circuit: room number or area served and load description with additional requirements as described in other Sections of this Specification including the following.

1. Submit source file (excel, etc.) of the as-built panel directories for approval.

2. All source files to be included on a portable USB flash drive and included with the O&M Manuals.

D. Receptacle cover plates shall be marked to indicate source panelboard and branch circuit breaker number inside cover plate. Use an indelible marker to inscribe panel and circuit number(s) and provide a durable tag inside the outlet box.

E. Label covers of pullboxes and junction boxes for systems operating over 600 volts with readily visible lettering at least ½-inch high warning "DANGER HIGH VOLTAGE KEEP OUT." Provide warning signs to unauthorized personnel at doors to buildings, rooms or enclosures containing equipment operating over 600 volts.

F. Label covers of pullboxes and junction boxes with readily visible lettering at least 1/4-inch-high system, source panel, circuit number and voltage. Provide typewritten self-adhering labels with black text and clear background, Brady or approved equal.

G. Install a permanently affixed sign at the service entrance equipment indicating the type and location of the on-site emergency power source. Install a sign on the main grounding box identifying all emergency and normal sources connected at that location.

H. Provide a reduced size "as-built" single line diagrams, framed under glass, and mounted in a conspicuous place adjacent to the main switchboard.

3.9 CUTTING, ALTERING AND PATCHING

A. Provide cutting, chasing, drilling, altering and rough patching required for the work of this division.

1. Including the restoring of existing work cut for or damaged by installation of new work, and where present work is removed.

2. Materials and workmanship required in connection with cutting, altering and rough patching shall match the existing work in every respect.

B. Do shoring, bracing, cutting, patching, piecing out, filling in, repairing, and refinishing of present work as made necessary by the alteration and the installation of new work.

C. Holes and openings occurring in the existing floors after equipment, partitions, floors, steel work, conduits are removed or installed shall be closed with materials like the adjacent work.

D. The size and location of items requiring an opening, chase, or other provisions to receive it shall be given by the trade requiring same in ample time to avoid undue cutting of any new work to be installed. These provisions shall not relieve the Contractor from keeping informed as to the required opening, chases, etc., nor from responsibility for the correctness thereof, nor for cutting and repairing after the new work is in place.

E. Include cutting, repairing, and patching in connection with the work that may be required to make the several parts come together properly and fit it to receive or be received by the work of other trades, as shown on the drawings and/or specified, or reasonably implied by the drawings and specifications.

F. Repairing, patching, piecing-out, filling-in, restoring and refinishing shall be neatly done by mechanics skilled in their trade to leave same in condition satisfactory to the Owner.

G. Materials and their methods of application for patching shall comply with applicable requirements of the specifications.

1. Materials and workmanship not covered by the specifications and items of work exposed to view adjoining existing work to remain shall conform to similar materials and workmanship existing in or adjacent to the spaces to be altered.

H. Cutting, repairing, and patching shall include items shown on the drawings, specified in the specifications, or required by the installation of new work or the removal of existing work.

I. Remove partitions, walls, suspended ceilings, etc., as necessary to perform the required alterations or new construction work. Avoid damage to construction and finishes that are to remain.

J. Protect and be responsible for the existing building, facilities, and improvements. Any disturbance or damage to the work, the existing building, and improvements, or any impairments of facilities resulting from the construction operations, shall be promptly rectified, with the disturbed, damaged, or impaired work, restored, repaired, or replaced at no extra cost.

K. Alterations which are not indicated on the drawings nor specified herein but necessary to make good existing work disturbed by reason of the work shall be restored to a condition satisfactory to the Owner.

L. Holes in masonry floors and walls are to be core drilled. Scan existing slabs and walls for concealed locations of equipment to include conduits, piping, rebar, and structural elements prior to being core drilled. Prior to core drilling, notify the building occupants of the potential for an unscheduled power outage. The Project Manager shall inspect core holes before installing conduits, sleeves, or poke-through devices. Conduits damaged during core drilling shall be restored immediately at the Contractor's expense.

M. Disturbed concrete and /or cement floor areas shall be patched with approved type latex mortar. When cement mortar is used for patching, the surfaces shall be depressed a minimum depth of 1".

N. Reinstall weather protection work in waterproof manner.

O. Openings in roofs shall be kept properly plugged and caulked, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of work, openings shall be permanently sealed.

P. Temporary openings cut in walls, floors or ceilings for conduit shall be closed off with non-combustible material except when mechanics are working at the opening.

3.10 PIPE & CONDUIT SEALS with SLEEVES

A. Pipe and conduit penetrations through concrete walls or floor slabs in contact with earth shall be modular, mechanical type, consisting of back-to-back inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall sleeve. Each seal shall have a permanent identification of the size and manufacturer's name visibly molded, include tie-rods to allow tightening and loosening both seals simultaneously. Seal element hardware shall be 316 stainless steels. Size the elastomeric element per the manufacturer's sizing procedure.

B. Manufacturer Model: Link-Seal FS

C. Sleeves for use with pipe and conduit seals: sleeves shall be seamless schedule 40 steel with full-circle 2" water stop collar. The entire sleeve shall be hot dipped galvanized. Length of sleeves shall be flush with concrete at wall locations and finish 2" above concrete at floor locations. Size the sleeve per the seal manufacturer's recommendations.

D. Manufacturer Model: Link-Seal WS

3.11 PIPE & CONDUIT SLEEVES

A. Pipe and conduit penetrations through interior concrete walls or floor slabs shall be sleeved prior to concrete pour.

B. Pipe and conduit sleeves shall be seamless schedule 40 steel with full-circle 2” water stop collar. The entire sleeve shall be hot dipped galvanized. Length of sleeves shall be flush with concrete at wall locations and finish minimum of 2” above concrete at floor locations.

C. Size the sleeve per the manufacturer’s recommendations requirements.

D. All sleeves passing through any rated construction shall be sealed with a UL listed fire and smoke resistive assembly.

E. Manufacturer Model: Link-Seal WS

3.12 FIRE-RATED SEALING

A. Where penetrating fire-rated floor slabs and partitions, pack the annular space between the sleeves and the conduits and cables with reusable fire-retardant modules, putty, sealant, or caulk. The sealant material shall be intumescent, asbestos free, and installed in accordance with UL and manufacturer's instructions. Sealant materials shall be easily removed and replaced for addition or deletion of cables.

1. Penetrations with annular space greater than 1/2" shall be provided with approved backing material.

2. Sealants and assemblies shall match or exceed the rating of the item being penetrated. Refer to Architectural drawings for ratings.

3. Fire-retardant sealer and system shall be UL listed for the application and meet ASTM E-84, ASTM E-814, and UL-1479 requirements. Fire stop systems shall have F-ratings and T-ratings as required by the rating of the item being penetrated and shall never be rated less than 1 hour.

4. Use Hilti Firestop Systems, CSD Sealing Systems, Nelson "FSP", Carborundum Co. "Fyre Putty", 3M "CP-25", IPC "Flamesafe", ROX System or approved equal.

B. Where cable tray penetrates rated floor slabs, ceilings or partitions, the cable tray shall stop at the floor, ceiling, or wall. Provide a fire-rated pathway through floor, wall, or ceiling of equivalent size to the cable tray dimensions. The cable tray shall then be continued on the opposite side of the floor, ceiling, or wall. The cable tray shall be grounded and bonded for electrical continuity. The contractor shall maintain the floor, ceiling, and wall rating.

1. Sealants and assemblies shall match or exceed the rating of the item being penetrated. Refer to Architectural drawings for ratings.

2. Fire-rated pathway products: Hilti Speed Sleeve CP653 or STI EZ-Path Series 22, 33 and 44 or approved equal by Wiremold.

C. Contractor shall photographically document proper sealing bushings, fire stopping, sleeve and pathway products have been provided before locations are hidden from view. Refer to Section

260500 for additional information.

3.13 SEISMIC RESTRAINT PER INTERNATIONAL BUILDING CODE

A. Provide seismic restraint of electrical systems as required per IBC Code Section 1613 or ASCE 7 and referenced sections and publications.

1. The building is of Seismic Design Category B: All mechanical and electrical components are exempt from the seismic requirements of ASCE 7-05 Chapter 13.

B. Seismic restraint calculations shall be provided for connections of components to the structure. Calculations must be stamped by a registered professional engineer with at least five years' experience in seismic design experience, licensed in the State of North Carolina.

C. Analysis must indicate calculated dead loads, seismic static loads, capacity of materials utilized for connection to equipment and structure. Analysis shall detail anchoring methods, bolt diameter, embedment and/ or welded length. Seismic restraint devices shall be designed to accept without failure, the lateral forces acting through the center of gravity.

3.14 PLENUM APPLICATION

A. Space above the hung ceilings shall not be used as a return air plenum (air transfer), except where specifically indicated on the mechanical drawings and/or other drawings. Material in spaces so noted shall be suitable for use in plenum application. In spaces so noted, no combustible materials shall be used. Wiring shall be in conduit, or shall be listed for the use, and shall comply with the requirements of NFPA 70, Section 300-22, as well as other applicable codes. Materials used in plenum spaces shall have flame spread/smoke developed ratings as required by code and/or authorities having jurisdiction.

3.15 TEMPORARY LIGHT AND POWER

A. Contractor shall furnish, install, and maintain a temporary light and power system to provide the buildings, field offices, and project site with temporary light to provide safe working conditions throughout, interior, and exterior, and to supply construction power as required on the job.

B. The system shall be furnished, installed, and operating soon.

C. Work for the system shall be in accordance with NEC Article 590, the requirements of the Utility Company, and as approved by the Owner and authorities having jurisdiction.

D. The work shall include generally, but not be limited to, the following:

1. Decide with the utility company or the Owner to furnish and install the temporary light and power service.

2. Review and coordinate the electrical needs of other trades on a continuing basis, until permanent power and light is available, and the temporary system is removed and no longer needed.

3. Furnish, install, and maintain required temporary system equipment, devices, and wiring. Remove when no longer needed, or at the direction of the Owner. Modify, add, or relocate equipment, devices, and wiring as required to suit job conditions.

3.16 TEMPORARY GENERATOR

A. Contractor shall furnish, install, and maintain a temporary generator system to provide the [project] with temporary power during construction-related, normal power interruptions.

B. The system shall be furnished, installed, and operating at before the first scheduled power outage.

C. Work for the system shall be in accordance with NEC Article 305 and 702 [with NYC Amendment], the requirements of the Utility Company, and as approved by the Owner and authorities having jurisdiction.

D. The work shall include generally, but not be limited to, the following:

1. Provide a 300 kW/375 kVA stand-by rated, trailer mounted generator set, 208Y/120 volt, 3 phase, 4 wire, for continuous operation 24 hours per day for two weeks. Unit shall be sound attenuated with a 300-gallon fuel tank. Include cabling, cable protection, switchgear, and connections for full output rating of the unit.

2. Maintain required temporary generator system equipment including fueling, devices, and wiring. Remove when no longer needed, or at the direction of the Owner. Modify, add, or relocate equipment, devices, and wiring as required to suit job conditions.

E. Protect temporary generator system including cabling during construction and when generator is running after normally attended construction periods.

F. Supplier: Provide a generator including installation and maintenance services from a supplier routinely involved with setting up and maintaining temporary power systems such as: Cummins Power Rent 1-877-POWR-NOW (1-877-769-7669) or approved equal.

3.17 LIGHTING CONTROL SYSTEM: ENGINEER-OF-RECORD TEST

A. A lighting control system test shall be performed and witnessed by the engineer-of-record prior to system turnover and owner training. The engineer-of-record's acceptance of the test and any related reprogramming shall be required by to close out the lighting control system scope of work. See below for requirements associated with engineer-of-record test:

1. Programming meeting – At least 2-weeks prior to programming of the lighting control system, the contractor, system manufacturer, and system programmer shall coordinate a meeting with all associated parties (engineer, architect, lighting designer, owner, etc.) to discuss and identify the required programming and integration of the system.

2. Engineer-of-record test/walkthrough - Once programming has been completed, the contractor shall coordinate an engineer-of-record test/walkthrough with the engineer and associated parties.

3. Programming deficiencies and incorrect lighting control sequence identified because of the test/walkthrough shall be addressed and resolved by the contractor, system installer, and/or programmer. Written documentation shall be provided when all identified items have been resolved.

3.18 COMMISSIONING

A. An independent commissioning agent ("agent") has been hired by the Owner to verify the performance of the new and modified central plant mechanical, electrical, and control systems. The commissioning agent shall include verifying operation of both the existing and new equipment and components as a complete integrated system.

B. The electrical contractor shall work closely with and cooperate fully with the agent and attend all meetings and testing sessions as requested by the agent.

C. The electrical contractor shall correct all system and installation deficiencies identified by the agent to achieve the goals outlined on the construction documents.

D. Testing shall include the following:

1. Demonstration of control sequences described in the specifications and on the drawings to confirm correct equipment and control system operation.
2. Operation of lighting control systems.
3. Operation and calibration of Owner electric metering equipment and surge protection equipment.
4. Testing and verification of proper operation of emergency lighting systems.
5. Testing and verification of proper operation of fire alarm systems and components.
6. Monitoring of space conditions (verification of sensor calibration).
7. Distribution overcurrent and ground fault protection according to the short circuit, coordination, and arc flash study.
8. Fire alarm systems and components.
9. Security and intercommunication.
10. Information technology.
11. VoIP public address.
12. CCTV.
13. Specialty lighting.
14. Motors, drives & starters.
15. Grounding.

E. Documentation/projection of energy savings of converted systems compared with existing/replaced systems in compliance with LEED measurement and verification standards and requirements.

F. The commissioning agent submittals shall include the following:

1. Testing procedures including sample reports and checklists specific to the work of this project.
2. Final report documenting including test procedures, corrective actions taken, control point check-outs, and final system measurements.
3. Energy savings analysis and documentation.
4. Sub-consultants such as mechanical, electrical, testing and balancing, and controls contractors.

3.19 WASTE MANAGEMENT

A. Comply with the requirements established by the Contractor for General Construction Work to separate and recycle, salvage or reuse cast-offs, surplus and waste material in accordance with the Waste Management Plan.

B. Arrange for suppliers to take back shipping and packing materials for reuse or recycling to the maximum extent economically feasible or include them in the Waste Management Plan.

END OF SECTION 260000

SECTION 260500
BASIC MATERIALS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and as required by job conditions.

1.2 REFERENCES

A. Perform the work of this section in accordance with the requirements of Section 260000 General Provisions.

B. See other Division 26 sections for requirements of specific electrical equipment and systems not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The criteria of design and performance to produce the required operation are based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturers' catalog data for the following basic materials:

1. Wireway, trough, and fittings.
2. Cable hangers.
3. Wire and Cables (MC, MI).
4. Wiring devices and wallplates.
5. Floor boxes and fittings.
6. Underground line marker tape.
7. Low voltage lighting power supply.

B. Submit scaled and dimensioned shop drawings for the following:

1. Custom-fabricated pull, junction boxes, and terminal boxes.
2. Exposed raceway installations in architecturally finished spaces.

C. Submit samples of the following:

1. Wiring device wall plates.
2. Wiring devices.

PART 2 - PRODUCTS

2.1 WIRING & RACEWAY SCHEDULE

A. Except where specialty wiring methods are called for, use wiring methods selected in accordance with the following list. Use threaded rigid steel conduit with wire installed as the wiring method for purposes and in locations not covered by the following list and where the listed wiring methods are excluded.

RACEWAY & WIRE	APPLICATION
Rigid Metal Conduit (RMC)	1. Elevator machine rooms, pits & shafts; fire pump, jockey pump; smoke exhaust fan feeders, and associated control circuits; hazardous (classified) locations. 2. Exposed outdoors, roofs, stub-ups, or penetrations through concrete slabs or equipment pads. 3. Circuits above 600 volts. 4. Refer to Fire Alarm (Section 284600) for additional requirements. 5. Conduit and fittings below grade or in concrete shall be PVC coated.
Electrical Metallic Conduit (EMT)	1. Interior, dry locations for: switchboard, panelboard, **and mechanical equipment feeders**. 2. Branch feeders and branch circuits, lighting, and appliance circuitry. 3. **Branch circuit** homeruns to overcurrent protection devices **from the last outlet served by the circuit.** Fire alarm (Section 284600). 4. Telecommunications (Division 27) IT Consultant specifications. 5. Sound & video (Division 27) Audio Video Consultant specifications. 6. Security (Division 28) Security Consultant /Vendor specifications).
Rigid Non-metallic Conduit (RNC)	1. Below grade, below slab – Schedule 40 2. Outdoors where exposed to physical damage and in corrosive locations where shown on drawings – Schedule 80. 3. Encased in concrete, concrete ductbanks - Schedule 40.
Flexible Metal Conduit (FMC)	1. Final connections, minimum 18 inches and less than six (6) feet, only for lighting and appliance branch circuitry in accessible voids of suspended ceilings 2. Final connections, minimum 18 inches and less than three (3) feet, to motors in mechanical rooms or other interior dry locations, or where located in plenums or other spaces used for environmental air. 3. Fixture whips to chain-suspended luminaires. 4. Provide grounding conductor.

Liquidtight Flexible Metal Conduit (LFMC)	1. Final connections, minimum 18 inches and less than three (3) feet, only for lighting and appliance and motor branch circuitry in exposed wet or damp locations. 2. Do not use in plenums or other spaces used for environmental air. 3. Provide grounding conductor.
Metal Clad Cable (MC)	**Where not subject to physical damage and in accordance with below:** 1. Limited to six (6) foot fixture whips in concealed locations. 2. Lighting and appliance branch circuitry concealed in dry wall partitions. 3. Lighting and appliance branch circuitry concealed above accessible suspended ceilings. 4. Mechanical equipment and panelboard feeders shall be EMT and wire. **MC cable is not permitted.** 5. Homeruns to overcurrent devices shall be EMT and wire from the last outlet served by the circuit. 6. **Not for use in Galleries and the Great Hall areas.** 7. Fire Alarm SLC and NAC circuits where run concealed above furred or suspended ceilings and permitted by local Codes. Type MC FPLP cable.
Mineral Insulated, Metal Sheathed Cable (MI) in Conduit, MC Fire Rated MC Power Cable, Fire Rated RHW-2 Power Cable in conduit– 2 Hour Rated	1. Exposed fire pump, elevator and emergency lighting and appliance circuits where specifically indicated on drawings.

B. Minimum raceway size: 3/4-inch. Exception: Provide minimum 1-inch below grade or below slab on grade locations and unless otherwise noted.

C. Provide equipment ground conductor per 3.4.

2.2 RACEWAYS

A. Provide raceways of the types and sizes indicated and specified, or as required to comply with codes and job conditions.

B. Metallic Conduit, Tubing, and Fittings

1. Rigid metal conduit (RMC) shall be hot dip galvanized, conforming to ANSI C80.1, UL 6, and NEC Article 344. Fittings and couplings shall be threaded. Set screw (Kwik-Couple) type products are not acceptable. For outdoor locations provide raintight conduit hubs with insulated throat and bonding screw equal to O.Z. Gedney Type CHM-T. Die-cast fittings are not acceptable. PVC coated conduit and fittings shall be Perma-Cote, Plasti-Bond or approved equal.

2. Electrical metallic tubing (EMT) shall be galvanized steel, conforming to ANSI C80.3, UL 797, and NEC Article 358. Provide with galvanized steel compression type fittings, couplings, and connectors for sizes less than 1-1/2 inch. Provide with galvanized steel double set screw type fittings, couplings, and connectors for sizes 1-1/2 inch and larger. Die-cast fittings are not acceptable.

3. Liquidtight flexible metal conduit shall have an interlocked flexible galvanized steel core with a permanently bonded polyvinylchloride (PVC) jacket, conforming to UL 360 and NEC Article 350. Die-cast fittings are not acceptable.

C. Flexible metal conduit shall be interlocked flexible galvanized steel conforming to UL 1 and NEC Article 348. Provide malleable iron fittings, UL 514B. Die-cast fittings are not acceptable.

D. Connectors for metal conduit shall be insulated throat type. Provide galvanized steel grounding bushings or locknuts at metallic raceway connections to sheet steel boxes and enclosures. Die-cast fittings are not acceptable.

E. Connectors for metal conduits which contain BOTH normal ground AND isolated-ground conductors, where the conduit is NOT being used as the equipment grounding conductor, shall be phenolic insulating types. O-Z Gedney Type ICC or approved equal. (For conduits containing only a normal ground conductor or only an isolated ground conductor, where the conduit is also used as the equipment grounding conductor, provide galvanized couplings and connectors as specified above.) Die-cast fittings are not acceptable.

F. Expansion fittings for metal conduit shall be as follows:

1. Rigid metal conduit in air: Provide 4-inches conduit expansion and contraction allowance; O.Z. Gedney Type AX or approved equal.

2. Rigid metal conduit in concrete or wet locations: O.Z. Gedney Type DX or approved equal.

3. EMT conduit in air: Provide 4-inches conduit expansion and contraction allowance; O.Z. Gedney Type TX or approved equal.

G. Non-Metallic Conduit and Fittings

1. Schedule 40 and Schedule 80 rigid non-metallic conduit shall be polyvinyl chloride (PVC), rated 90 degrees C., conforming to NEMA TC-2, UL 651, and NEC Article 352. Provide with matching fittings conforming to NEMA TC-3 and UL 514.

2. Expansion fittings for PVC conduit shall be as follows:

a. PVC conduit in concrete or wet locations: O.Z. Gedney Type EX or approved equal.

H. Wireways and Troughs

1. Provide factory-fabricated sheet metal wireways and troughs of the types, sizes, and configurations indicated, or as required to suit job conditions, complete with fittings, connectors, end plates, hangers, etc. as required for a finished installation. Products shall be galvanized steel with ANSI 61 gray acrylic electrocoat finish. Fittings and components shall conform to UL 870 and NEC Article 376.

2. Wireways, troughs, and components shall be as manufactured by Square D, Hoffman Engineering Co., Wiegmann & Co., or approved equal.

I. Cable Hangers

1. Provide non-compressing, non-continuous cable supports for low voltage, voice, data, and video wiring and fiber optic cable, of the sizes and configurations indicated, complete with fasteners, anchors, cable pulling protection and as required for a finished installation to Category 6A UTP standards.

2. Finish: A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process.

3. Manufacturers: Caddy CableCat, Panduit J-Pro or approved equal.

4. Installation: Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.

   a. Install cables using techniques, practices, and methods that are consistent with Category 6A UTP or higher requirements and that supports Category 6A UTP or higher performance of completed and linked signal paths, end to end.
   b. Install cables without damaging conductors, shield, or jacket.
   c. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
   d. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.
   e. Do not exceed load ratings specified by manufacturer.
   f. Adjustable non-continuous support sling shall have a static load capacity of 100 lbs.
   g. Cable hangers shall be sized for 30% fill based on the installed cable load.

5. Where cable penetrates floor slabs, ceilings and rated partitions, the cable tray shall stop at the floor, ceiling, or wall. Provide a fire-rated pathway through floor, wall, or ceiling of equivalent size to the cable tray dimensions. The cable shall then be continued on the opposite side of the floor, ceiling, or wall. The cable and sleeves shall be grounded and bonded for electrical continuity. The contractor shall maintain the floor, ceiling, and wall rating. Comply with UL 1479 and ASTM E 814.

   a. Fire-rated pathway products: Hilti CP 653, STI EZ-Path Series 22, 33 and 44 or approved equal by Wiremold.

2.3 600 VOLT WIRE AND CABLE

A. Wire and cable for secondary power and lighting circuits and for NEC Class 1 control circuits shall be fabricated of annealed 98% conductivity copper conductors with 600 volts, 90^{o}C-rated, thermoplastic or cross-linked polymer insulation, manufactured in strict accordance with applicable requirements of UL, NEMA, ICEA and ASTM.

B. Copper conductors No. 10, 12, and 14 AWG shall be solid or concentric stranded Type THHN/THWN-2; No. 8 AWG through No. 1 AWG shall be concentric stranded Type THHN/THWN-2; No. 1/0 AWG and larger shall be concentric stranded Type XHHW-2.

C. Type MC metal-clad cable minimum requirements:

1. MC cable installation to maintain minimum 12" separation or crossing at 90 degrees from all low voltage wiring systems.

2. Conform to UL 1569 and NEC Article 330.

3. Acceptable sizes limited to: No. 12 AWG through No. 10 AWG copper solid or stranded conductors with THHN insulation.

4. Green-colored insulated ground conductor.

5. Galvanized steel interlocked armor sheath. Aluminum armor sheath is not acceptable on this project due to electrical noise mitigation considerations.

6. Listed and labeled Type MC steel fittings per UL 514B. Type AC fittings are not acceptable. Die-cast fittings are not acceptable.

7. Multi-wire homeruns shall contain a single, oversized neutral conductor, sized to accommodate non-linear loads. Provide AFC “Super Neutral Cable” or approved equal.

8. Color coded conductors per Section 3.3.

9. Luminary MC Cables as follows:

   a. MC Luminary Cable Type MC-PCS MC Tuff Luminary Cable galvanized interlocking Steel Strip (blue striped), 600 volts rated with No 12 and No 10 THHN solid conductors and No 16 TFN solid conductors or approved equal.
   b. MC Luminary Cable Type MC-PCS MC Lite Luminary Cable galvanized interlocking Aluminum Strip, 600 volts rated with No 12, or 2 No 10 THHN solid conductors and No 16 TFN solid conductors or with No 12 or No 12 THHN stranded conductors and No 16 TFN solid conductors or approved equal.
   c. MC Luminary Cable Type MC-PCS MC Lite Luminary Cable galvanized interlocking Steel Strip with PVC jacket, 600 volts rated with No 12, or No 10 THHN solid conductors and No 16 TFN solid conductors or approved equal.

10. Metallic or Luminary MC Whips as follows:

    a. Metallic Whip to be Galvanized Type RW Steel Flexible Metal Conduit, 600 volts rated with No. 12 THHN conductors or approved equal.
    b. Luminaire Whip to be Galvanized Type RW Steel Flexible Metal Conduit, 600 volts rated with No. 12 THHN conductors and No 16 TFN conductors or approved equal.

11. Manufacturers: AFC Cable Systems or approved equals: Southwire, United Copper Industries.

D. Bare grounding conductors: See paragraph 2.7 Grounding Materials.

2.4 TERMINATIONS

A. Terminations, splices and taps under 600 volts:

1. Copper conductors No. 10 and smaller: Provide with copper compression type or twist-on spring-loaded connectors and nylon insulating covering. Connectors for outdoor conductors shall be suitable for direct burial installation.

2. Copper conductors No. 8 and larger: Provide hydraulic copper compression type UL 486B listed and pre-filled with antioxidant compound using manufacturer's recommended tooling, Burndy or approved equal; or mechanical bolted pressure type, Ilsco ClearTap or Cytolok spring compression terminator or approved equal. Exception: Wiring terminations rated 100,000 amperes short circuit current and greater shall be provided with compression type lugs.

3. Cable lugs and connectors: Provide compression type of tin-plated copper. Provide to match cable, pre-filled with antioxidant compound, UL486B listed, with marking indicating size and type. Where oversized feeders are installed to reduce voltage drop and the equipment terminations are not sufficient to accept the larger feeders, provide the proper equipment terminations or provide Burndy Type YE-series or approved equivalent compression adapters.

4. Lug connections to bus bars: Provide with tin plated lugs and Belleville compression washers. Use anti-seize compound on threads. Provide 2-hole type for ground lugs.

2.5 ELECTRICAL BOXES

A. Provide outlet, junction, pull, and floor boxes, complete with associated fittings and accessories, as indicated and specified, as required by codes, to suit job conditions, and compatible with the associated wiring methods and devices.

B. Interior Outlet Boxes

1. Provide galvanized pressed steel boxes of appropriate size and type. Provide each with appropriate plaster ring to suite wall construction.

2. Unless otherwise indicated, or required by job conditions, provide boxes as follows:

a. Flush wall power outlets in hollow partitions - 4" square, 2-1/2" deep, with 1- or 2-gang device cover; provide gang boxes for 3 or more adjacent outlets.

b. Flush wall power outlets in masonry walls - 3-1/2" deep masonry boxes, with number of gangs as required.

c. Recessed switches - 3" x 2" x 3-1/2" deep, gangable.

d. Surface mounted power devices - 4" square, 2-1/2" deep, with rounded corners and appropriate raised cover.

e. Flush or surface telecom outlets - 4" square, 2-1/8" deep, where 1" knockouts are required; 4-11/16" square, 2-1/8" deep, where 1-1/4" knockouts are required.

f. Refer to “Floor Box” product descriptions for specific floor box dimensions.

C. Exterior or Wet Area Outlet Boxes

1. Provide NEMA FB1, Type FS, FD, FSC & FDC corrosion-resistant cast boxes with threaded conduit entrance fittings. Material: Copper-free aluminum for wet locations and Duraloy cast iron for concrete; electrostatic powder coating. UL Standard 514A, Federal specification C22.2 No. 18, NEMA FB-1 compliant. Manufacturers: Hubbell Killark or approved equal by Woodhead or Cooper Pass & Seymour.

2. Covers shall be gasketed FS style, with spring-loaded weathertight-while-in-use covers as appropriate for the application.

D. In-ground Boxes (T-22 RATED)

1. Provide non-deliberate vehicular traffic bearing cast polymer resin concrete or non-traffic bearing cast fiberglass underground junction and pull boxes with closed bottoms, unless otherwise noted, for flush mounting as shown on drawings.

2. Cover shall be non-skid with neoprene gasket and stainless-steel cover screws. Cover legend: ELECTRIC, TELEPHONE, CATV and as shown on drawings.

3. Manufacturers: Cast iron or aluminum - O-Z Gedney, Crouse-Hinds; Polymer concrete – Quazite, Synertech or CDR Systems Corporation; Cast fiberglass – PenCell, CDR Systems Corporation; or approved equivalents.

E. Pull and Junction Boxes

1. General: NEMA 250, Type 1, galvanized steel, finished inside and out with manufacturer's standard enamel.

2. Hinged-Cover Enclosures: Except as noted otherwise, with continuous hinge cover and flush latch.

3. Cabinets: Except as noted otherwise, with removable interior panel and removable front. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

4. Outdoors or in wet areas, pull and junction boxes shall be NEMA 3R or NEMA 4 construction with Myers Scru-Tite or approved equal conduit hubs.

5. Manufacturers:

a. Hoffman Engineering Co.; Federal-Hoffman, Inc.
b. Spring City Electrical Manufacturing Co.
c. Erickson Electrical Equipment Co.

F. Floor Boxes

1. Provide floor boxes as indicated, suitable for the application, complete with compatible accessories including, but not limited to trim rings, device plates, service fittings, tile or carpet flanges and protective rings for mechanical and wet mop protection and extension rings and shims to match finished floor level.

2. Floor box fittings shall be equipped with gasketing and shall be constructed to meet or exceed UL scrub water exclusion requirements and be so listed.

3. Poke-through fittings shall be UL listed to maintain fire rating of floor construction. Do not use in new slabs unless specifically noted.

4. Floor boxes shall be cast iron for installation in slab-on-grade floors or wet floors, formed sheet steel for above-grade installations. Coordinate box depth with slab thickness and other job conditions. Boxes shall be adjustable before and after pour.

5. All floor boxes, regardless of whether poured-in-place or poke-thru types, shall be ADA-approved about height above finished floor and surface slope ratio.

6. Where new floor boxes are indicated in existing floors, provide required saw-cutting and patching of existing floors as required for flush installation.

7. Coordinate specific non-power connectivity requirements with the Owner's Information Technology and Telecommunication System vendors.

8. Poured-in-place concrete and wood floor boxes shall be provided in types as follows:

Label	Shape	Trim/Cover	Outlets	Description
Type 1	Square Cover	Brass [cutout or blank cover], flanged [flangeless], for carpet, tile, or furniture feed with finish per Architect as follows: Nickel Brass Black Bronze Gray	Two or four duplex outlets, data & A-V as indicated on plans.	Multi-service four gang four compartment box for installation in new concrete slabs. Accepts ¾" to 2" conduit (-2HUB required for 2"C). 13-1/8" L x 13-1/8" W x 4-1/16" deep. Legrand Wiremold Resource RFB4E for above grade. RFB4E--OG for on grade or wet locations. Dimensions & knockouts like RFB4E. Include barrier kits, extensions, tile shims & accessories.

9. Floor boxes for combination audio/visual and power work shall be provided in types as follows: [specified by the A-V/Theatrical Consultant.]

Label	Shape	Trim/Cover	Outlets	Description
Type 1V	Square	Brushed aluminum [Brass][Black][Oak], for carpeted [tiled] floors	Duplex IG receptacle and A/V. Steel flip-up cover with cable fold back slot.	Multi-service box for A/V and power installations in concrete slabs. 12.5" L x 10.5" W with interior angled brackets to provide mounting for power and signal receptacles. FSR, Inc., #FL-500P-*-** (Brass, S=Aluminum or BK=Black Paint, (2.25, 3, 4, 6, 8, 10" D max.)

10. Where different voltage systems are indicated to occupy a common box, provide internal metal barriers or dividers between systems.

2.6 WIRING DEVICES

A. Provide switches, receptacles, connectors, and other wiring devices complete with associated hardware and wall plates, as indicated, and specified. Devices of one type (such as switches and receptacles) shall be made by one manufacturer. Acceptable manufacturers are Hubbell, Pass and Seymour (P&S), Cooper, Bryant (Hubbell) or Leviton.

B. Verify device colors and plate materials and finishes with the Architect. Unless otherwise noted, the following color scheme shall apply:

1. Receptacles connected to emergency or standby power shall be “red”.

2. Isolated ground receptacles shall be factory embossed with an “orange” triangle.

3. Receptacles on UPS power shall be “blue”.

4. Receptacles in performance spaces shall be “black”.

C. Wiring devices shall comply with applicable UL and NEMA requirements and shall be UL labeled for the appropriate NEMA-classified document.

D. Local Switches (line voltage type):

1. Provide premium specification grade, quiet operating AC switches, rated 20 amperes at 120 volts. Switches shall be verified by UL to meet Federal Specification W-S-896E. Provide single pole, double pole, 3-way, or 4-way operation as indicated or required. Switches shall be Hubbell HBL1221 series or approved equal.

2. Weatherproof switches shall be 20 amp, 120 or 277 volts, tap action with waterproof neoprene plate, specification grade, self-grounding, Cooper #2991 with #2881 plate or approved equal.

3. Push button emergency power off (EPO) switches shall be 2.375 inch mushroom head, non-illuminated, momentary push contact, labeled "Emergency Stop" in red, GE #CR104P Series or approved equal.

4. Break glass emergency shutdown switches shall be single-pole, double throw, flush or surface mounted, 5 amps at 250 volts, 10 amps at 125 volts, aluminum drip-proof construction, as follows:

a. Generator shutdown – ASCO #124204 (flush) or #124304 (surface), Pilla ST120 series or approved equal.

b. Coordinate control wiring of break glass switches and the associated equipment with Division 23 work.

E. Receptacles

1. Receptacles shall be standard NEMA 5-20R configuration. Receptacles shall be two-pole, three-wire grounding type, with molded nylon body and face, premium specification grade, rated 20 amps at 125 volts. Receptacles shall meet Federal Specification W-C-596F. Receptacles shall be Hubbell Inc. 5362, series or approved equal.

2. Where 15 ampere rated receptacles are indicated or required, provide Hubbell Inc. 5252, series or approved equal.

3. Install receptacles with ground up or to the left when looking at receptacle.

4. Isolated ground receptacles without integral surge suppression shall have an insulating barrier between the grounding screw and the mounting strap and an orange triangle marking on the face to indicate isolated grounding type. The receptacles shall be NEMA 5-20R duplex, Hubbell #IG-5362 series, P&S IG6300 series or approved equal.

5. Ground fault circuit interrupter (GFCI) receptacles shall comply with UL 943 (2015 Revisions) and shall be rated 20 amps with 20-amp feed-through rating, 125-volt duplex, NEMA 5-20R. Receptacles shall consist of auto-monitoring/self-testing functions and reverse line-load misfire function, Pass & Seymour #2097TR, Hubbell #GFRST20 or approved equal.

6. Outdoor Weather Resistant and Tamper-Resistant GFCI duplex receptacles for all damp and wet locations shall be rated 20 amps, be permanently marked with the “WR” label, and contain a cam action mechanism to prevent use of the receptacle if an object is inserted in a single receptacle opening. Pass & Seymour 2097TRWR, Hubbell GFTW20, or approved equal.

F. Occupancy/Vacancy Sensors and Motion Sensors

1. Provide dimming ballasts and drivers as required per Section 265000.

2. Occupancy/Vacancy Sensors – Refer to Section 260943 for Digital Lighting Control Sensors.

3. Outdoor motion sensor switches shall be walling mounted combination infrared/ultrasonic types for remote or local lighting control. Photoelectric Control: Deactivates lights during daylight. Fully adjustable for 24-hour operation or custom applications. Switches shall be vandal resistant aluminum construction with polyethylene lens, minimum 180-degree detection pattern up to 30 feet from sensor, adjustable “on” time of 20 seconds to 15 minutes, hi/lo option for reduced light output, 500 watts remote or 250 watt local incandescent load control at 120 volts and 180 watts with hi/lo option, color: white. Provide RAB Tuff Dome or approved equal.

G. Cover Plates

1. Provide compatible wall plate for each outlet and switch installed. Plates shall be as follows:
   a. Stainless steel .040" Type 302/304 with brushed finish in general throughout.
   b. High-impact nylon plates shall be as manufactured by Lutron Claro only.
   c. Black nylon in performance spaces where located in black walls.
   d. Exact color and finish to be selected by Architect. Submit samples to Architect and obtain acceptance prior to installation.
   e. Refer to architectural/lighting consultant plans for engraving requirements.

2. Where two or more switches or devices are indicated at one location, mount under common plate.

3. Exterior cover plates shall be gasketed heavy duty die-cast zinc, with spring loaded, self-closing gasketed lift cover which maintains weatherproof integrity while in use.

4. Weatherproof lockable and flush covers for public outdoor, damp location outlets shall be specification grade enclosures with neoprene gasket seals and mortar tabs for positive holding means and retains weatherproof feature without plug inserted. Provide Pass & Seymour heavy duty cast aluminum cover No. 4600 series or approved equal.

5. Weatherproof lockable for public outdoor, wet location outlets shall be Extra Duty enclosure with gasket seals and lockable tab and retains weatherproof feature with or without plug inserted. Provide Taymac MX3200(vertical) or MX3300 (horizontal) or approved equal.

6. Weatherproof non-locking flush covers for non-public outdoor, wet or damp location outlets shall be Extra Duty enclosures with neoprene gasket seals and retains weatherproof feature with or without plug inserted. Provide Arlington Products In Box Series or Taymac MX-3200 Series or approved equal.

H. See other Division 26 sections for wallbox dimmers, low voltage switches, and other special-purpose devices.

2.7 GROUNDING MATERIALS

A. Provide a complete continuous grounding system to effectively ground the non-current carrying metal parts of every piece of installed equipment, and to provide a low impedance fault return to source. Where types, sizes, ratings, and quantities indicated are more than NEC requirements, provide the greater size, rating, and quantities.

B. Grounding materials shall be copper, bronze and/or brass construction with stainless steel or bronze threaded hardware, listed and approved for the use. Aluminum, cadmium, or zinc-plated threaded materials are not acceptable. Manufacturers: Burndy, Kearney, Thomas & Betts or approved equal. Provide as follows except as otherwise noted:

1. Equipment grounding conductors: Insulated with green color insulation.

2. Grounding electrode conductors: Stranded cable per ASTM B 8.

3. Underground conductors: bare, tinned, stranded per ASTM B 33.

4. Braided bonding jumpers: copper tape, braided No. 3/0 AWG bare copper wire terminated with copper ferrules.

5. Bonding straps: soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, except as indicated.

C. Connections:

1. Bolted pressure connectors: Clamps and terminals shall be heavy-duty type. Provide two-hole compression grounding lugs; one-hole lugs are not acceptable.

2. Exothermic-welded connections: Provide Harger UltraShot or approved equivalent for underground system connections and connections to structural steel.

D. Grounding electrodes and test wells:

1. Ground rods shall be copper-clad steel, 3/4" diameter x 120” per segment with compression couplers between segments and total length per drawings.

2. Plate electrodes: copper, square or rectangular shape, minimum 0.10 inch (3mm) thick, size as indicated.

3. Test wells: Prefabricated of Schedule 80 PVC with HDPE cover for non-vehicle traffic areas or cast-iron cover for vehicle traffic areas. 12-inch long by 8-inch diameter minimum.

E. Ground bus or grounding bars shall be bare annealed copper of rectangular cross-section, 2" wide x 1/4" thick unless otherwise indicated, complete with appropriate mounting hardware, clamps, and connectors. Hardware: silicon bronze.

2.8 CABLE SUPPORTS & CONDUIT VENTILATORS

A. Provide cable supports for supporting electrical cables in vertical conduit risers per NEC Article 300-19.

B. Cable supports shall be clamping device type with ventilating capability suitable for non-armored cables, 600 volts or less, O.Z. Gedney Type S or approved equal.

C. Provide conduit ventilators to allow movement of air through the vertical conduit riser where shown on the drawings; O.Z. Gedney Type KVM or KVF or approved equal.

2.9 CONDUIT ENVIRONMENTAL LINK-SEALS

A. Provide conduit sealing for penetrations against fluid and air pressure shall be as follows as manufactured by O.Z. Gedney, Thunderline Corporation, Burndy, or Thomas & Betts.

1. For slab on grade and below grade walls which have or will have membrane waterproofing:
   a. Cast-In-Place Installations: OZ/Gedney Co.'s Type FSK thru wall seal and Type FSKA membrane clamp adapter.
   b. Core drilled or Sleeved Installations: OZ/Gedney Co.'s type CSM and type CSMC with membrane clamp adapter.

2. For walls which will not have membrane waterproofing:
   a. Cast-In-Place Installations: OZ/Gedney Co.'s Type FSK.
   b. Core Drilled or Sleeved Installations: OZ/Gedney Co.'s Type CSM or Thunderline Corporation Link-Seal CS-316.

3. Provide abandonment plates for unused openings.

2.10 CONDUIT CABLE SEALANTS

A. Provide conduit / electrical duct sealants of closed-cell urethane foam where conduits run below building slab, below grade or entering the building.

B. Duct sealant shall be a 2-part, 98% closed-cell urethane foam that reacts to set in 5-10 minutes at 70°F (21°C). It shall be reusable and capable of sealing up to 12-inch (30-cm) conduits with multiple cable configurations. Duct sealant shall be reenterable. It shall be capable of withstanding temperatures from -20°F to 200°F (-30°C to 95°C); and be chemically resistant to gasoline, oils, dilute acids, and bases. Duct sealant shall not affect the physical or electrical properties of wire and cable.

C. Duct sealant shall have good adhesion to duct and cable jacket surfaces with good structural strength. It shall have 145-lb compressive strength (ASTM D1621). Duct sealant shall be capable of holding 22 ft (6.7 m) water head pressure continuous or 90 ft (27 m) water head pressure short-term. It shall block up to 5 psi (0.3 bar) gas or vapor continuous. It shall meet NEC codes for raceway seals and meet UL 94 fire rating HBF to be UL recognized.

D. Duct sealant for conduits 2" and larger: Polywater FST-250

E. Duct sealant for conduits 1.5" and smaller: Polywater FST-MINI

F. Cable seals for low voltage and signal cables shall be reusable simplex, duplex or triplex split design as required by Tyco Electronics or approved equal. Empty/spare conduit closed end caps shall be gasketed T-Cone plug with rope tie by ETCO ESPST-402T, low temperature shrinks Type LTCP by Tyco Electronics Raychem or approved equal.

2.11 UNDERGROUND LINE IDENTIFICATION MARKER TAPE

A. Underground line identification marker tape shall consist of a reinforced protective plastic jacket bonded to an electronically detectable solid aluminum foil core constructed in a tape type format.

B. The product shall be resistant to acids and alkalis commonly found in soil.

C. The tape shall be minimum 6" wide and 5 mils thick.

D. The tape shall be installed 12" below finished grade, directly above the buried raceway or cables.

E. The following stock imprinting shall be provided:

1. "CAUTION Telephone Buried Below!", for telecommunications duct banks, direct burial cable and/or conduits. Use black letters on orange background.

2. "CAUTION Electric Line Buried Below!", for electrical duct banks, direct burial cable and/or conduits. Use black letters on red background.

F. Provide custom imprinting where indicated, or where necessary to suit special applications.

G. Manufacturers:

1. Reef Industries, Inc., Terra Tape Sentry Line Detectable.
2. Scotch 400 Series Detectable.
3. Brady B-721 Detectable Identoline.

2.12 SECURITY SYSTEM

A. Refer to Division 28 Sections for Security Consultant's system requirements and details.

B. Electrical contractor shall furnish and install dedicated empty raceway and cable pathway system for the Security System. Security System equipment and wiring shall be furnished and installed as described in other Sections of specifications.

2.13 AUDIO-VIDEO (A-V) SYSTEM

A. Refer to Division 27 Sections for Audio-Video/Theater Consultant's system requirements and details.

B. Electrical contractor shall furnish and install a dedicated empty conduit system for the A-V System. Back boxes shall be furnished by the A-V system contractor and installed by electrical contractor. A-V System wiring shall be in conduit, minimum size shall be 3/4-inch and sized for maximum 40% fill and as shown on the drawings. A-V System wiring and equipment shall be furnished and installed as described in Division 27 Sections of specifications and as indicated on the A-V/Theater Consultant documents.

C. Electrical contractor shall coordinate with the Audio and/or Theater Consultants drawings and Division 27 specifications for A-V System device types and locations. Wire installation and termination is by the A-V System installer.

D. Electrical contractor shall submit shop drawings of A-V System conduit routing for the A-V Consultant and electrical engineer review.

2.14 TELECOMMUNICATION SYSTEM

A. Refer to Division 27 Sections for IT Consultant's system requirements and details.

B. Electrical contractor shall furnish and install dedicated empty raceway and cable pathway system including the incoming service entrance raceway for the Telecommunication System. Equipment. Refer to Division 27 Sections for cable installation requirements.

2.15 LOW VOLTAGE LIGHTING POWER SUPPLIES

A. Provide toroidal transformer low voltage power supplies designed with manual taps to achieve 12, 13, 14, and 15 volts for 12-volt operation and 24, 26, 28, and 30 volts for 24-volt operation as indicated on drawings. Proper transformer wattage shall equal or exceed total lamping wattage without derating as indicated on drawings. 250 volts primary and 12 volt or 24-volt secondary voltage compartments shall be separate. Power supply shall be inherently protected and include primary and secondary overcurrent circuit protection. Size power supply overcurrent protection according to manufacturer's recommendations.

B. Indoor housing shall be suitable for recessed or surface mounting for both walls and ceilings with zero clearance to combustible materials with damp locations label. Outdoor housing shall be UL listed for wet label direct burial. Provide 304 stainless steel diamond plate or bead blasted bronze covers with stainless steel hardware as required for application.

C. Products shall be QT (indoor) and QSET & QVAULT (exterior) Series by Q-Tran, Inc., or approved equals by Semper Fi, Inc.

PART 3 - EXECUTION

3.1 WIRING & RACEWAY - GENERAL

A. The drawings show the general layout and typical details. Provide complete systems. Drawings are based on the specified equipment. Raceway layouts, boxes, and wiring of the systems are subject to approved shop drawings.

B. Ensure that items to be furnished fit the space available. Make necessary field measurements to ascertain space requirements, including those for connections, and provide such sizes and shapes of equipment that final installation shall satisfy the intent of the drawings and specifications.

C. Locations of outlets, switches, appliances, etc. as shown on Electrical plans are approximate, coordinate with Architectural and Mechanical plans and details, and with job conditions. Install switches with "OFF" position down and on the strike side of doors, unless otherwise noted. Install receptacles with grounding pole in the up position for vertical mounting and at left for horizontal mounting.

D. Locate and install electrical equipment, junction and pull boxes, panelboards, switches, controls, and other apparatus requiring maintenance, inspection, and operation to be readily accessible. For finished locations, provide a suitable marked, hinged access panel only where approved by the architect.

3.2 RACEWAY INSTALLATION

A. Install conduit in accordance with the NECA "Standard of Installation".

1. In architecturally finished spaces, conduits and cables shall be run concealed in hung or furred ceilings, slabs, masonry, and partitions unless otherwise indicated. In unfinished spaces, raceways may be run exposed.

2. Raceway installation at existing slabs, existing masonry walls and existing furred partitions in finished areas shall be as indicated in the raceway schedule listed in paragraph 2.1, saw-cut or chopped into existing floor or partition and patched, unless otherwise specifically noted. Surface raceways shall only be used where specifically indicated or permitted by the Architect.

3. Submit shop drawings for exposed conduits or raceways indicated on drawings in architecturally finished spaces.

4. Shop drawings shall demonstrate coordination with related trades and the ability to provide a neat and workmanlike installation.

B. Unless otherwise indicated, exact routing of raceways shall be determined by the Contractor to suit project requirements and field conditions.

C. Where raceways cross expansion or seismic joints, provide approved expansion fittings, or combinations of fittings, which allow deflection in all directions equal to twice the movement allowed in the structural design. For conduits 1-1/4" trade size or smaller, a 24" length of flexible metal conduit, with bonding jumper, slack mounted, may be used.

D. Provide sealing on the ends of underground conduits and underslab conduits that terminate at indoor equipment. Install appropriate sealant after installation and testing of cables. Install at first accessible conduit locations upon entering.

E. Raceways and cables shall be neatly arranged on hangers and supports, with fittings designed for the purpose, and shall be installed parallel and perpendicular to walls, floors, structure, and ceilings in a neat and workmanlike manner. Group related raceways; provide space for 25 percent additional raceways.

F. Raceways installed near pipes of other trades shall be arranged to allow proper clearance for servicing, headroom and the like. Maintain minimum 6-inch clearance from steam, hot water, and flue piping.

G. Conduit ends shall be reamed smooth, and interiors shall be wiped clean and dry.

H. Use of running threads is not permitted; use conduit unions or split couplings in areas where threaded conduit cannot be turned.

I. Conduits passing through roof construction shall be flashed watertight.

J. Raceways shall be supported at intervals less than or equal to code with seismic bracing as described in this section.

K. Locate pull boxes and junction boxes including pull fittings and the like to comply with code and to prevent recommended values of wire and cable tensions and side wall pressures from being exceeded.

L. Conduit in concrete or masonry shall be securely held in place during pouring and construction operations. Change from non-metallic conduit to rigid steel conduit before rising above the floor or emerging from concrete.

M. Where conduits are embedded in concrete above metal decking or suspended below metal decking, provide spacers for 1-1/2-inch minimum gap from decking to avoid penetration of conduit by fasteners.

N. Where conduits are installed under roof decking, provide spacers for 1-1/2-inch minimum gap from decking to avoid penetration of conduit by fasteners.

O. Direct buried conduit and conduit below concrete slabs: Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand, or other fine fill, and it shall contain no particles that would be retained on a 1/4-inch sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively used. Backfill using fine material no less than 6 inches above the top of the conduit placed in 6-inch lifts and thoroughly tamped.

P. Provide a suitable pullstring in each empty conduit except sleeves and nipples less than 24 inches.

Q. Use suitable caps to protect empty conduit against entry of dirt and moisture.

R. Conduits and/or sleeves shall not be placed in concrete slabs or walls without prior approval of the Architect. Prepare a submittal detailing the number, size, spacing and layout of the proposed conduit and/or sleeves including material specifications. Adhere to the following limits in planning the conduit embedments:

1. Maximum outside diameter of embedded conduit or sleeve: ¼ the thickness of the slab or wall.
2. Minimum center-to-center conduit spacing: Six (6) times the outside diameter of the conduit.
3. Conduits shall be firmly supported at the mid-thickness of the slab or wall and shall be wired into place.
4. Conduits shall not be placed in contact with the concrete reinforcement.
5. Use of aluminum conduit or sleeves for embedment in concrete is not permitted.
6. Conduit or sleeves shall not be placed in columns or beams.
7. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
8. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

S. Close ends of conduits immediately after being placed to keep out foreign matter. The entire conduit system shall be tested for obstructions, omissions, and smooth joints by fishwire, and thoroughly swabbed out and made dry before pulling any wire.

T. Install covers on boxes and raceway fittings. Plug unused open knockouts and hubs.

U. Do not install outlet boxes back-to-back in walls. The use of thru-wall boxes is strictly prohibited.

V. Provide phenolic insulating connectors for metal conduits containing BOTH normal ground AND isolated-ground conductors, where the conduit is NOT being used as the equipment grounding conductor. (For conduits containing only a normal ground conductor or only an isolated ground conductor, where the conduit is also used as the equipment grounding conductor, provide galvanized couplings and connectors.)

W. Provide separate dedicated raceways, junction boxes, pull boxes and wireways for emergency life-safety system wiring.

X. Junction boxes/ pull boxes and enclosures associated with emergency distribution/circuits shall be permanently marked and clearly identified.

Y. Junction boxes/ pull boxes and enclosures shall be permanently marked with circuits/feeders they are serving.

Z. Optical Fiber/Communications Cable Raceway and fittings shall not be run exposed, in concrete slabs or direct buried in earth except as shown on drawings. Color code: ORANGE for communications.

3.3 WIRING INSTALLATION

A. Do not use wire smaller than No. 12 AWG for any power or lighting circuit. Use larger sizes where indicated, as required by codes, and as follows:

30 ampere circuit:	No. 10
40 ampere circuit:	No. 8
50 ampere circuit:	No. 6
60 ampere circuit:	No. 6

1. Minimum homerun and branch circuit wiring sizes and maximum homerun conduit fill for 120 Volt, 20 ampere circuits shall be as follows:

Length	Circuit Wire Size	Home Run Wire Size	Conduit Size (9 current-carrying conds. + G)
0' to 50'	#12	#12	3/4"
51' to 100'	#12	#10	3/4"
101' to 200'	#10	#8	1" (1-1/4" for 9 #8 AWG +G)

Greater than 200' - Request Direction from Architect.
Note: Provide derating per Code when installing more than 3 current-carrying conductors in conduit.

2. Home runs and branch circuit wiring for 277 Volt, 20 ampere circuits shall be as follows:

Length	Circuit Wire Size	Home Run Wire Size	Conduit Size (9 current-carrying conds. + G)
0' to 100'	#12	#12	3/4"
101' to 200'	#10	#10	3/4"

Greater than 200' - Request Direction from Architect.
Note: Provide derating per Code when installing more than 3 current carrying conductors in conduit.

B. Do not use wire smaller than No. 14 AWG for control circuits unless otherwise recommended by the equipment or system manufacturer on wiring shop drawings, and so approved by the Architect.

C. Where greater than three (3) current-carrying conductors are installed in any one conduit or cable, conductors must be derated and sizes increased, if needed, to accommodate conductor derating as required by NEC Article 310.15(B)(2)(a) Allowable Ampacities of Insulated Conductors Rated 0-2000 volts. Do not install more than nine (9) current-carrying conductors in conduit or raceway without approval from the Engineer.

D. Where conductors in conduits supported above roofs are exposed to sunlight, apply ambient temperature ampacity adjustment factors per Table 310.15(B)(2)(c) according to distance above roof from bottom of conduit.

E. Make splices only at outlets or accessible junction boxes. Make splices No. 10 AWG and smaller with Buchanan B-Cap wire-nuts or equivalent insulated solderless twist-on connectors. Make joints, taps, and splices in wires No. 8 AWG and larger with solderless mechanical connectors enclosed in molded covers. Splices shall be UL listed for the environment.

F. When pulling conductors through conduits, care shall be taken not to exceed manufacturer's maximum tension and side wall pressures.

G. Wire shall not be installed until work which may cause injury to wiring has been completed, and conduits are cleaned and dry.

H. Conductors shall be completely installed and connected. Provide terminals, lugs, and connectors to suit the application, and in compliance with equipment manufacturers' recommendations.

I. Branch circuit wiring for lighting and other single-phase applications shall be multi-wire, utilizing common neutrals, except dimmer circuits shall have separate neutrals, and as otherwise indicated.

1. Under no circumstances shall any switch or circuit breaker break a neutral conductor.

2. The circuit numbers indicated on the drawings are intended as a guide for proper connection of circuits at panels. However, it shall be the responsibility of the Contractor to ensure that the final circuiting work fulfills the following conditions:

a. Loads on panel busses shall be phase-balanced as evenly as possible.

b. No neutral conductor shall be common to more than one circuit conductor of the same phase leg.

3. Receptacle, LED lighting, and electronic low voltage lighting (track or fixed) branch circuits shall be considered non-linear loads and shall be provided with individual dedicated 100% neutral wires. Provide individual neutral conductors, if required by lighting controls.

4. Provide multi-pole circuit breakers or single-pole circuit breakers with an identified handle tie device for multi-wire circuits.

a. Provide separate neutrals and single pole circuit breakers with common trip handle for multi-wire circuits if multi-pole arc fault or ground fault circuit breakers are not available from the approved equipment manufacturer.

J. Wire lubricant shall be used to ease the pulling of cables and conductors in conduits. The lubricant used shall be fully compatible with the wire insulation or cable jacket material.

K. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.

1. Color-code 208Y/120V system as follows:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

d. Neutral: White.
e. Ground: Green.

2. Color-code 480Y/277V system as follows:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: White with a colored stripe or gray.
   e. Ground: Green with a yellow stripe.

3.4 GROUNDING & BONDING INSTALLATION

A. Install a complete building, equipment, and system grounding and bonding network as indicated and specified, and to meet or exceed the requirements of NEC Article 250 and the local utility.

B. Grounding Electrode System

1. Install a buried and bare tinned copper #4/0 AWG grounding electrode conductor looped to [4] equally spaced ground rods located outside the building electrical service entrance, 2 inches below finished grade. Connect both ends of the looped bare tinned copper #4/0 AWG grounding electrode conductor to the grounding electrode system.
   a. Locate rods a minimum of 1-rod length from each other and at least the same distance from any other grounding electrode.
   b. Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, except as otherwise noted.
   c. Interconnect with grounding electrode system. Use exothermic welds. Make these connections without damaging copper coating or exposing steel.

2. Install a buried bare tinned copper #4/0 AWG ground ring surrounding the building perimeter, minimum 24 inches below finished grade, and connect to the grounding electrode system.

3. Bond every corner building column, and every second perimeter column between corners, to the grounding electrode system. Use #4/0 AWG bare tinned copper. Provide a 1" PVC rigid conduit sleeve through the building slab for each column grounding conductor.

4. Bond structural steel, architectural metal building cladding and interior metal piping at accessible points to the grounding electrode system. Size bonding conductors per NEC. Interior metal piping includes water, fire protection, gas including corrugated stainless-steel piping (CSST), waste, drain, vent, and pneumatic systems.

5. For new construction: include a concrete encased (Ufer) electrode located within and near the bottom of a concrete foundation or footing that is in direct contact (no vapor barrier) with the earth. Electrode shall consist of 25’ minimum of bare tinned #4/0 copper conductor bonded to reinforcing steel at four locations. Connect to the grounding electrode system.

6. Bond lightning protection to the grounding electrode system in compliance with NFPA 780.

7. Route grounding conductors along the shortest and straightest path possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

8. Minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods to make contact points closer in order of galvanic series and as follows:
   a. Use electroplated or tinned materials to assure high conductivity.
   b. Make connections with clean, bare metal at points of contact.
   c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
   d. Make aluminum-to-galvanized steel connections with tinned copper jumpers and mechanical clamps.
   e. Coat and seal connections with listed material to prevent future penetration of moisture to contact surfaces.

9. Splices and compression-type connectors: Use hydraulic compression tools for compression connectors as recommended by manufacturer of connectors. Provide embossing die code to make a visible indication of adequate compression.

10. Test wells: Provide one for each driven grounding electrode, except as otherwise indicated. Connections at test wells shall be by exothermic weld. Set top of well flush with finished grade or floor. Fill above ground rod connection with 1-inch (25 mm) maximum-size crushed stone or gravel.

11. After completion of installation, test earth ground resistance by fall-of-potential or other approved method. If test result is greater than 3 ohms, drive two (2) additional ground rods and bond to the grounding electrode system. Provide a certified report of the test methods and results, including any corrective actions taken. Do not use salt or other chemical means to reduce earth resistance, unless so directed by the Architect.

12. Ground the service entrance grounded conductor (neutral) to the grounding electrode system. Size conductors per NEC but use no smaller than #4/0 AWG.

13. Water meter piping: Provide braided-type bonding jumpers to electrically bypass water meters with clamp connectors. Where a dielectric fitting is installed, connect grounding conductor to street side of fitting. Do not install a grounding jumper across dielectric fittings.

14. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and humidifiers. Use braided-type bonding straps.

15. 480Y/277V generator systems with 4-pole transfer switches: Bond the neutral (X_0) terminal and the equipment grounding terminal of the generator. Connect generator equipment grounding conductor to the building grounding electrode system for indoor installations. Installations with 4-pole transfer switches additionally require a supplemental ground rod at the generator. Size conductors per NEC but use no smaller than #4 AWG.

C. Equipment Grounding

1. Install an insulated ground conductor, run in the raceway with the phase conductors, for each feeder serving: panelboards, lighting dimmer boards, motors, equipment, and appliances unless otherwise noted.

2. Include an insulated ground conductor in conduit runs containing sections of flexible conduit unless otherwise noted.

3. Include an insulated ground conductor in branch circuit raceways or cables unless otherwise noted.

4. Note: Addition of equipment grounding conductor to AC circuits run in metallic enclosures does not lessen the requirement for conductor enclosure continuity, since part of total ground fault current will flow through the raceway and enclosure system. Therefore, the continuity of this system shall be maintained.

5. Provide bonding bushings and bonding conductors for boxes with concentric, eccentric, or over-sized knockouts. The bonding conductor shall be sized per NEC Table 250-122 and lugged to the box.

6. Grounded service conductor (neutral) of distribution system shall be grounded at only one point: service neutral connection to the ground bus. Under no circumstances shall system neutral be grounded at any other point. As part of final inspection procedures, demonstrate purity of system neutral.

7. Bond each separately derived system transformer. Bond grounded conductor (X0) to the transformer case, to the nearest available interior metal water piping, to nearest grounded building steel, and to other metal piping in accordance with requirements of NEC Article 250. If building steel does not exist (i.e., concrete structures), the transformer shall be grounded to main service ground bus. Size conductors per NEC but use no smaller than No. 4 AWG copper unless otherwise shown on the drawings. The transformer primary feeder ground is supplemental and shall be sized for primary feeder protection. Refer to contract drawings for additional bonding requirements.

8. Metal poles supporting outdoor lighting fixtures: Ground pole to a grounding electrode in addition to a separate grounding conductor with branch circuit. Grounding connections shall be accessible from pole hand-hole.

D. Specialty Grounding

1. Provide ground connections for anti-static floor covering materials according to manufacturer’s installation instructions.

2. Isolated grounding receptacles: Provide a separate insulated equipment grounding conductor to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding bar. Terminate at the equipment grounding terminal of the applicable derived system or source, except as otherwise indicated.

3. Isolated equipment enclosure circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a listed nonmetallic raceway fitting. Install fitting where raceway enters enclosure and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding bus. Terminate at the equipment grounding terminal of the applicable derived system, except as otherwise indicated.

4. Audio Isolated Ground Test - Verify the integrity of the audio isolated ground system, as specified by the A-V Consultant, and as follows:

   a. Confirm that continuity is measured between each isolated ground receptacle/outlet neutral conductor and the grounding electrode connection at the audio isolation transformer.

b. Disconnect the neutral bonding link at each audio isolation transformer and confirm that the neutral buss is isolated from the building ground. Locate and remove connections between the neutral buss and the building ground other than the main bonding jumper. Reconnect the neutral bonding link.

c. Confirm that continuity is measured between each isolated ground receptacle/outlet ground conductor and the grounding electrode at the audio isolation transformer.

d. Disconnect the isolated ground bonding link at each audio isolation transformer and confirm that the isolated ground buss is isolated from the building ground. Locate and remove connections between the isolated ground buss and the building ground other than the main bonding jumper. Reconnect the isolated ground bonding link.

e. Confirm that each isolated ground receptacle/outlet is wired with correct polarity.

3.5 RACEWAYS & CABLE PATHWAYS FOR TELECOMMUNICATION SYSTEM

A. Refer to Division 27 Sections for additional IT Consultant's system requirements and details.

3.6 RACEWAYS & CABLE PATHWAYS FOR SECURITY SYSTEM

A. Refer to Division 28 Sections for Security Consultant's system requirements and details.

3.7 RACEWAYS & CABLE PATHWAYS FOR AUDIO-VIDEO SYSTEMS

A. Refer to Division 27 Sections for Audio-Video/Theater Consultant's system requirements and details.

3.1 MECHANICAL EQUIPMENT WIRING

A. Unless otherwise indicated or specified herein, motors, motor starters, motor controllers, variable speed/frequency drives, and associated control devices are furnished by other Divisions and installed by this Division. Coordinate installation and locations with other Division contractors.

B. Power wiring from the indicated source to the starter/controller/drive unit, and from the starter/controller/drive unit to the motor, including any local disconnect switches provided and installed by this Division, and associated lugs, terminals, and connections, is the work of this Division.

C. Verify correct voltage, phase rotation and protection for equipment prior to start-up. Correct deficiencies before energizing equipment.

D. Control circuit wiring is generally furnished and installed under other Divisions, except that any such wiring shown on Electrical drawings is work of this Division.

E. Provide 120-volt power to temperature control panels (TCP's) supplied and installed by Division 23. Coordinate power requirements and panel locations with Division 23 Temperature Controls Contractor.

F. Cooperate and coordinate with the other trades in the installation, connection, and testing of mechanical equipment. Perform work of this section in accordance with equipment manufacturers' instructions.

3.2 FIRE PUMP WIRING

A. Provide power, emergency generator starting, and supervisory alarm wiring to/from the fire pump controller and automatic transfer switch furnished and installed by the Division 21 fire protection contractor.

B. Service conductors from the utility to the fire pump normal power service shall be physically routed outside the building or encased in a minimum of 2" of concrete or brick per NEC 695.6(A).

C. Power wiring from the normal power service to the fire pump controller shall be installed using one of the following methods per NEC Article 695.6(A)(2):

1. Encased in a minimum of 2" of concrete.
2. Run with an enclosed construction dedicated to the fire pump circuit and having a minimum of a 2-hour fire resistive rating.
3. A listed electrical circuit protective system with a minimum 2-hour fire rating.

Refer to drawings for method to be used and obtain approval from engineer for any deviations.

D. Overcurrent protection for the normal power source to the fire pump shall be rated to carry the sum of the locked-rotor current of the pump motor, and any accessories on the same circuit, indefinitely.

E. Disconnect switches and overcurrent protection for both normal and emergency power sources shall be lockable in the closed position. Disconnect switches and overcurrent protection devices shall be painted red. Refer to 'Disconnect Switches' for other fire pump disconnect switch requirements.

F. Provide start signal wiring and conduit as required from the fire pump controller and automatic transfer switch to the emergency generator to start the generator in the event of a utility power failure.

G. Provide supervisory alarm wiring from the fire pump controller to the fire alarm system. Supervisory alarms to be wired are power failure alarm, phase reversal alarm, and pump running alarm.

H. Coordinate all wiring and interfaces with the Division 21 fire protection contractor. Coordinate all alarm and starting contact voltages, ratings, and types (NO/NC) with the equipment being supplied.

I. Provide six (6) conductors plus ground from the fire pump controller/starter to the pump motor for pumps utilizing wye-delta starters – coordinate with Division 21 fire protection contractor.

3.3 SUPPORTS AND HANGERS

A. Provide metal framing, supports and braces for equipment installed. Provide floor mounted or free-standing supports for equipment not mounted to concrete or block walls. Support panelboards, pull boxes and outlet boxes independently of the conduit.

B. Support single conduit runs by individual hangers.

C. Support multiple conduits runs on trapeze hangers. Do not support conduit on hangers provided for mechanical runs.

D. Provide listed raceway roof support blocks. Wooden support blocks are not acceptable.

E. Securely fasten electrical items including lighting fixtures and their supports to the building structure, unless otherwise indicated. Do not use the ceiling-support wires or ceiling grid to support raceways and cables. Provide independent support wires, secured at both ends.

F. Do not support electrical items including disconnect switches, motor controllers, variable frequency drives, or conduit from the equipment or supports of other divisions.

G. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Do not support electrical items from the equipment or supports of other divisions.

H. Hanger rods shall be threaded galvanized steel, 3/8" minimum with galvanized double nuts, securely attached to the building structure. Provide sizes, quantities, and connections to safely support imposed loads.

I. Support horizontal and vertical conduits per code and to prevent visible deflections. Conduit shall be firmly fastened within 3 feet of each outlet box, junction box, cabinet or fitting.

J. Provide galvanized steel channel or angle as required for conduit and equipment supports. Provide independent support for items weighing 100 pounds, or more, mounted on gypsum board partitions.

K. Where MC cable is installed on a wall, cabling shall be installed within 12” of the ceiling. Installing contractor shall notify engineer of record where deviation from this requirement occurs.

L. Attach and anchor to the building structure as follows:

1. To structural steel provide anchors secured to the structure with beam clamps. Refer to paragraph below for MC cable supports.

2. In formed concrete slabs provide anchors by means of cast-in-place inserts. For wood or metal deck form work, use Hilti HCI-WF (wood) or HCI-MD (metal) cast-in anchors or approved equal by Powers or Simpson. Include Evaluation Service Report (ESR) for approved equal products.

3. To existing formed concrete, provide mechanical expansion anchors seismic rated for cracked concrete where structural steel is not available. Use Hilti KWIK Bolt-TZ and KWIK HUS-EZ-I anchors or approved equal by Powers or Simpson. Include Evaluation Service Report (ESR) for approved equal products.

4. To hollow concrete masonry unit (CMU) provide mechanical expansion anchors where structural steel is not available. Use Hilti HLC sleeve anchors or approved equal by Powers or Simpson. To solid concrete masonry unit (CMU) provide mechanical expansion anchors where structural steel is not available. Use Hilti Kwik Bolt 3 expansion anchors seismic rated or approved equal by Powers or Simpson. Include Evaluation Service Report (ESR) for approved equal products.

5. Powder or gas propelled inserts are not acceptable for this project.

M. Support MC cable independent of supports for other mechanical or ceiling support systems.

1. MC cable shall be supported by dedicated galvanized steel cable hangers to avoid bundling or derating. Attach cable hangers with beam clamp, threaded rod, or screw mounts on metal or wood studs in accordance with their listing and loading capacity. Manufacturer: Arlington Industries SMC series, Caddy Erico MAC or MCS Multirun or approved equal.

2. Adjust ampacity for more than three current carrying conductors in a cable per NEC 310.15.

3. Bundling cables shall not be permitted longer than 24 inches.

4. Beam clamps shall be bolt-on C-clamp types, NOT push-on friction-hold Caddy types.

5. Do not use “drop wire” or “pencil rod” for supports. Do not use tie-wraps for attachment.

6. MC cable shall be routed in a neat and workmanlike manner, parallel, and perpendicular to walls, floors, ceilings, and structure.

7. Provide cable hangers at minimum intervals of three (3) feet. Provide additional hangers if cable sag exceeds 12 inches.

3.4 HOUSEKEEPING PADS AND RUBBER MATS

A. Provide concrete housekeeping pads under floor mounted electrical equipment.

B. Pads shall be constructed of 3,000 psi concrete.

C. Pads shall be 4 inches high, and 4 inches wider than the equipment in both directions.

D. Rubber mats shall be provided in front of switchboards. The rubber mats shall be 36" wide and 8" longer than the overall length of the equipment.

3.5 LOW VOLTAGE LIGHTING POWER SUPPLIES

A. Install according to manufacturer’s instructions.

B. Mount where indicated on plans and install in a manner that prevents transmission of vibration into the structure. Refer to Section 260548 for further information.

3.6 OCCUPANCY/VACANCY SENSORS

A. Upon completion of the installation, the system shall be adjusted by the manufacturer's factory authorized technician or the electrician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.

B. Upon completion of the system adjustment the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.

C. Submit startup documentation for record and include in O&M Manuals for all occupancy sensors that they have been wired, adjusted, and tested by the installing Contractor and/or Factory Technician.

END OF SECTION 260500

SECTION 260548
ELECTRICAL VIBRATION & NOISE CONTROL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Install electrical equipment in a manner that prevents transmission of objectionable vibration into the structure. This isolation includes, but is not limited to, resilient mounting of transformers, dimmer racks, conduit, gas/diesel generators, automatic transfer switches, inverters, motor starters, remote fluorescent fixture ballast cabinets, and variable frequency motor controllers. The vibration isolation manufacturer shall provide supervision to ensure proper application, installation, and adjustment of the isolators. Upon completion of the installation and after the system is put into operation, the manufacturer shall make a final inspection and report. The Contractor shall submit this report to the Owner's Representative, in writing, certifying the proper performance of the installation. Refer to Section 260000 for noise criteria and additional information.

1.2 SUBMITTALS

A. Submit NEMA sound power ratings for transformers, dimmer racks, UPS's, gas/diesel generators, motor starters, remote fluorescent fixture ballasts, and variable frequency motor controllers.

B. Submit shop drawings for conduit passing through isolated block-outs in structure.

C. Submit shop drawings for resilient penetration sleeve/seals field fabricated or prefabricated.

D. Submittals shall show required efficiency, designed deflection and outside diameter of springs, when pertinent, and installation guidelines.

E. Submit shop drawings for neoprene mounts clearly marked to show equipment tag and weight, mount type and size, actual isolator deflection and maximum rated load for every mount. Submittals based on static load are not acceptable.

F. Indicate materials and show designs and calculations signed and sealed by a professional engineer in the State of North Carolina.

1.3 SEISMIC RESTRAINTS

A. Seismic restraints are not required on this project.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATIONS - GENERAL

A. Electrical equipment shall be mounted in accordance with the specifications below and with the specific requirements shown in the equipment schedules. The vibration isolation manufacturer shall provide supervision to ensure proper application, installation, and adjustment of the isolators. Upon completion of the installation and after the system is put into operation, the manufacturer shall make

a final inspection and report. The Contractor shall submit this report to the Architect, in writing, certifying the proper performance of the installation.

B. The isolation manufacturer shall supply unit isolators, complete rails, where required, and shall be responsible for the selection of vibration eliminators and shall guarantee to meet the requirements of this specification.

C. Vibration isolators shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphate primed, and finish painted with rust-resistant enamel. Nuts, bolts, and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with metal etching primer and painted with rust-resistant enamel. Isolators exposed to the weather shall have steel parts hot-dipped galvanized. Nuts, bolts, and washers shall be cadmium plated. Spring components shall be cadmium plated and neoprene coated.

D. Vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

E. Isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

F. The ratio of lateral to vertical stiffness shall be not less than 0.9 nor greater than 1.5.

G. The theoretical vertical natural frequency for each support point based upon load per isolator and isolator stiffness shall not differ from the design objectives for the equipment by more than + 10%.

H. Neoprene mountings shall have a shore hardness of 40 to 65, after minimum aging of 20 days or corresponding oven-aging.

2.2 MOUNTINGS

A. Type A, Non-Seismic, Floor Mount - double deflection oil-resistant neoprene type with steel reinforced top and base. The top and bottom surfaces shall be ribbed. mountings shall have a minimum static deflection of 0.5 inch. Metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom with minimum two bottom anchor holes and top ‘CS’ cap screw with washer. Include structural steel channel rails with leveling bolts that may be rigidly connected to the equipment. Basis of design: Mason Industries Type ND and Type DNR rails or approved equal by Kinetics Noise Control, Amber Booth or Korfund.

B. Type B, Non-Seismic, Floor Pad – pad shall be one or more layers of 5/16-inch thick ribbed or waffled bridge-bearing neoprene. The pads shall be sized for loading within the manufacturer’s recommended range. Basis of design: Mason Industries Type Super W or approved equal by Kinetics Noise Control, Amber Booth or Korfund.

C. Type C, Non-Seismic, Suspension Mount – bolt isolator consisting of bridge-bearing neoprene. Basis of design: Mason Industries Type HG or approved equal by Kinetics Noise Control, Amber Booth or Korfund.

D. Flexible Connectors

1. Penetrations of sound-rated walls, floors, and ceilings in sound-critical spaces shall be specially sealed in accordance with the requirements as outlined on the drawings.

2. Provide isolation couplings with molded neoprene sleeve, bonding jumper and hot-dip galvanized finish ductile iron end fittings for rigid metal conduit and intermediate metal conduit; Appleton Type CF-1, OZ Gedney Type DX or approved equal.

2.3 ISOLATION SCHEDULE

EQUIPMENT TYPE	ISOLATION TYPE
Floor Mounted Transformers	A
Floor Mounted Dimming Panels	A
Floor Mounted Unit Power Conditioners	A
Floor Mounted UPS's & Inverters	A
Suspended Transformers	C
Diesel/Gas Generators	B
Wall Mounted Equipment *	D

* Wall mounted equipment shall include dimmer panels, transformers, and all controls/control panels with transformers, contactors, relays, fans, and/or moving parts

2.4 RESILIENT PENETRATION SLEEVE/SEAL

A. Resilient penetration sleeve/seals shall be field fabricated from a pipe or sheet metal section that is ½-inch to ¾-inch larger than the penetrating element in all directions around the element and shall form a sleeve through the construction penetrated. Refer to drawing detail. Prefabricated sleeves shall be submitted for review prior to installation.

2.5 OUTLET BOX PAD

A. Outlet box pads shall be field installed to acoustically isolate spaces. Refer to drawing details and manufacturer's instructions. Box pad manufacturer shall be Harry A. Lowry & Associates, Inc., Sun Valley, CA 818-768-4661 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 Basic Materials and Methods.

3.2 INSTALLATION

A. Install vibration isolation devices and systems in accordance with the manufacturer's instructions.

B. Floor Mounted Equipment to include:

1. 4-inch-thick concrete housekeeping pads over entire floor area of supported equipment.
2. Supporting vibration isolation devices and bases.
3. Keying with hairpins integral with the structural slab.

C. Concrete per specification Division 3 describing requirements.

D. Verify installed isolators and mounting systems permit equipment motion in all directions.

E. Adjust or provide additional resilient restraints to limit startup equipment lateral motion to 1/4-inch.

F. Prior to startup, clean out foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base or isolators.

G. No rigid connections between equipment and building structure shall be made that degrades the vibration isolation system herein specified.

H. Do not install any equipment, piping or conduit that makes rigid contact with the "building" unless permitted in this specification. "Building" includes, but is not limited to slabs, beams, columns, studs, and walls. Use flexible conduit for connections to equipment vibration isolated with springs or neoprene (transformers, dimmers, pumps, fans, chillers, boilers, etc.). Flexible conduit shall be minimum of 25% greater length than the separation between the isolated equipment and the termination of rigid conduit. Install flexible conduit to be slack and not to exceed the manufacturer's minimum recommended bending radius. For conduit sizes greater than 2” diameter, use pre-manufactured flexible conduit connectors instead of flexible conduit.

I. Use flexible conduit or a flexible conduit connector at every location where conduit crosses a building expansion or isolation joint.

J. Resiliently mount to structure conduit connected to vibration isolated electrical equipment for a distance equal to 200 conduit diameters and for any additional extent indicated on the Drawings. Wrap conduit with 1” Armaflex prior to restraining with wall-mounted clamp.

K. Provide steel sleeve, grouted rigidly in place for conduit penetrations through walls, floors, and ceilings of mechanical equipment rooms, machine rooms, electrical equipment rooms and elevator equipment rooms. Make inside dimension of sleeve ½-inch to ¾-inch greater than outside dimension of penetrating item on all sides. The sleeve shall extend 1-inch beyond the penetrated construction on each side. The penetrating element shall pass through the sleeve without contacting the sleeve. Pack annular space to full depth of penetration with intumescent fire-rated sealant to form an airtight seal. Refer to Section 260000 and drawing details.

L. Coordinate work with other trades to avoid rigid contact with the "building". Inform other trades following, such as plastering, drywall, electrical or sheet metal, to avoid any contact that would reduce the vibration isolation.

M. Bring to the Owner's Representative's attention, prior to installation, any conflicts with other trades which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the contractor's expense.

N. Correct, at no additional cost, installations that are deemed defective in workmanship or material because of project completion inspection or subsequent inspections due to owner complaints within a period of one year following acceptance.

O. Position isolators:

1. Close to building structure.
2. Between building structure and supplementary steel if required.
3. Not to contact acoustic rated walls.

P. Suspend isolators from rigid and massive support points.

Q. Adjust isolators to eliminate contact of the isolated rod with the hanger rod box retainer or short circuiting of the spring.

R. Provide outlet box pads for electrical, telecommunications, fire alarm, security boxes and the like where indicated on the drawings.

1. There shall be a separation of 24" between centerlines of outlet boxes or receptacles set into opposite sides of the wall. Conduit connecting such boxes shall be flexible and shall provide 6" slack per 24" of run.

2. In a double wall, boxes in opposite sides of the wall shall be located 24" on center, minimum. Effectively, this means that boxes on the same side of the wall will be 48" apart if there is a box between them on the other side of the wall.

3. The boxes shall be treated to reduce sound transmission. Unused knock-out holes shall be plugged with knock-out caps or spot welded closed. The openings or cutouts in the walls to receive the boxes/receptacles shall be made no more than 1/4" oversize to allow a 1/8" gap all around. The flanges shall be perimeter sealed with acoustical caulking, prior to the boxes/receptacles being inserted.

4. Outlets installed in gypsum board only partitions in noise critical spaces will require that the outlet be wrapped on five sides with an acoustical pad. The pad is a polybutadiene-butyl material with a self-adhesive backing. Adhere pads to boxes before mounting box or attaching conduit according to manufacturer’s instructions. Install plaster rings and tightly secure before completely wrapping pad around gypsum board face of box. Fill any remaining voids between gypsum board and box with non-hardening acoustical sealant.

S. General Equipment Isolation and Seismic Restraint:

1. Provide 2-inch operating clearance between concrete inertia bases and housekeeping pad and 1-inch clearance between equipment or structural bases and housekeeping pad.

2. Isolation mounting deflection (minimum) as specified or scheduled on manufacturer's certified drawings.

3. Position equipment, structural base and concrete bases on blocks or wedges at proper operating height.

4. Electrical conduit connections to isolated equipment shall be looped or installed with flexible conduit to allow free motion of isolated equipment.

5. Install equipment directly on isolation system. Support rails between the equipment and isolators should not be used.

6. Position corner or side seismic restraints with equipment operation for operating clearance and weld or bolt seismic restraint to seismic anchor plates in housekeeping pad.

3.3 SEISMIC REQUIREMENTS

A. Adequately anchor floor mounted equipment to floor slab or housekeeping pad to resist 0.5g (minimum) horizontal accelerations. Where necessary, also provide U-channel bracing to structural steel or slab above.

B. Wall mounted enclosures and equipment on stud partitions or non-reinforced block walls shall be mounted via two (2) slab-to-slab steel U-channels anchored to the wall every 24 inches O.C. and anchored to the floor and ceiling slabs.

C. Where possible, conduit, cable tray & raceway hangers shall be less than 12 inches long. Where hangers are 12 inches or more in length, and conduit size is 2-1/2 inches or more and for cable tray, provide longitudinal and transverse sway bracing. Seismic restraints spacing shall be in accordance with hanger spacing.

D. Provide sway bracing for those conduit runs containing emergency and critical power and lighting, fire alarm circuits, other life safety systems regardless of conduit size.

E. Recessed lighting fixtures shall be independently supported from the structure above unless the suspended ceiling is seismic-rated, and the fixtures are provided with earthquake clips.

END OF SECTION 260548

SECTION 26 0943
NETWORK LIGHTING CONTROLS – LUTRON QUANTUM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Digital-network lighting control system and associated components:
   1. Power panels.
   2. Lighting management hubs.
   3. Lighting management system computers.
   4. Lighting management system software.
   5. Control stations.
   6. Low-voltage control interfaces.
   7. Wired sensors.
   8. Wireless sensors.
   9. Accessories.

1.02 REFERENCE STANDARDS

A. ANSI/ESD S20.20 - Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices).
B. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments.
C. IEC 60669-2-1 - Switches for Household and Similar Fixed Electrical Installations - Part 2-1: Requirements - Electronic Switches.
D. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements.
E. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test.
F. IEC 61000-4-5 - Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test.
G. IEC 61347-2-3 - Lamp Control Gear - Part 2-3: Requirements for A.C. and/or D.C. Supplied Electronic Control Gear for Fluorescent Lamps.
H. IEEE 1789 - Recommended Practice for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.
I. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
J. ISO 9001 - Quality Management Systems-Requirements.
K. NECA 1 - Standard for Good Workmanship in Electrical Construction.
L. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association.
M. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association.
N. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.
O. NFPA 70 - National Electrical Code; National Fire Protection Association.
P. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
Q. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
R. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.
S. UL 508A - Industrial Control Panels; Underwriters Laboratories Inc.
T. UL 924 - Emergency Lighting and Power Equipment.
U. UL 935 - Fluorescent-Lamp Ballasts.
V. UL 1310 – Class 2 Power Units.

W. UL 1472 - Solid-State Dimming Controls.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct on-site meetings with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:
   1. Low voltage wiring requirements.
   2. Separation of power and low voltage/data wiring.
   3. Wire labeling.
   4. Lighting management hub locations and installation.
   5. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
   6. Control locations.
   7. Computer jack locations.
   8. Load circuit wiring.
   9. Network wiring requirements.
   10. Connections to other equipment.
   11. Installer responsibilities.
   12. Power panel locations.

1.04 SUBMITTALS

A. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.

C. Shop Drawings:
   1. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
   2. Provide detailed sequence of operations describing system functions.

D. Samples:
   1. Wall Controls:
      a. Show available color and finish selections.
      b. Provide one sample(s) for each product.
   2. Sensors: Provide one sample(s) for each product.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual installed locations and settings for lighting control system components.

G. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

H. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in Owner's name and registered with manufacturer.

I. Software: one copy of software provided under this section.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications:
   1. Company with not less than ten years of experience manufacturing lighting control systems of similar complexity to specified system.
   2. Registered to ISO 9001, including in-house engineering for product design activities.
   3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.
D. Maintenance Contractor Qualifications: Manufacturer's authorized service representative.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.
   1. System Requirements - Lutron, Unless Otherwise Indicated:
      a. Ambient Temperature:
         1) Lighting Control System Components, Except Those Listed Below: Between 32- and 104-degrees F (0 and 40 degrees C).
         2) Lighting Management System Computer: Between 50- and 90-degrees F (10 and 35 degrees C).
         3) Fluorescent Electronic Dimming Ballasts: Between 50- and 140-degrees F (10 and 60 degrees C).
      b. Relative Humidity: Less than 90 percent, non-condensing.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Include additional costs for manufacturer's Enhanced Warranty with manufacturer Start-up; Silver Enhanced Warranty; Lutron LSC-E8S; coverage to include items listed under manufacturer's standard warranty with manufacturer start-up above, plus the following upgrades:
   1. Manufacturer Lighting Control System Components, Except Lighting Management System Computer, Ballasts/Drivers, and Ballast Modules:
      a. First Two Years:
         1) As-available Field Service response; no committed response time.
      b. Additional Coverage for Years 3-5: 50 percent replacement parts coverage, no manufacturer labor coverage.
      c. Additional Coverage for Years 6-8: 25 percent replacement parts coverage, no manufacturer labor coverage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Company, Inc; www.lutron.com.

B. Other Acceptable Manufacturers:

1. ETC “Paradigm”
2. Products by listed manufacturers are subject to compliance with specified requirements and prior approval of Architect.

C. Substitutions:
1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
2. Any proposed substitutions to be reviewed by Architect at Contractor's expense.
3. By using pre-approved substitutions, Contractor accepts responsibility and associated costs for all required modifications to related equipment and wiring. Provide complete engineered shop drawings (including power wiring) with deviations from the original design highlighted in an alternate color for review and approval by Architect prior to rough-in.

D. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

A. Sensor Layout and Tuning: No Lighting Control Manufacturer Sensor Layout and Tuning service to be provided; Lutron LSC-NO-SENS-LT.
1. Contractor to utilize Lighting Control Manufacturer Installation Instructions to place/install sensors.
2. At Pre-wire and Startup, Lighting Control Manufacturer to provide a rough sensor calibration only. Sensor fine-tuning to be the responsibility of Contractor.

B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.

C. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

D. Design lighting control equipment for 10-year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.

E. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

F. Dimming and Switching (Relay) Equipment:
1. Designed so that electrolytic capacitors operate at least 36 degrees F (20 degrees C) below the capacitor's maximum temperature rating when the device is under fully loaded conditions at maximum rated temperature.
    a. Utilize load-handling thyristors (SCRs and triacs), field effect transistors (FETs) and isolated gate bipolar transistors (IGBTs) with maximum current rating at least two times the rated operating current of the dimmer/relay.
    b. Capable of withstanding repetitive inrush current of 50 times the operating current without impacting lifetime of the dimmer/relay.
2. Surge Tolerance:
    a. Panels: Designed and tested to withstand surges of 6,000 V, 3,000 amps according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance.

b. Other Power Handling Devices: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.

3. Power Failure Recovery: When power is interrupted and subsequently restored, within 3 seconds lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
4. Dimming Requirements:
   a. cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage per cycle), frequency shifts (plus or minus 2 Hz change in frequency per second), dynamic harmonics, and line noise.
      1) Systems not providing integral cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
   b. Incorporate electronic "soft start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
   c. Utilize air gap off to disconnect the load from line supply.
   d. Control all light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
   e. Load Types:
      1) Assign a load type to each dimmer that will provide a proper dimming curve for the specific light source to be controlled.
      2) Provide capability of being field configured to have load types assigned per circuit.
   f. Minimum and Maximum Light Levels: User adjustable on a circuit-by-circuit basis.
   g. Line Voltage Dimmers:
      1) Dimmers for Magnetic Low Voltage (MLV) Transformers:
         (a) Provide circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.
         (b) Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.
      2) Dimmers for Electronic Low Voltage (ELV) Transformers: Operate transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.
      3) Dimmers for Neon and Cold Cathode Transformers:
         (a) Magnetic Transformers: Listed for use with normal (low) power factor magnetic transformers.
         (b) Electronic Transformers: Must be supported by the ballast equipment manufacturer for control of specific ballasts being provided.
         (c) .
5. Switching Requirements:
   a. Rated Life of Relays: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   b. Switch load in a manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   c. Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

G. Device Finishes:
   1. Wall Controls: To be selected by Architect.
   2. Standard Colors: Comply with NEMA WD1 where applicable.
   3. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.

4. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.03 POWER PANELS

A. Provide power panels with configurations as indicated on the drawings.
B. General Requirements:
   1. Listed to UL 508 as industrial control equipment.
   2. Comply with UL 508A and IEC 60669-2-1 as applicable.
   3. Delivered and installed as a listed factory-assembled panel.
   4. Field wiring accessible from front of panel without removing dimmer assemblies or other components.
   5. Passively cooled via free-convection, unaided by fans or other means.
   6. Shipped with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.
   7. Provided with branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the drawings.
   8. Branch Circuit Breakers:
      a. Listed to UL 489 as molded case circuit breaker for use on lighting circuits.
      b. Provided with visual trip indicator.
      c. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating.
         1) 25,000 rms symmetrical amperes at 277 VACS for dimming.
      d. Thermal-magnetic construction for overload, short-circuit, and over-temperature protection. Use of breakers without thermal protection requires dimmers/relays to have integral thermal protection to prevent failures when overloaded or ambient temperature is above rating of panel.
      e. Equipped with provision for tag-out/lock-out devices to secure circuit breakers in off position when servicing loads.
      f. Replaceable without moving or replacing dimmer/relay assemblies or other panel components.
      g. Listed as switch duty (SWD) so that loads can be switched on and off by breakers.
   9. Provide panels with listed short circuit current rating.
      a. Minimum Short Circuit Current Rating (SCCR): 25,000 A
   10. Panel Processor; Lutron Circuit Selector:
      a. Provide the following capabilities:
         1) Operate circuit directly from panel processor for system diagnostics and provide feedback of system operation.
         2) Electronically assign each circuit to any zone in lighting control system.
         3) Determine normal/emergency function of panel and set emergency lighting levels.
      b. Where indicated on the drawings, panels to provide two control links. Each circuit to be capable of transferring control based on independent programming between architectural control system and theatrical controls utilizing the USITT DMX-512 1990 or ESTA DMX-512A protocol.
      c. React to changes from control within 20 milliseconds.
   11. Diagnostics and Service:
      a. Replacing dimmer/relay does not require re-programming of system or processor.
      b. Include diagnostic LEDs for dimmers/relays to verify proper operation and assist in system troubleshooting.

c. Include tiered control scheme for dealing with component failure that minimizes loss of control for occupant.
   1) If lighting control system fails, lights to remain at current level. Panel processor provides local control of lights until system is repaired.
   2) If panel processor fails, lights to remain at current level. Circuit breakers can be used to turn lights off or to full light output, allowing non-dim control of lights until panel processor is repaired.
   3) If dimmer fails, factory-installed mechanical bypass jumpers to allow each dimmer to be mechanically bypassed. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

C. Product(s):
   1. Relay Panels:
      a. Product: Lutron XP Series Switching Panels.
         1) Utilize 20 A continuous use rated switching modules; able to switch 20 A receptacles.
         2) Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
         3) Switch load in a manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
         4) Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

2.04 LIGHTING MANAGEMENT HUBS

A. Product : Lutron Quantum Light Management Hub.
B. Provided in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
C. Connects to controls and power panels via RS485.
D. Enables light management software to control and monitor compatible dimming ballasts and ballast modules, power panels, power modules, and window treatments.
   1. Utilizes Ethernet connectivity to light management computer utilizing one of the following methods:
      a. Dedicated network.
      b. Dedicated VLAN.
      c. Shared network with Building Management System (BMS).
      d. Corporate network where managed switches are configured to allow multicasting and use of IGMP.
E. Integrates control station devices, power panels, shades, preset lighting controls, and external inputs into a single customizable lighting control system with:
   1. Multiple Failsafe Mechanisms:
      a. Power failure detection via emergency lighting interface.
      b. Protection: Lights go to full on if ballast wires are shorted.
      c. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.
   2. Manual overrides.
   3. Automatic control.
   4. Central computer control and monitoring.
   5. Integration with BMS via BACnet.
F. Furnished with astronomical time clock.
G. Furnished with solar clock to track the position of the sun to control the shades to limit penetration of direct sunlight.
H. Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten years without power.

I. BACnet Integration License:
   1. Provide ability to communicate by means of native BACnet IP communication (does not require interface) to lighting control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
   2. Requires only one network connection per system.
   3. Lighting control system to be BACnet Test Laboratory (BTL) listed.
   4. Basic BACnet integration license:
      a. The BACnet integrator can command:
         1) Area light output.
         2) Area enables or disable after hours mode.
         3) Area load shed level.
         4) Area load shed enable/disable.
         5) Area shade group presets and levels.
         6) Enable/Disable:
            (a) Automated solar adaptive shade control.
            (b) Cloudy day/shadow override mode for automated shade control.
            (c) Brightness override mode for automated shade control.
            (d) Area occupancy sensors.
            (e) Area daylighting.
         7) Daylighting level.
         8) Area occupied and unoccupied level.
         9) Occupancy sensor timeouts.
      b. The BACnet integrator can monitor:
         1) Area on/off status.
         2) Area occupancy status.
         3) Area fault.
            (a) Lamp failures.
            (b) Control devices not responding.
         4) Area load shed status.
         5) Area instantaneous energy usage and maximum potential power usage.
         6) Energy savings broken out by strategy (occupancy, timeclock, daylighting, personal control, tuning, load shed) down to the individual area.
         7) Area shade group presets and levels.
         8) Cloudy day and shadow sensor status.
         9) Light levels from window mounted sensors.
         10) Enable/Disable:
            (a) Status of automated solar adaptive shade control.
            (b) Status of cloudy day/shadow override for automated shade control.
            (c) Status of brightness override for automated shade control.
            (d) Area occupancy sensors.
            (e) Daylighting.
            (f) Timeclocks.
         11) Daylighting level.
         12) Light levels from photo sensors or Radio Window sensors.
         13) Area occupied and unoccupied level.
         14) Occupancy sensor timeouts.
      c. Shade assignment and grouping to be discoverable with third party building management software.

J. Integration with other devices over Ethernet via Telnet using the Lutron Integration Protocol.

K. Control other devices over Ethernet via TCP or Telnet by sending device specific strings.

2.05 LIGHTING MANAGEMENT SYSTEM COMPUTERS

1. Product: Lutron Q-Manager.
2. System PC (Desktop/Laptop):
   a. Suitable for occasional programming, monitoring, and control of digital network lighting controls.
   b. Unless otherwise indicated, computer(s) to be provided by lighting control system manufacturer.
   c. Location(s): As directed by Owner.
   d. Minimum Hardware Requirements:
      1) Processor: Single Intel® Core® i3 processor with minimum speed of 2.4 GHz.
      2) 16 GB RAM.
      3) 250 GB hard drive (40 GB for application).
      4) One 10/100/1000 Ethernet network interface for communication with lighting management hubs.
      5) Monitor with 1280 x 1024 resolution.
      6) 4 USB 2.0 ports.
      7) Dedicated Graphics Card with 256 MB of memory.
   e. Minimum Software Requirements:
      1) Licensed installation of US English 64-bit Microsoft® Windows® 7 Professional with Service Pack 1, US English 64-bit Microsoft® Windows® 8 Professional, or US English 64-bit Microsoft® Windows® 8.1 Professional.
      2) Microsoft® Internet Information Services (IIS) 7 or later.
      3) Microsoft® Internet Explorer 9 or later.
      4) Microsoft® .NET Framework 3.5.
      5) Microsoft® .NET Framework 4.5.
3. Server:
   a. Suitable for 24 hour per day, 7 day per week programming, monitoring, control, and data logging of digital-network lighting controls.
   b. Suitable to handle client machine request in multi-computer systems.
   c. Unless otherwise indicated, computer to be provided by lighting control system manufacturer.
   d. Minimum Hardware Requirements:
      1) Processor: Quad Core Intel® Xeon®.
      2) 16 GB Ram.
      3) 250 GB hard drive (40 GB for application and database).
      4) Two 10/100/1000 Ethernet network interfaces - one for communication with lighting management hubs and one for communication with corporate intranet to allow access from system PCs and/or energy saving display terminals. Only one Ethernet network interface is required if all lighting management hubs and client PCs are on the same network.
      5) Monitor with 1280 x 1024 resolution.
      6) 4 USB 2.0 ports.
      7) Dedicated Graphics Card with 256 MB of memory (only required if running client software from the server).
   e. Minimum Software Requirements:
      1) Licensed installation of US English 64-bit Microsoft® Windows® Server 2008 R2, Windows Server 2012 R1, or Windows Server 2012 R2.
      2) Microsoft® Internet Information Services (IIS) 7 or later.
      3) Microsoft® Internet Explorer 9 or later.
      4) Microsoft® .NET Framework 3.5.
      5) Microsoft® .NET Framework 4.5.
4. Computers Provided by Lighting Control System Manufacturer: Computer software to be preinstalled and tested prior to shipping.

2.06 LIGHTING MANAGEMENT SYSTEM SOFTWARE

A. Provide system software license and hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
B. Configuration Setup Software:
   1. Product: Lutron Q-Design.
   2. Suitable to make system programming and configuration changes using a graphical floor plan view or a generic system layout.
   3. Windows-based, capable of running on either central server or a remote client over TCP/IP connection.
   4. Publish Graphical Floor Plan: Allows the user to publish new graphical floor plan files, allowing users to monitor the status of lights, occupancy of areas, and daylighting status.
   5. Back-Up Project Database: Allows the user to back up the project database that holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
   6. Publish Project Database: Allows the user to send a new project database to the server and download the new configuration to the system. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
   7. Allows end-user (with training) to:
      a. Capture system design:
         1) Geographical layout.
         2) Load schedule zoning.
         3) Shade grouping.
         4) Equipment schedule.
         5) Equipment assignment to lighting management hubs.
         6) Daylighting design.
      b. Define the configuration for the following in each area:
         1) Lighting scenes.
         2) Shade group presets.
         3) Control station devices.
         4) Interface and integration equipment.
         5) Occupancy/after hours.
         6) Partitioning.
         7) Daylighting.
         8) Emergency lighting.
         9) Night lights.
      c. Startup:
         1) Addressing.
         2) Daylighting.
         3) Provide customized conditional programming.
C. Control and Monitor Software:
   1. Product: Lutron Quantum Vue.
   2. General Requirements:
      a. Web-based; runs on most HTML5 compatible browsers (including Internet Explorer, Chrome, and Safari).
      b. Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone; optimized for displays of 1024 by 768 pixels or higher.
      c. User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
      d. Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).

e. All functionality listed below must be available via a single application.

3. System Navigation and Status Reporting:
   a. Performed using graphical floor plan view or a generic system layout.
   b. Graphical Floor Plan View: Utilizes customized CAD based drawing of the building. Pan and zoom feature allow for easy navigation; dynamically adjusts the details presented based on zoom level.
   c. Area, scene, and zone names can be changed in real time.
   d. Adjustments can be made based on area type.
4. Control of Lights:
   a. Control and monitor zone/area lights.
      1) Area lights can be monitored for on/off status.
      2) All lights in an area can be turned on/off or sent to a specific level.
      3) For areas that have been zoned, these areas may be sent to a predefined lighting scene, and individual zones may be controlled.
      4) Area lighting scenes can be renamed and modified in real-time, changing the levels that zones go to when a scene is activated.
      5) High and low end of area lighting can be tuned/trimmed.
   b. Control and monitor area partition status from a graphical floor plan.
5. Control of Shades:
   a. Area shades can be monitored for current preset or position.
   b. Area shades can be opened/closed, sent to a preset, or sent to a specific position.
6. Occupancy:
   a. Area occupancy can be monitored.
   b. Area occupancy can be disabled to override occupancy control or in case of occupancy sensor problems.
   c. Area occupancy settings including level that lights turn on to when area is occupied, and level that lights turn off to when area is unoccupied can be changed in real-time.
   d. Monitor energy savings due to occupancy down to an individual area.
7. Daylighting:
   a. Daylighting can be enabled/disabled. Can be used to override the control currently taking place in the space.
   b. Daylight calibration can be adjusted for each daylit area.
   c. Daylight status can be monitored.
   d. Monitor energy savings due to daylight harvesting down to an individual area.
8. Load Shedding; Lutron IntelliDemand: Allows the building manager to monitor whole building lighting power usage and apply a customized load shed reduction to selected areas, thereby reducing a building's power usage; load shedding triggered via Quantum Vue software or BACnet.
9. Scheduling: Schedule time of day and astronomic time clock events to automate functions.
   a. Adjust or disable a single occurrence of a repeating scheduled event.
   b. Easily monitor and adjust scheduled events using a weekly calendar view.
10. Reporting: Provide reporting capability that allows the building manager to gather real-time and historical information about the system as follows:
    a. Energy Reports: Show a comparison of cumulative energy used over a period for one or more areas. Capable of displaying:
       1) Current savings in percent and kW.
       2) Historic energy savings in kWh saved.
       3) Historical views in time periods (days, weeks, months, years).
       4) Comparisons of historical periods (days, weeks, months, years).
    b. Power Reports: Show power usage trend over a period for one or more areas.
    c. Energy Density Report: Show energy usage in W/sq ft.

d. Energy Savings by Strategy Report: Show energy savings for any area broken down by strategy (tuning, occupancy, daylighting, scheduled events, personal control, and load shedding).
e. Space Utilization/Occupancy Reports: Show historical occupancy over a period for one or more areas using a graphical floor plan, generic system layout, and/or graphs and charts.
f. Activity Report: Show what activity has taken place over a period for one or more areas. Activity includes occupant activities (e.g., wall controls being pressed), building manager operation (e.g., controlling/changing areas using the control and monitor tool), and device failures (e.g. keypads or ballasts that are not responding).

11. Diagnostics: Allows the building manager to check on the status of all equipment in the lighting control system. Devices to be listed with a reporting status of OK, missing, or unknown.
12. Alerts and Alarms: Monitors the system for designated events/triggers and automatically generates alerts according to configured response criteria.
    a. Capable of monitoring for the following events/triggers:
        1) A failed piece of equipment (e.g., ballast, control, sensor, etc.); alert cleared when equipment is replaced.
        2) Luminaires with lamp operating hours more than designated time.
        3) A load shed event; alert generated for beginning and end of trigger.
        4) Energy usage higher than designated threshold target.
        5) Potential light level condition discrepancies (daylight sensors not agreeing with expected lighting status).
        6) Potential sensor failures (Radio Window sensors that have not seen a change in light level).
    b. View alerts on a customized graphical floor plan.
    c. Capable of generating alerts through visible changes in software or through email messages.
    d. Capable of customizing the frequency of alerts and providing notifications immediately or through daily, weekly, or monthly summaries.
    e. Capable of sending different alerts to different system users.
    f. Capable of generating historical reports of all alert activity within the system.
13. Administration:
    a. Users: Allows new user accounts to be created and existing user accounts to be edited.
        1) Supports Active Directory (LDAP) tying user accounts to network accounts.
    b. Area and feature access can be restricted based on login credentials with assigned levels of access rights (Monitor, Control Only, Control and Edit, Admin) and customized access levels available.
    c. Supports up to 20 concurrent users and 10,000 user accounts.
14. Quick Controls: Create shortcuts to activate customized system-wide actions, such as updating lighting and/or shade levels.
15. Provides control/monitoring of partition status to automatically reconfigure how the space operates based on the partition's open/closed status.
16. Variables: Used for custom program of a system and/or to signal a third-party system. Any change may cause a change in the behavior of the system.
    a. View the current state of system variables across subsystems.
    b. Update the current variable state across all subsystems.
17. Device Lock/Unlock: Allows the building manager to lock control station devices to prevent building occupants from activating their programming (button presses), until they are unlocked.
    a. Keypads can be locked to help ensure occupants cannot change light and shade levels in a public space during specific events or business hours.

b. Keypads can be unlocked after events/during after-hours to allow maintenance, cleaning, security, and others to perform their tasks without needing to contact a building manager.

18. Control and Monitor for Multiple Quantum Vue and/or Vive Vue Systems
    a. Allows user to view aggregate data from multiple connected Quantum Vue and/or Vive Vue systems spanning multiple buildings through a single user account:
        1) Space utilization/occupancy.
        2) Energy usage/savings.
        3) Alerts/alarms.
    b. Allows user to view details and adjust settings for any connected Quantum Vue or Vive Vue system; supports system navigation through campuses and buildings using graphical floor plans.

D. Quantum Mobile Control and Programming Software License:
1. Allows mobile control and programming of Quantum system via an Apple iPad or Windows 10 tablets/PCs.
2. Provides users the ability to:
    a. Control and monitor area lighting scenes, zones, and shade presets.
    b. Easily identify zones and shade groups.
    c. Edit area lighting scenes, shade presets, scene fade rates, and scene delay rates.
    d. Restrict user access by area.
    e. Restrict users from ability to make changes.
3. Connects to Quantum system via:
    a. An Ethernet connection directly to the processor or through the computer (server) in the system.
        1) If connecting to a server, it must be a server with only a single instance of Quantum system software.
    b. Wi-Fi.

E. API Integration License:
1. Product: Lutron Model QSW-API; one license required per Quantum processor.
2. Support communication, without requiring interface, between lighting control system and third-party systems via RESTful API.
3. API Integration Capabilities:
    a. Discovery:
        1) Areas: Area and scene names.
        2) Zones: Zone names, minimum and maximum light levels.
        3) Shade Groups: Shade group and preset names
    b. Monitoring:
        1) Area Information:
            (a) Occupancy status.
            (b) Occupancy enabled.
            (c) Lighting zone status.
            (d) Active scene.
            (e) Instantaneous and maximum lighting power.
        2) Zone Information:
            (a) Light intensity.
            (b) Switch level.
            (c) Contact closure output status.
            (d) Correlated color temperature (where controllable).
    c. Control:
        1) Lighting Control:
            (a) Activate scene.
            (b) Set lighting zone level and correlated color temperature (where controllable).

2) Shade Group Control:
(a) Set shade group level.
(b) Activate shade group preset.

F. Mobile Application:
1. Product: Lutron Quantum Lighting Designer App.
2. Enables system tuning and control from iOS mobile device.
3. Capabilities:
a. Control lighting zones and scenes.
b. Edit lighting scenes.
c. Control shade groups and presets.
d. Edit shade presets.
e. View and edit timeclock events.

2.07 CONTROL STATIONS

A. Provide control stations with configuration as indicated or as required to control the loads as indicated.
1. Multi-Scene Wired Control:
a. General Requirements:
1) Allows control of any devices part of the lighting control system.
2) Allows for easy reprogramming without replacing unit.
3) Replacement of units does not require reprogramming.
4) Communications: Utilize RS485 wiring for low-voltage communication.
5) Engrave keypads with button, zone, and scene descriptions to be selected by Architect.
6) Software Configuration:
(a) Customizable control station device button functionality:
(1) Buttons can be programmed to perform single defined action.
(2) Buttons can be programmed to perform defined action on press and defined action on release.
(3) Buttons can be programmed using conditional logic off a state variable such as time of day or partition status.
(4) Buttons can be programmed to perform automatic sequence of defined actions.
(5) Capable of deactivating select keypads to prevent accidental changes to light levels.
(6) Buttons can be programmed for raise/lower of defined loads.
(7) Buttons can be programmed to toggle defined set of loads on/off.
7) Status LEDs:
(a) Upon button press, LEDs to immediately illuminate.
(b) LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or LEDs to turn off if the button press was not processed.
(c) Support logic that defines when LED is illuminated:
(1) Scene logic (logic is true when all zones are at defined levels).
(2) Room logic (logic is true when at least one zone is on).
(3) Pathway logic (logic is true when at least one zone is on).
(4) Last scene (logic is true when spaces are in defined scenes).
b. Wired Keypads; Lutron seeTouch QS Keypads:
1) Style: Architectural Non-Insert Style.

2) Communications: Utilize RS485 wiring for low-voltage communications link.
3) Mounting: Wallbox or low voltage mounting bracket; provide wall plates with concealed mounting hardware.
4) Button/Engraving Backlighting:
   (a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
   (b) Backlight intensity adjustable via programming software.
5) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.
6) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
7) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.

2.08 LOW-VOLTAGE CONTROL INTERFACES

A. Provide low-voltage control interfaces as indicated or as required to control the loads as indicated.
B. UL listed.
C. Contact Closure Interface:
   1. Product: Lutron Model QSE-IO.
   2. Connects to lighting management hub via RS485.
   3. The contact closure input device to accept both momentary and maintained contact closures.
   4. The contact closure output device can be configured for maintained or pulsed outputs.
   5. Contact closure can be programmed using conditional logic off of a state variable such as time of day or partition status.
D. RS232 and Ethernet Interface:
   1. Product: Lutron Model QSE-CI-NWK-E.
   2. Connects to lighting management hub via RS485.
   3. Provide ability to communicate via Ethernet or RS232 to audiovisual equipment, touchscreens, etc.
   4. Provide control of:
      a. Light scene selections.
      b. Fine-tuning of light scene levels with raise/lower.
      c. Shade group presets.
      d. Fine-tuning of shade preset levels with raise/lower.
      e. Simulate system wall station button presses and releases.
   5. Provide status monitoring of:
      a. Light scene status.
      b. Shade group status.
      c. Wall station button presses and releases.
      d. Wall station LEDs.
   6. Provide ability to send custom output strings.
E. DMX Interface:
   1. Product : Lutron Model QSE-CI-DMX.
   2. Connects to lighting management hub via RS485.
   3. Provide ability to:
      a. Map a single zone intensity to a single DMX512 lighting channel.
      b. Map a single zone intensity to three DMX512 channels for RGB/CMY color control.
      c. Map a single zone intensity to a single DMX512 integration channel.
      d. Smoothly transition from one color to another in a cross fade.

e. Automatically sequence through a variety of colors.
f. Download, program, and customize a color wheel for each unit.

F. Sensor Modules:
1. Products:
a. Sensor module with both wired and wireless inputs; Lutron Model QSM2-4W-C.
2. Connects to lighting management hub via RS485.
3. Wired Modules:
a. Provide wired inputs for:
1) Occupancy sensors.
2) Daylight sensors.
3) IR receivers for personal control.
4) Digital ballast wall stations.
4. Wireless Modules:
a. Provide wireless communication inputs for:
1) Occupancy sensors.
2) Daylight sensors.
3) Wireless controller.
b. RF Range: 30 feet (9 m) between sensor and compatible RF receiving devices.
c. RF Frequency: 434 MHz; operates in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
5. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

2.09 WIRED SENSORS

A. Wired Occupancy Sensors:
1. General Requirements:
a. Connects directly to compatible ballasts and modules without the need of a power pack or other interface.
b. Turns off or reduces lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space.
c. Accommodates all conditions of space utilization and all irregular work hours and habits.
d. Comply with UL 94.
e. Self-Adaptive Sensors: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of the space; furnished with field-adjustable controls for time delay and sensitivity to override any adaptive features.
f. Provide capability to:
1) Add additional timeout system-wide without need to make local adjustment on sensor.
2) Group multiple sensors.
g. Power Failure Memory: Settings and learned parameters to be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.
h. Furnished with all necessary mounting hardware and instructions.
i. Class 2 devices.
j. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.
k. Wall-Mounted Sensors: Provide swivel-mount base.
l. Color: White.
2. Wired Passive Infrared Sensors:
a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
b. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
c. Product(s):

1) Ceiling-Mounted Passive Infrared Sensor, 450 square feet (42 sq m); Lutron Model LOS-CIR-450-WH; or Lutron Model ULOS-CIR-450-WH (BAA-Buy American Act Compliant)>>: Coverage of 450 square feet (42 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360-degree field of view; self-adaptive.
2) Ceiling-Mounted Passive Infrared Sensor, 1500 square feet (140 sq m); << Lutron Model LOS-CIR-1500-WH; or Lutron Model ULOS-CIR-1500-WH (BAA-Buy American Act Compliant)>>: Coverage of 1500 square feet (140 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360-degree field of view; self-adaptive.

3. Wired Dual Technology Sensors:
   a. Passive Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Ultrasonic: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
   c. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
   d. Isolated Relay: Provide an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging, and other control options.
   e. Integral Photocell: Provide an integral photocell with adjustable sensitivity to prevent lights from turning on when there is sufficient natural light.
   f. Product(s), With Isolated Relay and Integral Photocell:
      1) Ceiling-Mounted Dual Technology Sensor, 500 square feet (46 sq m); Lutron Model LOS-CDT-500R-WH; or Lutron Model ULOS-CDT-500R-WH (BAA-Buy American Act Compliant)>>: Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180-degree field of view; with isolated relay and integral photocell; self-adaptive.
      2) Ceiling-Mounted Dual Technology Sensor, 1000 square feet (93 sq m); Lutron Model LOS-CDT-1000R-WH; or Lutron Model ULOS-CDT-1000R-WH (BAAA-Buy American Act Compliant)>>: Coverage of 1000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180-degree field of view; with isolated relay and integral photocell; self-adaptive.
      3) Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CDT-2000R-WH; or Lutron Model ULOS-CDT-2000R-WH (BAA-Buy American Act Compliant)>>: Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360-degree field of view; with isolated relay and integral photocell; self-adaptive.
      4) Wall-Mounted Dual Technology Sensor; << Lutron Model LOS-WDT-R-WH; or Lutron Model ULOS-WDT-R-WH (BAA-Buy American Act Compliant>>: Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110-degree field of view; with isolated relay and integral photocell; self-adaptive.

4. Daylight Control Package:
   a. Product: Lutron CES Series (Lutron CES Analog Sensor, LC8 Controller, and Power Pack).
   b. Controller:
      1) Product: Lutron Model LC8.
      2) Automatically switches a dry contact according to changes in ambient light levels.
      3) Fully adjustable separate high and low setpoints, with an adjustable dead band between set points to prevent unwanted cycling.

4) Input time delay to prevent unwanted cycling due to intermittent light level fluctuations.
5) Signal/setpoint and relay status indication.
6) Sensor calibration input.

c. Sensors:
1) Class 2, three-wire analog devices.
2) Provision for zero or offset based signal.
3) Indoor Photo Sensors; Lutron Model CES/I: With fresnel lens and 60-degree cone of response; sensor range of 0 to 750 footcandles.
4) Outdoor Photo Sensors; Lutron Model CES/O: Weatherproof, with hood over aperture to shield sensor from direct sunlight; sensor range of 0 to 750 footcandles.

B. Infrared Partition Sensors:
1. Product: Lutron Model GRX-IRPS-WH.
2. Provide contact closure based on status of the partition wall (open/close) enabling automatic linking of controls.

2.10 ACCESSORIES

A. Emergency Lighting Interface:
1. Product : Lutron Model LUT-ELI.
2. Provides total system listing to UL 924 when used with lighting control system.
3. Senses all three phases of building power.
4. Provides an output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to 100 percent intensity. Lights to return to their previous intensities when normal power is restored.
5. Accepts a contact closure input from a fire alarm control panel.

B. Provide power supplies as indicated or as required to power system devices and accessories.
1. Product(s):
a. Power supply for keypads and accessories (not for shades/window treatments), and for providing additional low voltage power to communication link; Lutron Model QSPS-DH-1-75.

2.11 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Factory Testing; Lutron Standard Factory Testing:
1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.
2. Perform full-function factory testing on 100 percent of all ballasts and LED drivers.
3. Perform factory audit burn-in of all dimming assemblies and panels at 104 degrees F (40 degrees C) at full load for two hours.
4. Perform factory burn-in of 100 percent of all ballasts at 104 degrees F (40 degrees C).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive system components.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130.
B. Install products in accordance with manufacturer's instructions.
C. Provide dedicated network between lighting management system computer and lighting management hubs.
D. Define each dimmer/relay load type, assign each load to a zone, and set control functions.
E. Sensor Locations:
    1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with Drawings.
    2. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.
F. Mount exterior daylight sensors to point due north with constant view of daylight.
G. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.
H. Automated Shade Control Sensors:
    1. Mount rooftop cloudy day sensors to point in the direction of each facade.
    2. Ensure that window shadow sensor placement provides an unobstructed view of outdoors. Do not place at a skylight or above indirect luminaires.
I. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
J. Lamp Led Lengths: Do not exceed 3 feet (0.9 m) for T4 4-pin compact and T5 BIAX lamps and 7 feet (2.1 m) for T5, T5-HO, T8 U-bend, and T8 linear fluorescent lamps.
K. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).
L. System and Network Integration Consultation; Lutron LSC-INT-VISIT: Include additional costs for Lighting Control Manufacturer to conduct meeting with facility representative and other related equipment manufacturers to discuss equipment and integration procedures.
    1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.
M. Identify system components.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Manufacturer's Startup Services; Lutron Standard Startup Services:
    1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
    2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".
    3. Wire Termination Visit; Lutron LSC-POSTWIRE-VST: Include additional costs to conduct site visit to verify system is properly wired and ready for startup.
    4. Conduct site visit upon completion of lighting control system to perform system startup and verify proper operation:
        a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under “DIGITAL-NETWORK LIGHTING CONTROL

SYSTEM – GENERAL REQUIREMENTS", authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.

b. Verify connection of power wiring and load circuits.
c. Verify connection and location of controls.
d. Energize lighting management hubs and download system data program.
e. Address devices.
f. Verify proper connection of panel links (low voltage/data) and address panel.
g. Download system panel data to dimming/switching panels.
h. Check dimming panel load types and currents and supervise removal of by-pass jumpers.
i. Verify system operation control by control.
j. Verify proper operation of manufacturer's interfacing equipment.
k. Verify proper operation of manufacturer's supplied PC and installed programs.
l. Configure initial groupings of ballast for wall controls, daylight sensors and occupancy sensors.
m. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
n. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".
o. Obtain sign-off on system functions.
p. After Hours Startup; Lutron LSC-AH-SU: Include additional costs to perform manufacturer's startup procedures outside normal working hours (Monday through Friday, 7am to 5pm).

C. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.04 ADJUSTING

A. On-Site Scene and Level Tuning; Lutron LSC-AF-VISIT: Include additional costs for Lighting Control Manufacturer to visit site to conduct meeting with Engineer; Owner's representative; Lighting Designer; to make required lighting adjustments to the system for conformance with original design intent.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
B. See Section 01 7900 - Demonstration and Training, for additional requirements.
C. Demonstration:
D. Training:
1. Include services of manufacturer's authorized Service Representative to perform on-site training of Owner's personnel on operation, adjustment, and maintenance of lighting control system as part of standard system start-up services.
a. Include training on software to be provided:

1) Configuration software used to make system programming and configuration changes.
2) Control and monitor.
3) Energy savings display software.
4) Personal web-based control software.

3.07 PROTECTION

A. Protect installed products from subsequent construction operations.

3.08 MAINTENANCE

A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
B. Software Maintenance Agreement; Lutron LSC-SMA: Include additional costs for manufacturer to provide quarterly compatibility testing results for PC-based lighting control software and new patches issued for Microsoft Operating System, Database, and Browser tools.
   1. If new Microsoft patches create a software conflict, manufacturer to provide lighting control software patches to ensure continued operation.

END OF SECTION

SECTION 262200
DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials.

B. See other Division 26 sections for requirements of switchboards, panelboards, and other electrical distribution equipment not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The design is based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturers' catalog data for dry-type transformers, including the following information:

1. Rating, temperature rise, % impedance, sound levels, efficiencies, no-load losses, and total losses.
2. Enclosure type and dimensions.
3. Tap ratings and quantities.
4. UL, ANSI, and NEMA compliance.

B. Submit short circuit, arc flash and overcurrent protection coordination study as described in Section 260000. Study shall accompany equipment submittals. Failure to include the study with the equipment submittals will cause the equipment submittals to be rejected.

PART 2 – PRODUCTS

2.1 DRY TYPE TRANSFORMERS

A. Provide ventilated, dry type transformers, 3 phase delta primary, grounded wye secondary, copper windings, U.L. listed and labeled, of the indicated KVA ratings and voltages.

B. Transformers shall comply with applicable UL, NEMA and ANSI standards for general purpose dry type transformers.

C. As indicated on drawings: Indoors - Provide ventilated, drip-proof. Outdoors - Provide ventilated, rain-tight, NEMA 250, Type 3R.

D. Transformer insulating materials shall exceed NEMA ST20 standards and shall have a 220°C component recognized insulation system.

E. Transformers shall comply with Department of Energy standard DOE 2016 Efficiency for optimum energy efficiency at 35% load. Provide 115°C rise transformers for all transformers indicated on the drawings, unless specifically otherwise noted. Efficiencies shall be tested in accord with DOE 2016 Efficiency, in minimums as follows:

	Single Phase kVA	Efficiency	Three Phase kVA	Efficiency
a.	15	97.70%	15	97.89%
b.	25	98.00%	30	98.23%
c.	37.5	98.20%	45	98.40%
d.	50	98.30%	75	98.60%
e.	75	98.50%	112.5	98.74%
f.	100	98.60%	150	98.83%
g.	167	98.70%	225	98.94%
h.	250	98.80%	300	99.02%
i.	333	98.90%	500	99.14%
j.			750	99.23%
k.			1000	99.28%

F. Transformers specifically designated on the drawings shall be Class 155 insulation minimum per UL 1561 and shall be designed for a maximum winding temperature rise of 115°C at rated load in a 40°C ambient. 115°C transformers shall comply with DOE 2016 Efficiency standard and shall be designed for low energy losses at loads greater than 50% of nameplate rating. 115°C rise transformers shall have a continuous emergency overload capability of 15%. Provide 115°C rise transformers unless otherwise noted on the drawings.

G. Where indicated on the drawings with a K-Factor rating, transformers shall be constructed, listed, and labeled to supply non-linear loads of the specified K-Factor, including a 200% secondary neutral. K-Factor transformers shall be provided with winding temperature rise of 115°C at rated load in a 40°C ambient. K-Factor transformers with winding temperature rise rated at 150°C shall not be acceptable.

H. Provide primary winding voltage taps, minimum, as follows:

1. 15 KVA and below: four 2 1/2%, two FCAN and two FCBN.
2. 30 KVA and above: six 2 1/2%, two FCAN and four FCBN.

I. Core and coil assemblies shall be mounted on vibration isolators and visibly grounded by means of a flexible grounding conductor to prevent noise transmission to case and building. There shall be no metal-to-metal contact between the core and coil and the enclosure except for the flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices shall not be acceptable. Sound levels shall be certified by the manufacturer not to exceed the following values:

1. 15 - 50 KVA < 45 dB
2. 51 - 150 KVA < 50 dB
3. 151 - 300 KVA < 55 dB
4. 301 - 500 KVA < 60 dB
5. 501 - 700 KVA < 62 dB
6. 701 - 1000 KVA < 64 dB
7. 1001 - 1500 KVA < 65 dB
8. 1501 - 2000 KVA < 66 dB

J. Units up to and including 45 KVA shall be suitable for either wall or trapeze/ceiling mounting.

K. Units up to and including 112.5 KVA shall be suitable for trapeze/ceiling mounting.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide energy saving WatchDog transformers manufactured by Square D or Energy Saver by General Electric or equivalent by one of the following:
1. Eaton Cutler-Hammer
2. Siemens Industry Inc.

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 INSTALLATION - TRANSFORMERS

A. Provide primary and secondary connections with 24" of flexible steel conduit to minimize vibration transmission to the building structure.

B. Bond grounded conductor to the transformer case, to the nearest available interior metal water piping, to nearest grounded building steel, and to other metal piping in accordance with requirements of NEC Article 250. Size conductors per NEC but use no smaller than No. 4 AWG copper.

C. For K-Factor rated transformers, connect with secondary neutral conductors rated 200% of rated secondary amperes.

D. Provide vibration & noise control and seismic restraints. [Refer to Section 260548.] Floor mounted transformers shall be directly mounted on double deflection neoprene-in-shear isolators, selected for minimum 3/8-inch static deflection and shall be Mason Industries, Inc. Type BR, and Type DNR rails or approved equivalent by Kinetics Noise Control, Amber Booth or Korfund. Trapeze mounted transformers shall be supported by hanger rod isolators with neoprene-in-shear element encased in a steel retainer housing, selected for 3/8-inch static deflection and shall be Mason Industries, Type RBA/RCA, and Type DNR rails or approved equivalent by Kinetics Noise Control, Amber Booth or Korfund.

E. Provide lockable disconnect switch as indicated and field label switch location on transformer.

F. Provide a concrete housekeeping pad, minimum 4-inches thick, for floor-mounted transformers.

3.3 FIELD QUALITY CONTROL

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Verify grounding and bonding of transformer per specifications and drawing details.

END OF SECTION 2622000

SECTION 262212
ISOLATION TRANSFORMERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials.

B. See other Division 26 sections for requirements of general-purpose transformers, panelboards, and other electrical distribution equipment not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The criteria of design and performance to produce the required operation is based on equipment of the named manufacturers. Equipment of other manufacturers may be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturer's technical product data and performance specifications for computer-grade isolation transformers and components, including the following information:

1. Ratings, including % impedance.
2. Enclosure type and dimensions.
3. Tap ratings and quantities.
4. UL, ANSI, and NEMA compliances.
5. Noise attenuation.
6. Transient voltage suppression system ratings.

B. Submit short circuit, arc flash and overcurrent protection coordination study as described in Section 260000. Study shall accompany equipment submittals. Failure to include the study with the equipment submittals will cause the equipment submittals to be rejected.

PART 2 - PRODUCTS

2.1 TRANSFORMER CONSTRUCTION

A. Provide ventilated dry-type computer-grade isolation transformers, 3 phase, delta primary, grounded wye secondary, U.L. listed and labeled, of the indicated ratings and voltages.

B. Transformers shall comply with Department of Energy standard DOE 2016 Efficiency for optimum energy efficiency at 35% load. Provide 115°C rise transformers for all transformers indicated on the drawings, unless specifically otherwise noted. Efficiencies shall be tested in accord with DOE 2016 Efficiency, in minimums as follows:

	Single Phase kVA	Efficiency	Three Phase kVA	Efficiency
a.	15	97.70%	15	97.89%
b.	25	98.00%	30	98.23%
c.	37.5	98.20%	45	98.40%
d.	50	98.30%	75	98.60%
e.	75	98.50%	112.5	98.74%
f.	100	98.60%	150	98.83%
g.	167	98.70%	225	98.94%
h.	250	98.80%	300	99.02%
i.	333	98.90%	500	99.14%
j.			750	99.23%
k.			1000	99.28%

C. Transformers specifically designated on the drawings shall be Class 155 insulation minimum per UL 1561 and shall be designed for a maximum winding temperature rise of 115°C at rated load in a 40°C ambient. 115°C transformers shall comply with DOE 2016 Efficiency standard and shall be designed for low energy losses at loads greater than 50% of nameplate rating. 115°C rise transformers shall have a continuous emergency overload capability of 15%. Provide 115°C rise transformers unless otherwise noted on the drawings.

D. Isolation transformers shall be constructed with copper windings and minimum dual electrostatic (Faraday) shielding.

E. The transformers shall be constructed, listed, and labeled to supply non-linear loads with a K-factor of K-13 minimum, including a 200% secondary neutral.

F. Provide transformers with six 2-1/2 percent primary winding taps, two above and four below nominal voltage.

G. Enclosures shall be suitable for indoor locations, either floor or platform mounting.

H. Transformers shall be convection cooled.

2.2 RATINGS

A. Common mode noise attenuation – 140 dB.

B. Transverse mode noise attenuation – 90 dB.

C. Output voltage harmonic distortion: 0.5% with linear load; 5.0% maximum for 2/3 switched mode power supply load.

D. Impedance - 3% minimum, 5.5% maximum.

E. Efficiency - 96%, minimum.

F. Audible sound, maximum at 5 feet:
15-50 kVA – 45 dBA
51-150 kVA – 50 dBA
151-225 kVA – 55 dBA

G. Magnetic field strength – less than 0.1 gauss at 1.5 feet.

H. Operating ambient conditions - 0^{o}C. to 40^{o}C, 0-95% RH (non-condensing).

2.3 TRANSIENT SUPPRESSION

A. Units shall be constructed in accordance with NEMA Standard LS 1, UL 1449 Second Edition and tested using the transient waveforms specified in ANSI/IEEE C62.41 in accordance with the procedures set forth in ANSI/IEEE C62.45.

B. Provide factory-installed input surge arresters of appropriate voltage rating, and having the following performance characteristics:

1. FOW sparkover - 3200 volts maximum.

2. Discharge voltage (8x20 microsecond waveform) - 2.2 KV maximum @ 1500 amperes.

C. Provide a factory-installed output transient suppression network of appropriate voltage rating, fused, with status indicating lights, and having the following performance characteristics:

1. Peak current handling - 40,000 amperes, minimum.
2. Energy absorption - 200 joules per phase, minimum.

2.4 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide computer-grade isolation transformers manufactured by one of the following:

1. Controlled Power – Ultra K Series 600K
2. On-Line Power – Iso-Care Plus
3. General Electric – Guard II

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 INSTALLATION - TRANSFORMERS

A. Provide primary and secondary connections with 24" of flexible steel conduit to minimize vibration transmission to the building structure.

B. Bond grounded conductor to the transformer case, to the nearest available interior metal water piping, to nearest grounded building steel, and to other metal piping in accordance with requirements of NEC Article 250. Size conductors per NEC but use no smaller than No. 4 AWG copper. Provide single-point ground per Section 260500 and as indicated on drawings.

C. Connect with secondary neutral conductors rated 200% of rated secondary amperes.

D. Provide vibration & noise control and seismic restraints. Refer to Section 260548. Floor mounted transformers shall be directly mounted on double deflection neoprene-in-shear isolators, selected for minimum 3/8-inch static deflection and shall be Mason Industries, Inc. Type BR, and Type DNR rails or approved equivalent by Kinetics Noise Control, Amber Booth or Korfund. Trapeze mounted transformers shall be supported by hanger rod isolators with neoprene-in-shear element encased in a steel retainer housing, selected for 3/8-inch static deflection and shall be Mason Industries, Type RBA/RCA, and Type DNR rails or approved equivalent by Kinetics Noise Control, Amber Booth or Korfund.

E. Provide lockable disconnect switch as indicated and field label switch location on transformer.

F. Provide a concrete housekeeping pad, minimum 4-inches thick, for floor-mounted transformers.

3.3 FIELD QUALITY CONTROL

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly and connection of components, and the testing and adjusting of transformer components and accessories.

C. Testing Agency: Owner will engage a qualified independent testing agency to perform field quality-control testing.

D. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

E. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing.

F. Test Labeling: On satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to tested component.

G. Schedule tests and provide notification at least 7 days in advance of test commencement.

H. Report: Submit a written report of observations and tests. Report defective materials and installation.

I. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.

1) Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.

2) Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3) Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.

a) Minimum Test Voltage: 1000 V, dc.

b) Minimum Insulation Resistance: 500 megohms.

c) Duration of Each Test: 10 minutes.

d) Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.

J. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

END OF SECTION 262212

SECTION 262413
SWITCHBOARDS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this Section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this Section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials and Section 262700 Electric Service.

B. See other Division 26 Sections for requirements of panelboards and other electrical distribution equipment not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The criteria of design and performance to produce the required operation is based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturers' catalog data for switchboards and components, including [modification and] construction details and device specifications.

B. Submittals: Provide dimensioned plans and elevations, including required clearances and service space, component, and device lists, and a single-line diagram showing main- and branch-bus current ratings and short-time and short-circuit ratings of switchboard, major features, and voltage rating. Include the following:
   1. Enclosure type and dimensions with details.
   2. Dimensioned floor plan and elevation views.
   3. Utility company metering provisions with indication of approval by utility company.
   4. One-line diagram showing main and feeder devices.
   5. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
   6. Description of ground fault protection system.
   7. Bus configuration, lug sizes, materials, and current ratings.
   8. Short-circuit current rating of switchboard.
   9. Details of utility fire pump tap section and other auxiliary compartments, including top/bottom pullbox sections.
   10. Installation instructions and requirements.
   11. Description of meters, metering equipment.

12. Accessories and options furnished.
13. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.

C. Submit short circuit, arc flash and overcurrent protection coordination study as described in Section 260000. Study shall accompany equipment submittals. Failure to include the study with the equipment submittals will cause the equipment submittals to be rejected.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. General Construction

1. Furnish and install a dead front, completely metal enclosed, self-supporting switchboard structure, independent of wall supports for equipment rated 1200 amperes and larger and as indicated on the drawings. Voltage and ampere ratings shall be as indicated on the drawings. Switchboards shall consist of the required number of vertical sections bolted together to form one rigid structure. The sides and rear shall be covered with removable screw-on plates. Edges of front cover panels shall be formed. Emergency switchboard circuit breakers shall be individually mounted in separate vertical switchboard sections. Enclosures shall be NEMA 1 indoor construction.

2. Equipment shall comply with the latest applicable standards of NEMA PB2, UL 891 and NEC 408. Where switchboards are used as service entrance equipment, they shall comply with NEC and UL requirements for service entrance, and a UL service entrance label shall be provided.

3. Small wiring, fuse blocks, and terminal blocks within the switchboard shall be furnished as required. Groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Fuse and terminal blocks shall be readily accessible behind front access doors or covers, insulated or isolated from power bus bars and terminations.

4. Switchboards shall be provided with adequate lifting means and shall be capable of being rolled or moved into installation position and bolted directly to the 4" high concrete housekeeping pads without the use of floor sills.

5. Furnish cable pull sections and top cable pull boxes as required, complete with cable tie down supports.

6. Switchboard components and cabling shall be front-accessible, and structures shall be rear-aligned, suitable for mounting against a wall, except that main device sections rated 2500 amperes or more shall be provided with side or rear access as recommended by the manufacturer.

7. Wiring terminals for switchboards rated less than 100,000 amperes short circuit current shall be pressure type lugs. Switchboards rated 100,000 amperes short circuit current and greater shall be provided with compression type lugs.

8. Units indicated as "Space" shall have necessary provisions including bus for future installation of a switch or breaker. Where the manufacturer's standard arrangements provide additional blank spaces, such spaces shall also have provisions for future devices.

B. Bussing

1. Bus bars shall be silver-plated copper with bolted connections at joints. The bus bars shall be of sufficient size to limit the temperature rise to UL and NEMA standards at rated ampacity. Provide full height vertical bus for distribution sections. Provide full capacity neutral bus in each switchboard. Include provisions for future bus extensions and additional switchboard sections.

2. A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. Ground bus cross-sectional area shall be minimum 25% of the main bus.

3. Hardware used on bus bars shall be high-tensile strength and plated. Terminals shall be of the anti-turn solderless type suitable for copper or aluminum cable of sizes indicated, with 75°C insulation. Provide necessary bus splice hardware for field installation at shipping splits.

C. Short-Circuit Ratings

1. Switchboards and devices shall be fully rated for the short-circuit currents indicated and shall be so labeled. Series rating of main and feeder devices will not be accepted.

D. Utility Compartments

1. Where applicable, provide suitable compartments complete with bus work and supports for the installation of utility company metering transformers.

   a. Confer with Utility company prior to submission of metering and tap compartments to ensure compliance with Utility requirements.
   b. See Section 262700 Electric Service for additional information.

E. Fire Pump Tap Compartments

1. Where applicable, provide suitable fire pump tap compartment ahead of service entrance disconnect switch complete with bus work and supports for the installation of utility company fire pump metering transformers.

F. Switchboard Sections

1. Provide separate vertical switchboard sections for normal, life-safety emergency, legally required standby, and optional standby power in switchboards fed by the emergency power system.

2. The engineer's design drawings and details show schematic locations, sizes, and number of sections for each switchboard for design planning purposes. The contractor is responsible for coordinating the number and size of switchboard sections to conform with Code, overcurrent protective device installation constraints and dimensions, tap section requirements, and project space layout requirements.

2.2 LOW-VOLTAGE PROTECTIVE DEVICES

A. Refer to Section 262800 for Low-Voltage Protective Devices for Switchboard Circuit Breaker Protective Devices and Switchboard Fusible Switch Protective Devices.

2.5 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide switchboards and components manufactured by one of the following:

1. Basis of Design: Siemens Industry Inc.
2. Eaton Cutler-Hammer
3. General Electric Company
4. Square D Company

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260000 General Provisions, Section 260500 Basic Materials and Section 262700 Electric Service.

3.2 INSTALLATION

A. Install and assemble switchboards and components in strict accordance with manufacturer's instructions.

B. Field coordinate's exact locations for bottom entry conduits, where applicable.

C. Drawings show schematic locations for switchboards with the contractor responsible for final field installation to Code standards and working clearances.

D. Clearly label the exterior of each switchboard with I.D. number from drawings, system voltage, and ampere rating of bussing and main protective device / MLO, and rating/Class of fuses on engraved nameplates. Refer to Section 260000 paragraphs under "IDENTIFICATION" for additional Switchboard Directory requirements. Provide additional labeling to the exterior of all switchboards as follows:

1. Provide and install panel specific "Arc-Flash Hazard Warning" labeling per NEC 110.16 on all panelboards meeting the requirements of NEC 110.21.B.
2. Provide "Available Fault Current" labeling per NEC 110.24 on all "Service Equipment Rated" switchboards.
3. Refer to Section 260000 paragraphs under "IDENTIFICATION" for Short Circuit, Arc Flash and Overcurrent Protection Coordination Study labeling requirements.

3.3 FIELD ACCEPTANCE TESTING

A. Testing Agency: Provide the services of a qualified independent testing agency to perform specified acceptance testing.

B. After switchboard installation and assembly, but prior to energizing, the contractor shall provide the services of factory-authorized field service technicians to inspect each assembly, perform factory-recommended tests and adjustments, and to calibrate and set solid-state trip units to suit project requirements.

C. Make insulation-resistance tests of each switchboard bus, component, and connecting supply, feeder, and control circuits.

D. Make continuity tests of each circuit.

E. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.1, 7.5 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.

F. Perform a dielectric voltage-withstand test and subject the entire switchboard for 1 minute to the application of a 60 hertz essentially sinusoidal potential of 1000 volts plus twice the rated voltage per UL 891.

G. Perform a ground fault protection test of the main device using a simulated ground fault by wrapping several turns of wire through the sensor per UL 891.

H. A signed field service report for each factory unit shall be submitted for record.

I. Adjust circuit breaker trip and ground fault settings in accordance with the approved coordination study and equipment manufacturer's recommendations.

J. Performance test the ground fault system in accordance with the requirements of NEC 230-95c.

K. Infrared Scanning: After Substantial Completion, but not more than two months after Final Acceptance, perform an infrared scan of new switchboards. Make bus joints and connections accessible to a portable scanner and perform scanning during a period of normal working load as advised by Owner.

1. Follow-up Infrared Scanning: Perform one additional follow-up infrared scan at same locations as before, 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for scanning device used for electrical distribution equipment.
3. Record of Infrared Scanning: Prepare a certified report identifying all connections checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262413

SECTION 262700
ELECTRIC SERVICE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this section in accordance with the requirements of Section 260000 General Provisions and section 260500 Basic Materials.

B. See other Division 26 sections for requirements of electric service distribution equipment not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The criteria of design and performance to produce the required operation is based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturers' catalog data for the following service equipment:

1. Meter sockets.

B. Submit shop drawings for the following fabricated service equipment:

1. CT/PT cabinets, including bus work and mounting hardware.

1.5 UTILITY FEES

A. Provide work, materials, and fees required and/or charged by the Electric Utility Company relating to the establishment of electric service for the project.

PART 2 - PRODUCTS

2.1 METER SOCKETS

A. Provide meter sockets, which comply with requirements of the local utility company.

B. Confer with Utility company prior to purchase and submission of metering and tap compartments to ensure compliance with Utility requirements.

2.2 CT/PT CABINETS

A. Provide CT/PT cabinets and mounting hardware, which comply with requirements of the local utility company. Unless otherwise indicated, CT's and PTs for revenue metering will be furnished by the utility company.

B. Where so indicated, CT/PT cabinets shall be an integral component of the electric service distribution equipment.

C. [Provide main circuit breaker and current transformer service entrance equipment as indicated on the drawings. Include hot or cold sequence metering, top or bottom feed, indoor or outdoor construction as shown. Manufacturers: Square D CTC Metering Equipment, Siemens BCT Service Cubicle or approved equal by Eaton Cutler-Hammer.]

2.3 TRANSFORMER VAULT/PAD

A. Provide precast or cast in place concrete transformer vault/pad for utility distribution transformer in accordance with utility specifications.

B. Precast transformer vault/pads shall meet utility requirements, size: 76" x 70" x 36" deep, suitable for 500-2500 kVA transformers.

C. Provide minimum of two (2) ground rods and #4/0 bare tinned copper ground loop placed 12-inches below undisturbed earth and 12-inches from pad perimeter and bonded to the transformer per utility.

D. Conduit orientation: Facing the conduit opening on the top section of the pad, primary conduits shall be on the left side and secondary conduits shall be on the right side. Primary conduits shall have a 90-degree sweep up inside the pad.

E. Protection: Where subject to vehicular damage, provide 4-inch vertical steel pipes filled with concrete and locate one at each corner of the concrete pad or as required by Utility. Minimum height above grade shall be 60-inches, minimum depth below grade shall be 40-inches. Deliver the transformer after protection is installed.

2.4 MISCELLANEOUS MATERIALS

A. Provide painted plywood backboard, conduit, wire, and any other miscellaneous materials and hardware required by the utility company.

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 COORDINATION WITH ELECTRIC UTILITY COMPANY

A. Consult with the electric utility company for verification of scope of work to be performed. Perform work pertaining to the electric service in strict accordance with utility company standards and requirements. Verify service voltage, phasing, and connections. In event of conflict between design and/or scope of service, notify Architect in writing.

3.3 INSTALLATION OF SERVICE-ENTRANCE EQUIPMENT

A. Where applicable, receive utility company equipment at the property line, transport to indicated installation location, install, and connect per utility company instructions.

B. Set field-adjustable GFP devices, where applicable, for pickup and time-current sensitivity ranges as indicated or directed by the Architect.

C. Identify service disconnecting means per NEC 230-70(b) and 230-77.

D. Bond and ground service entrance equipment in accordance with codes, utility company requirements, as indicated, and as specified in another Division 26 section.

3.4 FINAL INSPECTION

A. Upon completion of installation and testing of service-entrance equipment and electrical circuitry, arrange for final inspection by the utility company and local authorities, energize circuitry, and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

END OF SECTION 262700

SECTION 262800
LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and as required by job conditions.

1.2 REFERENCES

A. Perform the work of this section in accordance with the requirements of Section 260000 General Provisions, Section 260500 Basic Materials, Section 262413 Switchboards and Section 262416 Panelboards.

B. See other Division 26 sections for requirements of specific electrical equipment and systems not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The criteria of design and performance to produce the required operation are based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturers' catalog data for the following basic materials:

1. Fuses
2. Safety disconnects switches.
3. Enclosed circuit breakers
4. Circuit breaker protective devices
5. Fusible switch protective devices

PART 2 - PRODUCTS

2.1 FUSES

A. Where low voltage fusing is indicated, and unless otherwise specified, provide as follows:

1. Motor and transformer branch circuits 0 - 600 amperes: Class RK5; Bussmann Fusetron, Type FRN-R (250 volt) or FRS-R (600 volt), time delay, 200 kA, or approved equal by Mersen Ferraz Shawmut.

2. Motor and transformer branch circuits 601 - 6000 amperes: Class L; Bussmann Low-Peak, Type KRP-C, 600-volt, time delay, 200 kA, or approved equal by Mersen Ferraz Shawmut.

3. Non-motor branch circuits 0 - 600 amperes: Class J; Bussmann Low-Peak Type LPJ, 600-volt, dual element, time-delay, 200 kA, or approved equal by Mersen Ferraz Shawmut.

B. Fuses shall be of the same manufacturer. Provide three (3) spare fuses of each type and size installed, in manufacturer's original packaging.

2.2 SAFETY & DISCONNECT SWITCHES

A. Provide safety and disconnect switches as shown and required to comply with requirements of codes and enforcing agencies. Refer to Divisions 14, 21. 22 and 23 for additional information and requirements. Provide equipment by the same manufacturer as the service equipment.

1. Ampere ratings, voltage ratings, fusing and poles shall be as indicated or required. Provide non-fused type unless otherwise noted.

2. Safety switches shall have provision for padlocking in "off" position.

3. Safety switches shall have a listed interrupting capacity of no less than the interrupting capacity of the installed fuses, where applicable, and minimum of 100,000 amperes, unless otherwise noted.

B. Safety switches indicated by symbol of box with slash on drawings, for two and three-pole loads greater than 1/2 horsepower, shall be heavy duty NEMA Type HD complying with NEMA KS 1 with quick-make/quick-break blades, rejection fuse holders, and equipment grounding kit.

C. Safety switch enclosures shall have hinged door with interlock to prevent unauthorized door opening when switch is in "on" position or closing of switch with door open. Enclosures shall be:

1. NEMA Type 1 (interior dry locations)
2. NEMA Type 3R (outdoor locations)
3. NEMA Type 4 (wet or damp indoor locations)
4. NEMA Type 4X stainless steel (kitchen areas)
5. NEMA Type 7C (hazardous locations).

D. Safety switches rated 1200 amperes and larger shall be bolted-pressure or high-pressure-contact type as shown on drawings, 100% rated, per UL 977.

E. Disconnect switches indicated by symbol S_M on drawings, for single-phase, one or two-pole loads, 1/2 horsepower and less, shall be toggle-type, AC manual motor-rated disconnect/starting switches. Switches shall be U.L. 60947-4-1 Listed.

1. Switches shall be two-pole, rated 30 amperes at 600 VAC. Provide manufacturer’s standard NEMA 1 enclosure where indoors and NEMA 3R enclosure where outdoors. Provide enclosures for each type unless otherwise noted. Leviton N1302-DS NEMA 1 switch with metal enclosure; Leviton N3302-DS NEMA 3R switch with metal enclosure or approved equal.

F. Provide accessory dry contacts in disconnect switches:

1. For motors controlled by an electronic variable frequency drive unit. Provide interlock wiring from auxiliary contacts to drive "Run-Permit" circuit to prevent drive from attempting to start motor with remote disconnect open.

G. Mounts disconnect switches 4'-6" above finished floor to center of operating handle.

H. Identify the source supplying each circuit disconnecting means as required by NEC Section 110.22.

I. Fire pumps disconnect switches: Disconnect switches shall be lockable in the on and off positions with 2 sets of normally open and normally closed Form C contacts rated 4 amperes @ 30 volts DC. Provide connections for switch open or tripped to signal a trouble alarm at the fire alarm control panel and to interrupt the fire pump ATS emergency generator start circuit and provide a status signal to the Building Management/Automation System (BMS/BAS). Switches shall be service entrance rated where required by Code.

J. Fire alarm control panel disconnect switches: Shall be lockable in the on and off positions with red color identification.

2.3 CIRCUIT BREAKER PROTECTIVE DEVICES

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics for frame sizes between 100 – 1200 amperes.

B. Protective devices shall be insulated case, fixed mounted, for sizes above 1200 ampere frame size unless otherwise indicated.

C. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.

D. Provide enclosed circuit breakers where indicated on plans and as specified below with handle locking devices and padlocking hasps, mounted in enclosures as follows:

1. NEMA Type 1 (interior dry locations)
2. NEMA Type 3R (outdoor locations)
3. NEMA Type 4 (wet or damp indoor locations)
4. NEMA Type 4X stainless steel (kitchen areas)
5. NEMA Type 7C (hazardous locations).

E. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

F. Provide Ground-Fault Protection of Equipment type circuit breakers where required.

G. Circuit breakers for HVAC and refrigeration unit equipment shall be listed by UL as Type HCAR.

H. Circuit breakers 15 to 100 ampere frame shall be provided with fixed thermal-magnetic trip units.

I. Circuit breakers shall be full-size type: Half-size, twin or tandem breakers are not acceptable.

J. One and two pole circuit breakers for lighting circuits shall be labeled for switching duty (SWD) and (HID), if used for switching high intensity discharge lighting.

K. Circuit breakers 225 ampere frame and above shall be provided with field-changeable, field-adjustable thermal-magnetic trip units with inverse time-current characteristics. Trip mechanisms shall include instantaneous, long time, and short time.

L. Molded case circuit breakers 400 ampere frame through 1200 ampere frame shall be provided with microprocessor-based RMS sensing trip units and displays with features noted below. For emergency and standby distribution, provide electronic trip units as necessary to achieve selective coordination in accordance with the equipment manufacturer's short circuit study and NEC Articles 700 and 701.

1. Adjustable long-time pickup and delay.
2. Adjustable short-time pickup and delay.
3. Adjustable instantaneous pickup (up to 10X).
4. Trip target for each function.
5. Adjustable ground-fault pickup and delay (up to 1200 amperes pickup & 1 sec delay maximum) where indicated.
6. Arc-flash reduction maintenance mode.

M. Insulated case circuit breakers above 1200 ampere frame shall be provided with microprocessor-based RMS sensing trip units and displays with features noted below. For emergency and standby distribution, provide electronic trip units as necessary to achieve selective coordination in accordance with the equipment manufacturer's short circuit study and NEC Articles 700 and 701.

1. Adjustable long-time pickup and delay.
2. Adjustable short-time pickup and delay.
3. Adjustable instantaneous pickup (up to 10X).
4. Trip target for each function.
5. Voltage on each phase.
6. Instantaneous current on each phase.
7. Kilowatt hours & kilowatt demand.
8. Instantaneous kVA & kVA demand.
9. Power factor.
10. Harmonic distortion.
11. Adjustable ground-fault pickup and delay (up to 1200 amperes pickup & 1 sec delay maximum) where indicated.
12. Cause of trip indicator target.
13. Arc-flash reduction maintenance mode.

N. Provide 100% rated UL 489 compliant circuit breakers where indicated for application at 100% of the breaker's continuous current rating. Circuit breaker shall be marked: "Suitable for continuous operation at 100 percent of rating".

O. Provide circuit breakers with handle locking devices and padlocking hasps where indicated.

P. Accessories

1. Where so indicated, provide circuit breakers with accessories indicated below and on drawings. If required, provide a switchboard-mounted portable power pack for each switchboard to power the trip unit to set or adjust trip set points when the breaker is not powered.

    a. Shunt Trip Device
    b. Undervoltage Trip Device
    c. Current Sensing Phase Failure Relay Trip Device
    d. Auxiliary Contacts. Contacts on an auxiliary switch; operation is designated "a" if open when the main circuit breaker contacts are open and "b" if closed when the main circuit breaker contacts are closed.

e. Alarm Switch. Alarm switch shall operate upon the tripping of the circuit breaker. Contacts on an auxiliary switch; operation is designated “a” if open when the main circuit breaker contacts are open and “b” if closed when the main circuit breaker contacts are closed.
f. Auxiliary Switch. Switch shall be interlocked with the main circuit breaker contacts.
g. Electrical Operator.

H. Subject to compliance with requirements, provide circuit breakers manufactured by one of the following:

1. Basis of Design: Siemens USA
2. Eaton Cutler-Hammer
3. Schneider Electric / Square D Company
4. ABB / General Electric

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260000 General Provisions and Section 260500 Basic Materials.

3.2 INSTALLATION

A. Install in accordance with Section 260000 General Provisions and Section 260500 Basic Materials.

END OF SECTION 262800

SECTION 263200
EMERGENCY POWER SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this Section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials.

B. See other Division 26 Sections for requirements of emergency system panelboards and other electrical distribution equipment not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The criteria of design and performance to produce the required operation is based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturers' project-specific technical data for emergency power system equipment and components, including construction details, engine, and alternator performance specifications, and mounting and installation instructions.

B. Submit project-specific shop drawings including the following:

1. Factory dimensioned layout and arrangement drawings. Typical catalog cuts are not acceptable.

2. Complete wiring diagrams for system components.

3. Complete rigging diagrams and assembly procedures for the generator and generator enclosure

C. Submit a listing and report of factory tests performed.

D. Submit certified field test report upon completion of work.

E. Submit complete operating and maintenance manual.

F. Submittals shall be tabbed and indexed for easy reference and location of submitted components (i.e., generator, radiator, silencer, fuel system, enclosure, load bank, etc.).

G. Submit short circuit, arc flash and overcurrent protection coordination study as described in Section 260000. Study shall accompany equipment submittals. Failure to include the study with the equipment submittals will cause the equipment submittals to be rejected.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide a complete integrated emergency power system including, but not limited to, engine-generator set(s), automatic transfer switch(es), fuel system, exhaust system, sound-attenuated weather protected enclosure, remote annunciation, and power distribution, as indicated, and herein specified. The system shall provide specified voltage, power and frequency to the designated circuits and loads within 10 seconds of loss of utility power.

B. The emergency power system shall be following the following codes and standards:

1. NEC Compliance: Comply with applicable requirements of NEC Articles 700 (Emergency Systems), 701 (Legally Required Standby Systems), and 702 (Optional Standby Systems) pertaining to emergency and standby systems.

2. NFPA Compliance: Comply with applicable requirements of NFPA 37, "Stationary Combustion Engines and Gas Turbines", and NFPA 110 "Emergency and Standby Power Systems" (Level 1).

3. UL Compliance: Provide standby power generator system and enclosure components that are listed and labeled to UL 2200 standard.

4. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1 "Motors and Generators", and MG 2 "Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators".

C. The system manufacturer shall have a factory-authorized parts and service facility within a reasonable distance of the jobsite.

2.2 ENGINE-GENERATOR SET

A. The engine-generator set shall be nominally rated as indicated on the drawings. The kW rating shall be at 0.8 power factor, 122°F/50°C ambient air temperature, for standby operation for the duration of any utility power outage. Motor-starting capability shall be minimum 250 kVA at 90% sustained voltage with a maximum 15% voltage dip for fire pump. The manufacturer shall provide oversized components as may be necessary to meet this requirement.

B. Engine

1. The engine shall be an 1800 rpm water-cooled compression ignition diesel. Engine shall meet specifications when operating on No. 2 (Grade DF-2) domestic burner oil. Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil coolers, fuel transfer pump, fuel priming pump, and gear driven water pump. The engine shall be Cummins Model C200D6D. The engine shall be configured for low exhaust emissions and comply with Tier 3 (less than 500 kW) Tier 2 (500 kW and larger) per EPA guidelines.

2. The engine governor shall be isochronous electronic type and shall maintain frequency regulation not to exceed 0.25% (0.15 Hertz) from no load to full rated load.

3. The unit shall be mounted on a structural steel sub-base and shall be provided with adjustable spring-type vibration isolators. Provide anchor bolts of hot dipped galvanized steel, of the types and sizes recommended by the manufacturer.

4. Provide safety shut offs for high water temperature, low water level, low oil pressure, overspeed and engine overcrank.

5. Provide a thermostat-controlled thermal circulation type jacket water heater to maintain engine jacket water at 90°F in an ambient temperature of 0°F, minimum 750-watt, 120 volts.

6. Provide a crankcase emission control system that shall remove a minimum of 99% of crankcase emissions including NOX, hydrocarbon, and oil.

7. An engine-mounted radiator with blower type fan shall be sized to maintain rated operation at 122°F/ 50°C maximum outside air temperature. The radiator shall be stacked core design. The aftercooler circuit shall be rated at 140°F. The engine cooling system shall be filled with an anti-freeze solution of 50/50 ethylene glycol/ water mixture. Rotating parts shall be guarded against accidental contact per OSHA requirements.

C. Starting System

1. Provide engine-generator unit with a 12- or 24-volt (manufacturer's standard) DC electric starting motor with positive engagement drive capable of three complete cranking cycles without overheating.

2. Provide a non-gassing lead calcium recombination type engine starting battery set [of the heavy-duty diesel type] to avoid requirements for ventilation. The battery set shall be of sufficient capacity to provide for one- and one-half minutes total cranking time without recharging. Include a corrosion-resistant battery rack, [battery electric heating,] and necessary cables and clamps.

3. Engine mounted battery charging alternator shall be 45 amperes minimum with solid-state voltage regulator.

4. Provide a current limiting battery charger located at the generator to automatically recharge batteries and to maintain at full charge. Charger shall float at 2.20 volts per cell and equalize at 2.40 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressors, DC voltmeter, DC ammeter, and fused AC input. AC input voltage shall be 120 volts. Amperage output shall be no less than 10 amperes. Provide Stored Energy Systems Model NRG or approved equal.

D. Exhaust System

1. Provide an internally mounted critical grade exhaust silencer, including rain cap along with appropriately sized piping to the engine exhaust manifold. Final connection to the manifold shall be flexible stainless steel for vibration isolation. The silencer and piping shall be of high temperature and corrosion-resistant (aluminized shell & heads) construction. Manufacturer: GT Exhaust Systems, Inc.; Model 201-7100 Extreme Application series or approved equal.

E. Generator (Alternator)

1. The generator shall be a three-phase, wye-connected, grounded neutral, 60 Hertz, single bearing, four pole, synchronous type, 105°C temperature rise at 220 kW / 275 kVA standby output, 480Y/277 volts with brushless exciter and shall be built to NEMA Standards. 125°C or 150°C temperature rise is not acceptable. Shunt excitation is not acceptable. Class H insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy dipped and baked impregnation. Stator shall be skewed with 2/3 pitch windings to minimize field heating and voltage harmonic effects. Generator shall be Onan Frame Size: UCD3J/ADS212 or approved equal.

2. A generator mounted solid-state voltage regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be +/- 2% from no load to full rated load. Readily accessible voltage droop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of +/- 5%. One-step application of 100% rated load shall result in a voltage drop of no greater than 15% of rated, and recovery to steady state shall be within 5 seconds. Generator output voltage distortion shall be less than 5% total harmonic distortion (THD) line-to-line and line-to-neutral when supplying full rated linear load with no greater than 3% individual harmonic content. To limit voltage distortion for non-linear load current harmonics, the generator per unit sub-transient reactance shall not exceed 0.11 at generator temperature rise rating under full load.

    a. The manufacturer shall review the generator application, and the indicated loads served, to determine what level of filtering or derating, if any, is recommended or required for satisfactory regulator and generator performance. Provide equipment accordingly.

    b. Provide alternator anti-condensation heater, thermostatically controlled, 100-watt, 120 volts.

3. Connection to the engine flywheel shall be via a semi-flexible disc coupling.

4. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase faults at approximately 300% of rated current for more than 10 seconds.

5. Provide separate unit mounted, three-pole, molded-case circuit breakers for life safety, fire pump and stand-by loads at the generator output terminals in NEMA 1 enclosure(s) to protect the generator and the generator supply conductors against overload as indicated on the drawings. Circuit breakers shall have field-adjustable electronic trip units (LSI)[LSIG], with field-interchangeable rating plugs within frame size to enable emergency system coordination with downstream devices. Refer to Section 260500 for additional circuit breaker requirements. Each circuit breaker shall have a trip rating as indicated on the drawings with ground fault alarm indication interlocked to the remote annunciator. The circuit breaker for fire pump emergency operation shall include (2) two Form C contacts to signal the fire alarm control panel and prevent generator startup if the circuit breaker is open per NFPA 20 and 70.

6. Provide service entrance rated disconnect switch(es) as indicated on the drawings with overcurrent protection properly sized and set to provide overload protection for the generator and fire pump supply conductors. Each switch shall have a trip rating as indicated with ground fault alarm indication interlocked to the remote annunciator. The circuit breaker for fire pump emergency operation shall include (2) two Form C contacts to signal the fire alarm control panel and prevent generator startup if the circuit breaker is open per NFPA 20 and 70.

7. Provide (2) sets of ear protection to reduce noise levels to 20 db for the person wearing the headsets. Provide rack to hang heads sets by entry door.

F. Engine-Generator Set Control:

1. The generator set shall be provided with a microprocessor-based control system, which is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. Provide PowerCommand 2100 digital generator set control with InPower and PowerCommand for Windows software or approved equal.

2. The control hall be mounted on the generator set. The control shall be vibration isolated, and prototype tested to verify the durability of components in the system under the vibration conditions encountered.

3. The control shall be UL508 labeled, CSA282-M1989 certified, and meet IEC8528 part 4. Switches, lamps, and meters shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate more than 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions. The entire control shall be tested and meet the requirements of IEEE587 for voltage surge resistance.

4. The generator set mounted control shall include the following features and functions:

a. Three position control switch labeled RUN/OFF/AUTO: In the RUN position the generator set shall automatically start and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

b. Red "mushroom-head" push-button EMERGENCY STOP switch: Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.

c. Push-button RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

d. Push-button PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

e. Generator Set AC Output Metering: The generator set shall be provided with digital and analog metering set including the following features and functions:

1) 2.5-inch, 90-degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (kW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and kW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings more than 100%: red.

2) Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output kW, kW-hours, and power factor.

Generator output voltage shall be available in line-to-line and line-to-neutral voltages and shall display three phase voltages (line to neutral or line to line) simultaneously.

f. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel (in addition, provide items designated (*) to signal at remote annunciator):

pre-low oil pressure (alarm)*
low oil pressure (shutdown) *
oil pressure sender failure (alarm)
low coolant temperature (alarm)*
pre-high coolant temperature (alarm)*
high coolant temperature (shutdown)*
engine temperature sender failure (alarm)
low coolant level (alarm or shutdown--selectable) *
fail to crank (shutdown)
overcrank (shutdown) *
overspeed (shutdown) *
low DC (battery) voltage (alarm)*
high DC (battery) voltage (alarm)*
normal DC (battery) voltage*
weak battery (alarm)*
battery charger malfunction*
low fuel-daytank (alarm or shutdown--selectable) *
high AC voltage (shutdown)
low AC voltage (shutdown)
under frequency (shutdown)
over current (warning)
over current (shutdown)
short circuit (shutdown)
[ground fault (alarm)]
overload (alarm)
emergency stop (shutdown)
generator running*
normal utility power*
EPS supplying load*
Not in auto*
Fault* (owner selected condition)

a. In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

b. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:

c.

engine oil pressure (psi or kPA)
engine coolant temperature (degrees F or C; Both left and right bank temperature shall be indicated on V-block engines.)
engine oil temperature (degrees F or C)
engine speed (rpm)
number of hours of operation (hours)
number of starts attempts.
battery voltage (DC volts)

g. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

h. Control Functions: The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.

i. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

j. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.

k. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

l. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which can discriminate between failed sender or wiring components, and an actual failure condition.

m. Alternator Control Functions: The generator set shall include an automatic voltage regulation system that is matched, and prototype tested with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level. The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.

n. Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.

o. Controls shall be provided to monitor the kW load on the generator set and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.

p. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

q. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

r. Provide a battery monitoring system to load test the batteries each time the engine is started. Test failure shall alarm when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.

s. When required by National Electrical Code or indicated on project drawings, the control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps and include adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set and provide relay which will function correctly in system as installed. Provide a remote annunciator for ground fault conditions. The alarm shall provide a visual and audible alarm in the event of a ground fault more than the setting of the ground fault sensor of the generator circuit breaker(s).

t. Control Interfaces for Remote Monitoring - Control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

1) Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.

2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.

3) A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.

4) A fused 20-amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit continuously from the engine starting/control batteries.

5) Serial interface communication port to allow the control to communicate with a personal computer running InPower software.

6) Echelon LonWorks interface.

7) Input/output expansion module – provides up to 16 configurable Form-C relays, 12 configurable discrete inputs and 8 analog inputs.

8) Digital output relay module – provides (3) relays, each with 2 normally open and 2 normally closed contacts rated 10A at 600 VACS, 5A at 24 VDC. Relay functions are configurable.

G. Remote Annunciator

1. Provide a remote alarm annunciator, (18) light minimum (refer to 2.02-F-4-f), in a surface-mounted NEMA 1 enclosure containing indicating lights/LED's for low oil pressure, high water temperature, overspeed, overcrank, low battery, low fuel level, fuel tank leak, other indications for NFPA 110, Table 3-5.5.2 (d) Level 1 (refer to generator control panel requirements), and an alarm horn with silencing pushbutton and light.

2. Remote annunciator shall be powered by the genset storage battery.

3. The remote annunciator shall have provisions to signal a common emergency power system alarm to the building security system. (See other Division 26 section for security system requirements).

H. Shutdown Switch

1. Provide a breakglass-type remote manual shutdown switch per NFPA 110, 5.6.5.6. Switch shall be located externally mounted to the outdoor generator enclosure, weatherproof type.

I. Sound Attenuated Weather Protected Enclosure

1. Provide corrosion-resistant, sound attenuated weather protected enclosure for engine-generator set made of aluminum. Enclosure shall be sized for the engine-generator set and local auxiliaries (batteries, charger, day tank/sub-base tank, and as specified and indicated). The enclosure shall be provided with necessary louvers, louver operators, maintenance access doors and heaters.

2. Enclosures shall be Cummins Quiet Site Stage II or approved equal with measured sound pressure level performance as follows: average 73 dBA, maximum 74 dBA measured at 7 meters.

J. Acceptable Generator Manufacturers

1. Subject to compliance with requirements, provide Cummins/Onan diesel engine-generator set Model C200D6D Series (or approved equal as manufactured by one of the following:
   a. Kohler
   b. Generac

2.3 FUEL SYSTEM & SUB-BASE TANK

A. Provide UL 142 listed sub-base tank and packaged fuel transfer system, size as hereinafter specified, complete with required connections and hardware.

B. The tank and all associated components shall be suitable for the application. Tanks with limitations on lengths of fill and/or vent piping shall not be permitted. Tanks shall have pressure ratings to comply with Code and local laws.

C. The tank shall be constructed of heavy gauge steel, have a removable gasketed inspection plate 6" square, fuel level gauge, and fuel inlet strainer. Tank construction shall be double wall, with automatic interstitial leak detection and alarm.

D. The interior of the tank shall be epoxy coated and the exterior shall be rust-proofed and painted to match the color of the generator set.

E. Plumbing and wiring between the sub-base tank and the generator set shall be factory-installed.

F. Sub-base storage tank shall be sized for minimum 24hour full load capacity, minimum 366 gallon (1354 liter), and be provided with appropriately sized and completely piped fill, drain, overflow and vent assemblies. Fuel system shall include auxiliary hand pump, integral dual fuel transfer pumps, motors, starters, automatic level controls, solenoid valve(s) and alarms for trouble, leak, low and high fuel. Each pump and motor shall be appropriately sized by the manufacturer for the required GPM and lift. For outdoor units: The fuel transfer pump shall be mounted on the sub-base storage tank within the weatherproof generator enclosure. Each alarm shall indicate at the remote annunciator and signal a fault to the security system and Building Management/Automation System (BMS). Provide “Reset” switch to extinguish and clear alarms until next event. Provide piping between the sub-base tank and the main storage tank as specified under Division 23.

G. Provide the following dry contact outputs to the fuel oil pumping control system furnished by Division 23: Low fuel level (at 40% tank capacity), turn lead pump on (at 50% tank capacity), turn lead pump off (at 80% tank capacity), high fuel level (at 90% tank capacity), and leak detection in rupture basin. Provide total of 5 dry contact outputs to Division 23 control equipment.

H. Tank fill and vent piping shall be provided and installed by Division 23.

I. Provide remote fill alarm panel in NEMA 3R enclosure, adjacent to outdoor fuel fill lines. Provide wiring as required between sub-base fuel tank and monitoring panel. Pryco Inc. or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 INSTALLATION

A. Install and connect generator sets and accessories where indicated, in strict compliance with manufacturer's instructions.

B. Coordinate fuel system, exhaust system, and combustion/cooling air requirements with Division 23.

C. Provide power, control, and signal wiring and connections as required for specified operation. Assure proper phasing of transfer switch normal and emergency source power connections.

D. Coordinate wiring of ATS auxiliary contacts and Selective Load (BMS) Disconnect Contacts with Sections 263623 and 230923. Provide wiring and conduit from these contacts to mutually agreed termination locations at the Division 14 and 23 interface equipment. Refer to Sections 263623 and 230923.

E. Install a sign at the service entrance equipment indicating the type and location of the on-site emergency power source. Install a sign on the main grounding box identifying all emergency and normal sources connected at that location.

F. The enclosure manufacturer shall provide supervisory labor during the rigging and re-assembly of the generator set enclosure at the jobsite.

3.3 FIELD ACCEPTANCE TESTING

A. After completion of the emergency power system installation, perform a complete on-site performance test per NFPA 110, Paragraph 7.13.

B. Testing shall be conducted by authorized representatives of the equipment manufacturer(s) and witnessed by the Owner's representatives and any interested local authorities.

C. Provide necessary calibrated test equipment, load banks, temporary cabling, and connections, etc. as required to perform the testing in an approved manner.

D. A certified report of test procedures, results, and any corrective measures taken shall be provided to the Owner.

E. Demonstrate operating procedures to Owner's personnel and provide written operating and maintenance instructions.

F. Tests and Approval:

1. Factory Test: The engine-generator shall be tested fully assembled at the factory with a 0.8 PF inductive load bank. The generator set shall conform to the performance criteria of this section.

2. The tests shall be conducted as follows:

   a. Operation at full rated load for a minimum of two hours.

   b. Records shall be maintained, throughout the test period on water temperature, oil pressure, [fuel gas pressure,] ambient air temperature, voltage, current, frequency, noise readings, connected load and power factor.

3. On-Site Tests: The complete installation shall be tested for compliance with the Specification following completion of site work with a 1.0 PF resistive load bank for a minimum of 2 hours, or longer if required by NFPA 110 for specific occupancies and site conditions. [For paralleled systems, the load bank shall be sized to full load test the largest single generator.] Testing shall be conducted by representatives of the manufacturer, with required test equipment, witnessed by the Owner. Certified copies of test procedures and results shall be provided to the Owner.

4. On-Site load test shall repeat factory load test as described above and include the following:

a. Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.

b. Test (prior to cranking engine) for proper operation of accessories that normally function while the set is in a standby mode. Accessories include engine heaters, battery chargers, generator and control enclosure strip heaters and remote annunciators.

c. Check (during start-up test mode) for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

d. Test, by means of simulated power outage, automatic start-up by remote-automatic starting, transfer of load, and automatic shutdown. Prior to this test, adjust transfer switch timers for proper system coordination. Monitor throughout the test engine temperature, oil pressure, battery charge level, generator voltage, amperes, and frequency.

e. Perform manual transfer of loads to generator simulating loss of automatic transfer switch operation.

f. Test for proper interfacing and sequences of operation of ATS auxiliary and selective load shedding (elevator/BMS) contacts with equipment and sequences described herein, on the drawings, and in Section 230923.

g. Upon completion of installation, demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

5. Provide complete instructions, consisting of three (3) operating and maintenance manuals, parts books, dimensional drawings. Separate unit wiring diagrams, and schematics and interconnection wiring diagrams shall be provided.

6. Owner Orientation: A representative of the supplier shall meet the Owner at the time of start up, and shall review the operation and parts books, starting and control methods, and recommended preventative maintenance procedures.

   a. Furnish training as follows for a minimum of four employees of the system user:

      1) Training in the receipt, handling, and acknowledgement of alarms.

      2) Training in the system operation including manual control of output functions from the system control panel.

      3) Training in the testing of the system including logging of detector sensitivity, field test of devices and response to common troubles.

      4) The total training requirement shall be a minimum of 4 [8] hours or as required by the Owner, conducted on three successive days, but shall be sufficient to cover the items specified.

G. Refill fuel oil storage tanks so that Owner is provided with full tanks upon successful completion of testing. This shall be at no cost to the Owner.

3.4 WARRANTY

A. The complete electrical power system (generator set, controls, and associated accessories) as provided by the single source manufacturer shall be warranted by the manufacturer against defects in materials and workmanship for a period of five (5) years or 1500 hours, whichever occurs first from the date of system start-up. Coverage shall include parts, labor, travel expenses, and labor to remove/reinstall said equipment per the manufacturer's standard published limited warranty. There shall be no deductibles applied to warranty.

3.5 MAINTENANCE SERVICES

A. The contractor or manufacturer shall offer for the owner’s consideration at the time of system submittal a priced inspection, maintenance, and repair contract in full compliance with the requirements of NFPA 110.

1. The services offered under this contract shall be performed at no charge during the first year after system acceptance and the owner shall have the option of renewing for single or multiple years up to five years at the price quoted upon completion of the warranty period.

2. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification of the completed system to the UL for specific installed system listing.

END OF SECTION 263200

SECTION 263623
AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this Section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials.

B. See other Division 26 Sections for requirements of emergency system panelboards and other electrical distribution equipment not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The criteria of design and performance to produce the required operation is based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

D. Transfer switch shall meet or exceed the requirement of the International Building Code (IBC) for importance factor 1.5 Electrical Equipment. For use in Zone 5 or less severe Seismic Regions.

1.4 SUBMITTALS

A. Submit manufacturers' technical data for automatic transfer equipment and components, including construction details, performance specifications, and furnished options and features.

B. Submit project-specific dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry, gutter space, installed features and devices, and material list for each switch specified.

C. Manufacture Seismic Qualification Certification. Submit certification that the transfer switches accessories, and all components will withstand seismic forces defined in division 26 Section “Vibration and Seismic Controls for Electrical System”. Include the following:

1. Basis for certification includes whether withstand certification is based on actual tests of assembled components or on calculation.

    a. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to seismic forces specified.”
    b. The term “withstand” means “the unit will remain in place without separation of any parts

from the device when subjected to seismic forces specified and the unit will be fully operational after the seismic event.

2. Dimensioned outline drawings of equipment unit: Identify center of gravity and located and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Qualification Data: For manufacturer and testing agency.

E. Submit certified field test report upon completion of work.

F. Submit complete operating and maintenance manual for each automatic transfer switch.

G. Submit short circuit, arc flash and overcurrent protection coordination study as described in Section 260000. Study shall accompany equipment submittals. Failure to include the study with the equipment submittals will cause the equipment submittals to be rejected.

1.5 WARRANTY

A. All equipment under warranty within the first two (2) year coverage period will be replaced or put in proper operating condition, free of all charges, and the correction of any defects by repair or replacement by Seller shall constitute fulfillment of all obligations and liability of Seller to the Buyer.

1. **Years 1 and 2**
   a. Seller warrants all associated Power Transfer Switches designated herein to be free from defects in material and workmanship for a period of two (2) years from the date of shipment from its factory. Coverage to include parts, labor, and associated travel/lodging expense if on-site labor is required.

2. **Years 3 through 5**
   a. Seller warrants all associated Power Transfer Switch Parts against material defects for a period of five (5) years from the date of shipment from its factory.

3. **Years 6 through 10**
   a. Seller warrants all associated Power Transfer Switch Main Contacts against material defects for a period of ten (10) years from the date of shipment from its factory.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install automatic transfer with 4 poles, amperage as indicated on the drawings, 480 volts, and withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All automatic transfer and controllers shall be the products of the same manufacturer.

2.1 CODES AND STANDARDS:

The automatic transfer switch(es) and controls shall conform to the requirements of:

A. UL 1008 – Standard for transfer switch equipment.

B. CSA certified to CSA 22.2 No. 178 – 1978 automatic transfer switches.

C. IEC 60947-6-1 Low-voltage Switchgear and Controlgear; Multifunction equipment; Automatic Transfer Switching Equipment.

D. NFPA 70 - National Electrical Code.

E. NFPA 99 - Essential Electrical Systems for Health Care Facilities.

F. NFPA 110 - Emergency and Standby Power Systems.

G. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

H. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches.

I. UL 508 Industrial Control Equipment.

2.2 MECHANICALLY HELD TRANSFER SWITCH:

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 800 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Designs, where the wiring harness, controller, and contactor are not all fabricated and assembled by one manufacturer are not acceptable.

F. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

G. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof,

which are ***not*** intended for continuous duty, repetitive switching, or transfer between two active power sources are not acceptable.

H. Where neutral conductors must be switched, the ATS shall be provided with fully rated neutral transfer contacts.

2.4 ENCLOSURE:

A. The switch shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.

B. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

2.5 MICROPROCESSOR CONTROLLER:

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to 1% of nominal voltage. Frequency sensing shall be accurate to 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1.	EN 55011:1991	Emission standard - Group 1, Class A
2.	EN 50082-2:1995	Generic immunity standard.
3.	EN 61000-4-2:1995	Electrostatic discharge (ESD) immunity.
4.	ENV 50140:1993	Radiated Electro-Magnetic field immunity.
5.	EN 61000-4-4:1995	Electrical fast transient (EFT) immunity.
6.	EN 61000-4-5:1995	Surge transient immunity.
7.	EN 61000-4-6:1996	Conducted Radio-Frequency field immunity.

2.6 CONTROLLER DISPLAY AND KEYPAD:

A. A four-line, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input

port. The following parameters shall only be adjustable via DIP switches on the controller:

i. Nominal line voltage and frequency.
ii. Single or three phase sensing.
iii. Operating parameter protection.
iv. Transfer operating mode configuration:
(Open transition, Closed transition, or Delayed transition)

B. All instructions and controller settings shall be easily accessible, readable, and accomplished without the use of codes, calculations, or instruction manuals.

2.7 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING:

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E,3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.

F. The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

2.8 TIME DELAYS:

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for

controlled timing of transfer of loads to emergency.

C. Two-time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails, and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0-to-5-minute time delay in any of the following modes:

1. Prior to transfer only.
2. Prior to and after transfer.
3. Normal to emergency only.
4. Emergency to normal only.
5. Normal to emergency and emergency to normal.
6. All transfer conditions or only when both sources are available.

F. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

G. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

H. An adjustable time delay of 0 to 6 seconds to override momentary emergency source outage to delay all re-transfer signals during initial loading of engine generator set.

2.9 ADDITIONAL FEATURES:

A. A three-position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. Switches which require utilizing the keypad and display function or have no manual time delay bypass means are not acceptable.

C. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

D. Auxiliary contacts rated 10 amps, 250 VACS shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

F. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip, and reset settings for each source.

G. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

H. An In-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be equal to ASCO Feature 27.

I. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

J. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine:
   1. The user shall be able to:
      a. Enable or disable the routine.
      b. Enable or disable transfer of the load during routine.
      c. Set the start time:
         i. Time of the day
         ii. Day of the week
         iii. Week of the month (1^{st}, 2^{nd}, 3^{rd}, 4^{th}, alternate or every)
      d. Set the duration of the run.

   2. At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

K. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both inhibit signals can be activated through the keypad or serial port. The transfer switch will operate in a non-automatic mode with this feature activated.

L. System Status - The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position.

M. Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

N. Communications Interface – The controller shall be capable of interfacing, through an optional communication module, with a network of transfer switches, locally or remotely. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control, and setup of parameters.

O. Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date

stamped and maintained in a non-volatile memory:

1. Event Logging:
   a. Data and time and reason for transfer normal to emergency.
   b. Data and time and reason for transfer emergency to normal.
   c. Data and time and reason for engine start.
   d. Data and time engine stopped.
   e. Data and time emergency source available.
   f. Data and time emergency source not available.

2. Statistical Data:
   a. Total number of transfers.
   b. Total number of transfers due to source failure.
   c. Total number of days controller is energized.
   d. Total number of hours both normal and emergency sources are available.

P. Optional Accessories:

1. 2pole D/T contacts that operate when emergency and normal source voltage is present at transfer switch terminals. The contacts shall be equal to ASCO Accessory 18B and 18G.

2. Selective Load disconnect circuit to provide a pre-transfer and/or post transfer signal when transferring from emergency to normal and/or normal to emergency. The signal can be programmed to occur during all transfers or only when the transfer is occurring between two live sources. The length of the pre and post transfer delays can be set to 0-5 minutes 59 seconds. The contacts shall be equal to ASCO Accessory 31Z.

3. Communication Interface - A Quad – Ethernet module shall be provided to allow several different serial devices that communicate at different baud rates and with different protocols to a common Ethernet media. The module shall be used to connect ATS Annunciators to the standard Ethernet network. The module shall be designed to communicate with multiple clients such as Web Browsers, and PowerQuest® systems simultaneously over the Ethernet connection. Shall be equal to the ASCO accessory 72EE.

2.10 WITHSTAND & CLOSE-ON RATINGS:

A. The automatic transfer switch shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.

B. The automatic transfer switch shall be UL listed in accordance with the latest revisions of UL-1008 and be labeled in accordance with that standard's 0.025 and 0.05 second, time-based ratings. Automatic transfer switch which are not tested and labeled with time-based ratings and have series, or specific breaker ratings only, are not acceptable.

2.11 TEST AND CERTIFICATION:

A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency, and time delay settings are in compliance with the specification

requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

A. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001.

2.12 SERVICE REPRESENTATION

A. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

2.13 ACCEPTABLE MANUFACTUERES:

A. Subject to compliance with requirements, provide automatic transfer switch equal as manufactured by one of the following:

1. Automatic Switch Company (ASCO) 4000 Series.
2. Cummins Model OTPC automatic transfer switches
3. Generac PSTS
4. Caterpillar CTS
5. Russelectric RTS-03

B. Substitutions: Proposed substitutions shall include complete submittal data, as specified herein, clearly denoting all deviations and/or exceptions to the equipment specified. The complete proposal must be submitted to the engineer or architect for approval/disapproval not less than 10 days prior to the scheduled bid date. If approved, the contractor is responsible for the charges for all necessary revisions.

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 INSTALLATION

A. Install and connect transfer switches and accessories where indicated, in strict compliance with manufacturer's instructions.

B. Provide power, control, and signal wiring and connections as required for specified operation. Assure proper phasing of transfer switch normal and emergency source power connections.

C. Coordinate wiring of ATS auxiliary contacts and Selective Load (Elevator/BMS) Disconnect Contacts with Divisions 14 and Section 230923. Provide wiring and conduit from these contacts to mutually

agreed termination locations at the Division 14 and 23 interface equipment. Refer to Sections 14000 and 230923.

D. Coordinate wiring of ATS auxiliary contacts for selective load shedding with Division 23. Provide wiring and conduit from these contacts to mutually agreed termination locations at the Division 23 interface equipment. Refer to Division 23.

3.3 SEQUENCE OF OPERATION

A. Provide the following generator and automatic transfer switch (ATS) control and transfer sequence:

1. Transition Mode

   a. Unless otherwise specified, all transition shall be open-transition, break-before making with an in-phase monitor control circuit if power is available on both the normal and emergency sources, which causes the ATS to only transfer when the in-phase monitor senses synchronized sources to limit current inrush.

2. Loss of Normal Power

   a. Each transfer switch shall monitor the normal power source to the ATS. When voltage and/or frequency are out of tolerance for three (3) seconds, the automatic transfer switch shall signal a call to start.

   b. The transfer switch shall automatically transfer, via open transition, the load to the emergency source when the following conditions are met:

      1) Emergency power is signaled to be at acceptable voltage and frequency levels by the ATS mounted controller.

      2) Expiration of the load-priority time delays:

         a. Within 9 seconds, transfer Emergency ATS-LS.
         b. At 15 seconds, transfer Optional Standby ATS-SB.

      3) The ATS receives a transfer to emergency enabled signal in the form of an actuated relay contact from the priority load controller (permissive).

3. Activation of The Transfer Test Switch at ATS:

   a. The activation of the local transfer test switch on each ATS shall effectively simulate a loss of normal power, resulting in the same sequence as a loss of normal power.

   b. The transfer switch shall automatically transfer the load to the emergency source when the following two (2) conditions are met:

      1) Emergency power is signaled to be at acceptable voltage and frequency levels by the ATS mounted controller.

      2) Expiration of the load-priority time delays:

         a. At 9 seconds, transfer all Emergency ATS-LS

b. At 15 seconds, transfer Optional Standby ATS-SB

3) Expiration of the pre-transfer signal If ATS' is serving an elevator and/or load and requires a pre-transfer signal.

4) ATS receives a transfer to emergency enabled signal in the form of an actuated relay contact from the priority load controller (permissive).

4. Restoration of Normal Power:

a. Each transfer switch shall monitor the normal power source to the ATS. When the ATS is connected to the emergency at the voltage and frequency of the normal source is within tolerance [user-determined amount of time].

b. The transfer switch shall automatically re-transfer the load to the normal source when the following conditions are met:

1. Normal power is signaled to be at acceptable voltage and frequency levels by the ATS mounted controller.

2. Expiration of the re-transfer time delay, unless the user activated the re-transfer time delay bypass function at the ATS control panel this step will be skipped.

3. Expiration of the pre-transfer signal If ATS' is serving an elevator and/or load and requires a pre-transfer signal.

4. The normal power and emergency power voltage and frequency are synchronized.

5. Generators cool down – After load re-transfer to the normal source, the generator shall run unloaded for [user-determined amount of time]. At the end of the cool down period the generator is signaled to shut down by the ATS.

3.2 FIELD ACCEPTANCE TESTING

A. After completion of the transfer switch installation, perform a complete on-site performance test of the emergency power system per NFPA 110, Paragraph 7.13.

B. Testing shall be conducted by authorized representatives of the equipment manufacturer(s) and witnessed by the Owner's representatives and any interested local authorities.

C. Provide necessary calibrated test equipment, load banks, temporary cabling, and connections, etc. as required to perform the testing in an approved manner.

D. A certified report of test procedures, results, and any corrective measures taken shall be provided to the Owner.

E. Demonstrate operating procedures to Owner's personnel and provide written operating and maintenance instructions.

F. Test for proper interfacing and sequences of operation of ATS auxiliary and selective load shedding (BMS) contacts with equipment and sequences described herein, on the drawings, and in Division 23 Section 230933.

END OF SECTION 263623

SECTION 264113
LIGHTNING PROTECTION SYSTEM

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this Section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this Section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials.

1.3 WORK INCLUDED

A. The contractor shall design, furnish, and install equipment and cable as necessary to provide a complete UL Master Label lightning protection system for the project.

1.4 QUALIFICATIONS

A. Installing contractor shall be a Master Installer Designer (MID) certified specialist from the Lightning Protection Institute (LPI) who is qualified to survey a building or set of plans to determine the basic configuration of a lightning protection system, design the system, supply layout and detail drawings and specify materials for installation.

1.5 SUBMITTALS

A. Submit manufacturers' technical product data for components to include but not necessarily limited to air terminals, chimney points, base mounts, connectors, clamps, splices, cables, fasteners, supports, hardware, exothermic welds, ground electrodes, corrosion protection and sealants for waterproofing.

B. Provide layout and arrangement drawings for each structure. Include sufficient detail to describe each air terminal location, primary conductor, secondary conductor, roof penetration, down conductor, ground connection, counterpoise, bonding to adjacent metal bodies and bonds to electric, water, gas, telephone, cable television and other utilities, as applicable.

C. Provide installation details and specification notes to include: each typical air terminal, chimney point, roof penetration, splice, ground connection, bond, cable sleeve or other details specific to this project.

D. Earth resistance test report.

E. Submit a copy of the installing contractor’s Master Installer Designer (MID) certificate.

PART 2 – PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Provide lightning protection system materials and components of types, sizes, ratings, and Class of Service required, which comply with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for complete installation. Where type of components or materials are not otherwise indicated, comply with NFPA 780, Lightning Protection Institute (LPI), and UL96 standards.

B. Materials:

1. Provide lightning protection materials as described below. Aluminum lightning protection materials are not acceptable for this project except where required by UL for galvanic corrosion mitigation.

Air Terminals:	Corrosion Resistant Tinned Solid Copper
Air Terminal Bases:	Tinned Bronze with Stainless Steel Bolts & Washers
Connectors/Fittings:	Tinned Bronze with Stainless Steel Bolts & Washers
Conductors:	Corrosion Resistant Tinned Copper
Ground Rods:	Copper-clad steel, 3/4" diameter, 10 feet long.
Raceways:	Non-metallic: Where exposed to physical damage outdoors and less than six feet above grade, stub-ups or penetrations through concrete slabs, in corrosive locations and where shown on drawings. Electrical metallic tubing (EMT): Where exposed to physical damage in building interiors and less than six feet above finished floor.

C. Coordinate the products furnished with field and installation conditions. Furnish products that are compatible with the building components to which attached.

D. Air terminals at roof parapets shall be equipped with flexible adapters and stainless-steel safety chain to allow façade maintenance equipment and personnel to work in these areas. Provide Harger 12x series or approved equal.

E. Air terminals adjacent to occupied roof areas shall include tip protection to minimize personnel injuries caused by accidental falls. Provide Harger Stat 2000 or approved equal.

2.2 UL CERTIFICATION

A. Provide the Owner with third party inspection of the lightning protection system. Each system shall receive a UL Lighting Protection Inspection Certificate to verify the system complies with UL96A and NFPA 780.

2.3 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the requirements, provide equipment manufactured by one of the following:

1. Harger
2. East Coast Lightning Equipment
3. Heary Brothers
4. Robbins Lightning Inc

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 INSTALLATION OF LIGHTNING PROTECTION SYSTEMS

A. Install lightning protection systems in accordance with equipment manufacturer's written instructions, and in compliance with applicable requirements of NEC, NFPA 780, LPI-175, and UL 96A to ensure lightning protection systems comply with requirements.

B. Coordinate with other work, including electrical wiring, site, and roofing work, as necessary to interface installation of lightning protection system with other work. Refer to architectural drawings for roof and building configurations and details.

C. Conceal system conductors.

D. Conceal down conductors.

E. Conceal interior conductors.

F. Conceal conductors from normal view from exterior locations at grade within 200 feet (60 m) of building.

G. Cut and seal roof penetrations in strict accordance with roof installer's written instructions.

H. Arrange for any necessary UL inspections of concealed work prior to its being closed in.

I. Install ground rods vertically, top of rod 12 inches below finished grade.

J. Install underground ground cables minimum 18 inches below finished grade; utilize one-inch Schedule 40 PVC pipe sleeve where cables run through concrete slabs or foundations.

K. Install conductors with direct paths from air terminals to ground connections; avoid sharp bends and narrow loops, minimum 90 degrees per bend and 8-inch or greater radius.

L. Unless otherwise indicated or approved by architect, conceal conductors within building finishes.

M. Use exothermic welding, Harger UltraShot or approved equivalent, for underground system connections and connections to structural steel.

3.3 GROUNDING AND BONDING

A. Provide equipment grounding and bonding connections to assure permanent and effective grounds and bonds. Follow manufacturer’s requirements for proper installation of bonding and grounding connectors and fittings.

B. Bond rooftop metallic housings, vent pipes, enclosures, ladders and railings and other metal objects to the lightning protection system. Use side mounted terminal bases and avoid top mounted bases to maintain water tightness of enclosures whenever possible.

C. Bond lightning protection conductors to metallic protective sleeves, building steel, well casings, water, and interior metal piping, electrical, cable, data, and telephone services.

D. Do not use piping and enclosures as conducting elements of the lightning protection system.

3.4 TESTING

A. Upon completion of installation of lightning protection system, test resistance-to-ground (earth connection) using three-point ground resistance measuring equipment as manufactured by Biddle or approved equivalent. Where tests indicate resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms or less, by driving additional ground rods, or adding buried mesh grids. Chemical treatment of the soil is not acceptable to reduce earth resistance. Retest to demonstrate compliance. Include test results with record drawing submittal.

3.5 ADMINISTRATION

A. The installer shall provide a UL Lightning Protection Inspection Certificate bearing his name and address for record to the owner for each structure that is protected under this project.

END OF SECTION 264113

SECTION 264313
SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials.

B. See other 26 sections for requirements of switchboards, panelboards and other electrical distribution equipment not included herein.

1.3 SUMMARY

A. Section includes field-mounted SPD for low-voltage (120 to 600 V) power distribution and control equipment.

1.4 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. VPR: Voltage Protection Rating.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Qualification Data: For qualified testing agency.

C. Product Certificates: For SPD devices, from manufacturer.

1. UL 1283.
2. UL 1449.

D. Field quality-control reports.

E. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.

F. Upon request, unencapsulated but complete SPD shall be presented for visual inspection; proprietary technology included. MOV type & quantity shall reflect kA ratings on cutsheet, verification of individual fusing, thermal protection, monitoring, etc.

G. Warranties: Sample of special warranties.

1.6 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The design is based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL listed and labeled for, the intended use or application.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2-2002 and test devices according to IEEE C62.45-2002.

D. Comply with UL 1283 and UL 1449.

E. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

A. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

1.9 COORDINATION

A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance.

B. Coordinate SPD devices with Division 23 for remote monitoring connections.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

A. Manufacturers: Service entrance suppressor until shall be ASCO, Model 460XXXXP30ATTG10 as Basis of Design or Model Select SL3 150 unit by Current Technology is acceptable

B. Surge Protection Devices:

1. UL 1449 Listed as a Type 1 or Type 2.
2. 200kA Short Circuit Current Rating (SCCR) minimum.
3. 20kA I-nominal rating minimum.
4. Life cycle testing using 10kA (8x20µs), 20kV (1.2x50µs), Category C surge current with less than 5% degradation of let through voltage shall equal or exceed 15,000 surges per mode.
5. Integral disconnect switch if no breaker positions available.
6. Redundant suppression circuits.
7. The system shall be constructed using multiple surge current diversion thermally protected metal oxide varistors (TPMOV). The surge current circuit shall be designed and constructed in a manner that ensures surge current sharing.
8. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
9. LED indicator lights for power and protection status. Every suppression component of every mode, including N-G shall be monitored.
10. Audible alarm, with silencing switch, to indicate when protection has failed.
11. Form-C contacts rated at 5 A and 250 V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
12. Active Surge Monitor – The SPD shall be equipped with a power quality monitor including the following monitoring features:

    a. Communication via RS-485, Modbus TCP/RTU, Form C, Ethernet, SNMP, SMTP, with Embedded Webpage capable of generating charts, graphs, and downloadable reports.
    b. Integral LCD Display providing real-time system RMS voltage, Average Voltage, VTDH, Crest Factor, Phase Imbalance, Voltage Harmonic Distortion, & Frequency.
    c. Event Date/Time stamp with Duration/Magnitude for Surge, Sag, Swell, Temporary Overvoltage (TOV), Overvoltage, Phase Loss/Outage, Voltage Interruption/Dropout, Voltage Harmonics (VTDH), Over/Under Frequency, & Neutral Bond conditions. Event thresholds shall be capable of password-protected user modification at the system display and Embedded webpage.
    d. System monitor shall verify the integrity of N-G Bond.
    e. System memory shall be capable of on-board storage & retrieval of a minimum of 2,000 logged events.
    f. Event diagnostics providing SPDs life cycle status with remaining surge protection percentage, and a resettable counter providing the number of Surge, Sag, and Swell events since last reset.
    g. System monitoring shall incorporate user defined thresholds for multiple alarm conditions. Alarms must be configurable as audible, relay, or both.

C. Peak Single-Impulse Surge Current Rating: 300 kA per phase, and 150 kA per Mode L-N, L-G, N-G, and L-L per each mode of protection.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Neutral to Ground: 1200 V for 480Y/277 V.
4. Line to Line: 2000 V for 480Y/277 V.

E. Connection Means: Permanently wired.

F. Each phase shall be protected with Thermally protected MOV's to allow for maximum specified surge current capacity.

G. Suppressor shall not consist of plug-in type circuit boards within the path of primary current and power. Primary path of suppression shall not be to ground.

2.2 DISTRIBUTION PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, ASCO, Model 440XXXXP20AWTJ20 is basis of design for Distribution Panel Suppressors. Equivalent unit by Current Technology, TransGuard TG3 100 Series is acceptable.

B. Surge Protection Devices Description: Non-modular, sine-wave-tracking type with the following features and accessories:

1. UL 1449 Listed as a Type 2 UL 1283 Filter.
2. Short-circuit current rating complying with UL 1449 and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
3. 20 kA I-nominal rating minimum.
4. Life cycle testing using 10kA (8x20µs), 20kV (1.2x50µs), Category C surge current with less than 5% degradation of let through voltage shall equal or exceed 15,000 surges per mode.
5. All suppression components shall be Thermally Protected and rated to allow maximum specified surge current capacity.
6. Fabrication using bolted compression lugs for internal wiring.
7. Integral disconnect switch if no breaker positions available.
8. Redundant suppression circuits.
9. The system shall be constructed using multiple surge current diversion thermally protected metal oxide varistors (TPMOV). The surge current circuit shall be designed and constructed in a manner that ensures surge current sharing.
10. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
11. LED indicator lights for power and protection status. Every suppression component of every mode, including N-G shall be monitored.
12. Audible alarm, with silencing switch, to indicate when protection has failed.
13. Form-C contacts rated at 24V, 2A for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
14. Active Surge Monitor – The SPD shall be equipped with a power quality monitor including the following monitoring features:

    a. Communication via RS-485, Modbus TCP/RTU, Form C, Ethernet, SNMP, SMTP, with Embedded Webpage capable of generating charts, graphs, and downloadable reports.
    b. Integral LCD Display providing real-time system RMS voltage, Average Voltage, VTDH, Crest Factor, Phase Imbalance, Voltage Harmonic Distortion, & Frequency.

c. Event Date/Time stamp with Duration/Magnitude for Surge, Sag, Swell, Temporary Overvoltage (TOV), Overvoltage, Phase Loss/Outage, Voltage Interruption/Dropout, Voltage Harmonics (VTDH), Over/Under Frequency, & Neutral Bond conditions. Event thresholds shall be capable of password-protected user modification at the system display and Embedded webpage.
d. System monitor shall verify the integrity of N-G Bond.
e. System memory shall be capable of on-board storage & retrieval of a minimum of 2000 logged events.
f. Event diagnostics providing SPDs life cycle status with remaining surge protection percentage, and a resettable counter providing the number of Surge, Sag, and Swell events since last reset.
g. System monitoring shall incorporate user defined thresholds for multiple alarm conditions. Alarms must be configurable as audible, relay, or both.

C. Peak Single-Impulse Surge Current Rating: 200 kA per phase, 100 kA L-N, L-G, N-G, and L-L per each mode of protection.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Neutral to Ground: 1200 V for 480Y/277 V.
4. Line to Line: 2000 V for 480Y/277 V.

E. Connection Means: Permanently wired.

F. Each phase shall be protected with Thermally protected MOV's to allow for maximum specified surge current capacity.

G. Suppressor shall not consist of plug-in type circuit boards within the path of primary current and power. Primary path of suppression shall not be to ground.

2.3 BRANCH PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, ASCO, Model 430xxxxP10ACAJ20 is basis of design for Branch Panels Suppressors. Equivalent unit by Current Technology, TransGuard 100 Series is acceptable.

B. Surge Protection Devices Description: Non-modular, sine-wave-tracking type with the following features and accessories:

1. UL 1449 Listed as a Type 2. UL 1283 Filter.
2. Short-circuit current rating complying with UL 1449 and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
3. 20 kA I-nominal rating minimum.
4. Life cycle testing using 10kA (8x20µs), 20kV (1.2x50µs), Category C surge current with less than 5% degradation of let through voltage shall equal or exceed 15,000 surges per mode.
5. All suppression components shall be individually fused and rated to allow maximum specified surge current capacity.
6. Fabrication using bolted compression lugs for internal wiring.
7. Integral disconnect switch if no breaker positions available.
8. Redundant suppression circuits.

9. The system shall be constructed using multiple surge current diversion thermally protected metal oxide varistors (TPMOV). The surge current shall be designed and constructed in a manner that ensures surge current sharing.
10. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
11. LED indicator lights for power and protection status. Every suppression component of every mode, including N-G shall be monitored.
12. Audible alarm, with silencing switch, to indicate when protection has failed.
13. Form-C contacts rated at 24V, 2A for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Peak Single-Impulse Surge Current Rating: 100 kA per phase, 50 kA L-N, L-G, N-G, and L-L per each mode of protection.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 208Y/120 V.
2. Line to Ground: 800 V for 208Y/120 V.
3. Neutral to Ground: 800 V for 208Y/120 V.
4. Line to Line: 1200 V for 208Y/120 V.

E. Connection Means: Permanently wired.

F. Each phase shall be protected with Thermally protected MOV's to allow for maximum specified surge current capacity.

G. Suppressor shall not consist of plug-in type circuit boards within the path of primary current and power. Primary path of suppression shall not be to ground.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

B. Outdoor Enclosures: NEMA 250 Type 4X.

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 INSTALLATION

A. Install SPD devices at service entrance on load side, with ground lead bonded to service entrance ground.

1. Provide 60 A circuit breaker as a dedicated disconnecting means for Service Entrance SPD unless otherwise indicated.
2. Minimum conductor size is #6 AWG copper.

B. Install SPD devices for switchboards, panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

3. Provide 30 A circuit breaker as a dedicated disconnecting means for Distribution and Branch Panel SPD unless otherwise indicated.
4. Minimum conductor size is #10 AWG copper.

C. Surge protection remote alarm: Provide for remote alarm monitoring connections. Provide raceway and 3#14 AWG conductors from surge protection device dry contacts to a junction box located adjacent to the switchboard/panelboard including empty conduit from junction box to BMS. Final connection of SPD alarm contacts is provided under Division 23 and shall not require access to switchboard/panelboard or de-energizing of switchboard/panelboard.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

C. SPD device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Do not energize or connect service entrance equipment, switchboards, panelboards, control terminals, or data terminals to their sources until SPD devices are installed and connected.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION 264313

SECTION 265000
LIGHTING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.

1.2 REFERENCES

A. Perform the work of this section in accordance with the requirements of Section 260000 General Provisions and Section 260500 Basic Materials.

B. See other Division 26 sections and architectural reflected ceiling plans for exact location of each architectural luminaires, and of lighting control and dimming equipment and systems, not included herein.

1.3 MATERIALS, EQUIPMENT AND SYSTEMS

A. Factory wiring of components shall conform to state and local codes and laws.

B. The design is based on equipment of the named manufacturers. Equipment of other manufacturers will be considered, subject to acceptability in the Engineer's judgment and opinion. The equipment must conform to the dimensions established by the drawings for mechanical spaces and other clearances.

C. Materials and products provided shall be suitable for, and where applicable UL or CSA listed and labeled for, the intended use or application.

1.4 SUBMITTALS

A. Submit manufacturers' technical product data for luminaires and components, including the following:

1. Dimensions.
2. Materials and construction.
3. Finishes.
4. Photometric data.
5. Drivers and ballasts (including normal, emergency and dimming).
6. Lamps.
7. Mounting accessories and details.

B. Submit scaled and dimensioned shop drawings for custom-fabricated luminaires, and for custom field assemblies.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Provide luminaires of sizes, types and ratings indicated, complete with, but not limited to, housing, lenses, louvers, baffles, lamps, lamp holders, reflectors, drivers, ballasts, wiring and mounting accessories.

B. Luminaire types are indicated on schedules and drawings. Luminaires must comply with minimum requirements as stated therein or in the listed manufacturers' published data. Review architectural drawings and specifications to verify ceiling types, modules, and suspension systems appropriate to installation.

C. Subject to compliance with requirements and acceptance by the Architect, manufacturers other than those listed will be considered, unless indicated "No Substitutions".

D. Coordinate with the ceiling system supplier to ensure that the luminaires and components supplied will be fully compatible with the ceiling system construction.

E. Provide electrical wiring within luminaire suitable for the ampacity and operating temperature.

2.2 LED DRIVERS

A. Drivers shall be designed for 10-year operational life while operating at maximum case temperature. Driver types shall be as indicated on drawings and with the following features:

a. Surge tolerance: 4000 volts per IEEE C41.2.
b. Class A sound rating: inaudible at 27 dBA ambient sound level.
c. Total harmonic distortion (THD): less than 20% per ANS C82.11.
d. Drivers to track evenly across multiple lamp lengths and all light levels.
e. No visible change in light output with +/- 10%-line voltage input.

B. Constant voltage drivers:

a. Support from 200 mA to 2.1 amp in 10 mA steps.
b. Support LED arrays up to 40 watt or 50 watts (710 mA to 1.05 amp in 10 mA steps).

C. 3-Wire control:

a. Dimming range: 100 to one percent relative light output.
b. Integral fault detection to prevent driver failure in the event of a mis-wire.
c. Operating voltage: 120-277 volt.

D. Digital control:

a. Dimming range: 100 to one percent relative light output.
b. Operating voltage: 120-277 volt.
c. Lights automatically return to the setting prior to power interruption.
d. Each driver responds up to 32 occupancy/vacancy sensors.
e. Responds to digital load shed command.

E. Forward phase control:

a. Dimming range: 100 to one percent relative light output.

2.3 LAMPS

A. Provide lamps as indicated on drawings or schedules, or to suit the specified luminaires.

B. Lamps shall be rated for dimming duty by the manufacturer where dimming control is shown on the drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. See Section 260500 BASIC MATERIALS.

3.2 INSTALLATION OF LUMINAIRES

A. Install luminaires at locations and heights as indicated, in accordance with luminaire manufacturers' written instructions, applicable requirements of NEC and NEMA standards, and with recognized industry practices, to ensure that luminaires fulfill requirements.

B. Electrical drawings show luminaire types, quantities, circuiting and approximate locations. Exact locations shall be as per the architectural drawings. Where exact dimensions are not given luminaires shall generally be centered in the room or area, equally spaced, sides parallel to walls, level, and in a straight line (for rows). Where conflicts occur or where exact locations cannot be determined, request clarification from the Architect.

C. Provide necessary boxes, canopies, stems, chain, and mounting hardware for a complete installation.

D. Luminaire suspension and mounting methods shall be capable of supporting the weight of the luminaire, plus the forces applied during re-lamping and maintenance.

E. Suspended luminaires shall be stem (pendant), aircraft cable, or chain suspended as follows:

1. Individual luminaires shall have two supports, equally spaced from each end. Continuous rows with rigid couplers shall have supports near the center of each luminaire, equally spaced. Luminaires shall be hung plumb and level, parallel and perpendicular to walls.

2. Stem-supported luminaires shall be wired via one of the stems. In finished or semi-finished areas, outlet boxes and stem mountings shall be provided with decorative canopies.

3. Aircraft cable-supported luminaires shall be wired via manufacturer’s standard fixture cable whip strapped to the cable to provide a neat appearance, with appropriate cable connectors at each end.

4. Chain-supported luminaires shall be wired via 3/8” flexible metal conduit (Greenfield), strapped to the chain to provide a neat appearance, with appropriate connectors at each end.

F. In unfinished areas and areas without finished ceilings including but not limited to Mechanical Equipment Rooms, storage rooms and utility corridors, install luminaires after completion of ductwork and piping, in approximately the locations shown. Luminaires shall not be mounted above ducts or pipes where rendered inaccessible or where the light will be substantially blocked. Luminaires shall not be supported from ductwork or piping. In Mechanical Equipment Rooms mounting heights and exact locations shall be field-determined, but in no case shall mounting height be less than 7'-0". Provide necessary support as described in Section 260500 Supports and Hangers.

G. Continuous rows of luminaires shall be rigidly aligned to provide a true straight-line appearance.

B. Luminaires in any one area or corridor shall be mounted with the light sources and lenses oriented in the same direction.

H. Ceiling mounted lighting track sections, recessed downlights, outlet boxes, exit signs, etc. shall be securely mounted to the ceiling grid system and not supported by the acoustical ceiling tile only. Track shall be installed parallel and perpendicular to the grid system, unless otherwise indicated.

I. Lay-in troffers for exposed grid ceilings shall be provided with hold-down clips to prevent T-bar spread and subsequent falling of luminaire.

J. Recessed luminaires weighing more than fifty pounds shall not be installed directly on the concealed or exposed ceiling spline of a lightweight, mechanical acoustical ceiling system. Such fixtures shall be supported from the channel iron or the building structure.

K. Surface or pendant type luminaires, regardless of their weight, shall not be mounted directly on the concealed or exposed ceiling spline of lightweight, mechanical acoustical ceiling system. Such luminaires shall be supported from the channel iron or the building structure. Refer to Section 260500 Supports and Hangers.

L. Install flush mounted luminaires to eliminate light leakage between luminaire frame and finished surface.

M. Provide plaster frames for recessed luminaires installed in other than suspended grid types acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

N. Support surface mounted luminaires greater than 2' in length at a point in addition to the outlet box luminaire stud.

O. Install exit signs to be readily visible per Code and adjust locations up to five feet from locations shown on drawings at no additional cost.

3.3 ADJUSTING AND CLEANING

A. Clean luminaires of dirt and debris upon completion of installation.

B. Protect installed luminaires from damage during remainder of construction period.

C. Adjust the aiming of adjustable floodlights, track-mounted luminaires, wall-wash luminaires, etc. as directed, or as required to direct the illumination to the intended locations. Where applicable, such adjustments shall be performed at night.

D. Level and grout pole and bollard bases.

3.4 MAINTENANCE STOCK

A. At date of substantial completion, turn over to Owner, in original factory packaging, spare lamps equaling 10% of the installed quantity of each type, and spare ballasts equaling 5% of the installed quantity of each type, minimum two (2) of each type.

3.5 LUMINAIRE SCHEDULE, CUTSHEETS AND CONTROL MATRIX

A. Refer to electrical drawings and architectural drawings for luminaire descriptions in addition to those shown on the following schedule and matrix:

LIGHTING FIXTURE SCHEDULE

TYPE	LAMP/VOLTAGE	MOUNTING	CONTROL	DESCRIPTION	CATALOG #
A1	45 W LED, UNV	SUSPENDED PENDANT	0-10V	4' DIAMETER PENDANT MOUNTED LED RING, DIRECT/INDIRECT WITH DIALED DOWN 4,000 LUMEN, 90 CRI AND 3000K CCT. SUSPENDED AT VARIOUS HEIGHT IN GIFT SHOP.	DAY-O-LITE #COML-24-DI-DP-930-4000-4-AC-W
A2	45 W LED, UNV	SUSPENDED PENDANT	0-10V	3' DIAMETER PENDANT MOUNTED LED RING, DIRECT/INDIRECT WITH DIALED DOWN 4000 LUMEN, 90 CRI AND 3000K CCT. SUSPENDED AT VARIOUS HEIGHT IN GIFT SHOP.	DAY-O-LITE #COML-24-DI-DP-930-4000-3-AC-W
A3	45 W LED, UNV	SUSPENDED PENDANT	0-10V	2' DIAMETER PENDANT MOUNTED LED RING, DIRECT/INDIRECT WITH DIALED DOWN 4000 LUMEN, 90 CRI AND 3000K CCT. SUSPENDED AT VARIOUS HEIGHT IN GIFT SHOP.	DAY-O-LITE #COML-24-DI-DP-930-4000-2-AC-W
B1	9W/FT LED, UNV	RECESSED	0-10V	3" APERTURE X 2' LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 825 LUMEN/FT, 90 CRI AND 3000K CCT, RECESSED IN GRID CEILING	DAY-O-LITE #PRFL-44-D-G-FL-930-HO-2-G-W-DIM10
B2	9W/FT LED, UNV	RECESSED	0-10V	3" APERTURE X 6' LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 825 LUMEN/FT, 90 CRI AND 3000K CCT, RECESSED IN GRID CEILING	DAY-O-LITE #PRFL-44-D-G-FL-930-HO-6-G-W-DIM10
B3	9W/FT LED, UNV	RECESSED	0-10V	3" APERTURE X 10' LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 825 LUMEN/FT, 90 CRI AND 3000K CCT, RECESSED IN GRID CEILING	DAY-O-LITE #PRFL-44-D-G-FL-930-HO-10-G-W-DIM10

C	31 W LED, UNV	SUSPENDED PENDANT	0-10V	4.5" DIAMETER PENDANT MOUNTED LED 7" CYLINDER DOWNLIGHT, 3,000 LUMEN, 90 CRI AND 3000K CCT WITH 90 DEG BEAM ANGLE. RECESSED INTO ARMSTRONG METALWORKS OPEN CELL CEILING SLOTS AND FLUSH WITH OPEN CELL, LOCATION TO BE COORDINATED IN FIELD WITH THE OPEN CELL SLOTS.	3G LIGHTING #3G-PDL45RF-7H-30-H9030K-90D-UNV-DIM-WH-WI-WCN-BC-S48
D1	25 W LED, UNV	RECESSED	0-10V	4.5" SQUARE RECESSED LED DOWNLIGHT, WIDE BEAM DISTRIBUTION WITH 1,900 LUMEN, 90 CRI AND 3000K CCT.	HE WILLIAMS #4DS-L20-930-DIM-UNV-OW-OF-CS-MWT-N-F1
D2	25 W LED, UNV	RECESSED	0-10V	4.5" SQUARE RECESSED LED WALL WASHER, WIDE BEAM DISTRIBUTION WITH 1,900 LUMEN, 90 CRI AND 3000K CCT.	HE WILLIAMS #4DS-L20-930-DIM-UNV-AWW-OF-CS-MWT-N-F1
D3	12 W LED, UNV	RECESSED	0-10V	4.5" SQUARE RECESSED LED DOWNLIGHT, MEDIUM BEAM DISTRIBUTION WITH 1,000 LUMEN, 90 CRI AND 3000K CCT.	HE WILLIAMS #4DS-L10-930-DIM-UNV-OM-OF-CS-MWT-N-F1
E	30 W LED, UNV	SUSPENDED PENDANT	0-10V	1' x 4' SUSPENDED LED ROUND LENS INDUSTRIAL PENDANT, INCLUDE REFLECTOR, HANGER, AND CHAINS, ADJUST DOWN TO 4,000 LUMEN, 80 CRI AND 3500K CCT.	HE WILLIAMS #80R-4-L52/835-(L40)-VBY-1-UNV
F	90 W LED, UNV	SUSPENDED PENDANT	0-10V	16" DIAMETER PRISMATIC LED LOW BAY PENDANT, INCLUDE REFLECTOR, WITH 10,000 LUMEN, 80 CRI AND 3500K CCT.	SPECTRUM #PRDDH16LX-100L-35K-DS10X-SC1-CD72-DF16-DR16D-PP-MB
G	40 W LED, UNV	RECESSED	0-10V	2' x 4' CLEAN ROOM LED FLAT PANEL, ISO CLASS 5-9 WITH LENS, 5,000 LUMEN, 80 CRI AND 3500K CCT.	ADVANTAGE ENVIRON. LTG #CLQ-24-3500-40W-M-FK24
H	28 W LED, UNV	RECESSED	0-10V	2' x 2' RECESSED LED WITH 2" DROP LENS, 2980 LUMENS, 90 CRI AND 3000K CCT.	DAY-O-LITE #AFNL-D-WOA20-930-SO-22-G-W-DIM10
J	47 W LED, UNV	RECESSED	0-10V	2' x 2' RECESSED LED FLAT PANEL, 4,200 LUMENS, 90 CRI AND 3000K CCT.	HE WILLIAMS #SQR-G-22-L42-930-F-FG125

K	65 W LED, UNV	SURFACE/ WALL	0-10V	6" x 4' LINEAR WALL MOUNTED LED LENS FIXTURE, INCLUDE INTEGRAL OCCUPANCY SENSOR FOR STEP DIMMING, 2600 LUMENS, 80 CRI AND 3500K CCT.	HE WILLIAMS #SLF-4-L26-835-HIA-SD40
L1	9W/FT LED, UNV	RECESSED	0-10V	2" APERTURE X 5' LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 650 LUMEN/FT, 90 CRI AND 3000K CCT; RECESSED IN PLASTER CEILING	DAY-O-LITE #PRFL-24-D-FL-930-HO-5-TRL-W-DIM10
L2	9W/FT LED, UNV	RECESSED	0-10V	2" APERTURE X 6' LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 650 LUMEN/FT, 90 CRI AND 3000K CCT, RECESSED IN PLASTER CEILING.	DAY-O-LITE #PRFL-24-D-FL-930-HO-6-TRL-W-DIM10
L3	9W/FT LED, UNV	RECESSED	0-10V	2" APERTURE X 7' LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 650 LUMEN/FT, 90 CRI AND 3000K CCT, RECESSED IN PLASTER CEILING.	DAY-O-LITE #PRFL-24-D-FL-930-HO-7-TRL-W-DIM10
L4	9W/FT LED, UNV	RECESSED	0-10V	2" APERTURE X 8' LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 650 LUMEN/FT, 90 CRI AND 3000K CCT, RECESSED IN PLASTER CEILING.	DAY-O-LITE #PRFL-24-D-FL-930-HO-8-TRL-W-DIM10
M	25 W LED, UNV	RECESSED	0-10V	SAME AS TYPE D1 BUT USED AS EM FIXGTURE IN EXHIBIT TUNNEL ONLY.	HE WILLIAMS #4DS-L20-930-DIM-UNV-OW-OF-CS-MWT-N-F1
N	10 W LED		0-10V	ARCH SELECTED VANITY FIXTURE	SIMILAR TO '0 TO 60 LED VANITY LIGHT' BY LUMENS, BUT 277V
P	95 W LED, UNV	SUSPENDED PENDANT	0-10V	13" ROUND DIRECT LED CYLINDER PENDANT, WITH VARIOUS STEM HEIGHT. 8,000 LUMENS, 90 CRI AND 3000K CCT, MEDIUM OPTICS.	SPECTRUM #C1320XT-80L-30HK- MD-DO10X-SC1-TMB-HC-MB

Q	9W/FT LED, UNV	RECESSED	0-10V	2" APERTURE X VARIOUS CUSTOM LENGTH LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 650 LUMEN/FT, 90 CRI AND 3000K CCT. RECESSED IN 6 DEG. ANGLED FLOATING CEILINGS, RUN LENGTH ENDS 8" BEFORE EACH END.	DAY-O-LITE #PRFL-24-D-FL-930-HO-VARIOUS-TRL-W-DIM10
R	1248 W LED, 24V	RECESSED TAPE LIGHT	0-10V	CUSTOM 24V CURVED LED TAPE LIGHT, RECESSED UNDER SOFFIT. INCLUDE CHANNEL AND 13-96W DRIVERS.	PRECISE LED #ZNLT-ARC2-AS-XX-XXR-2ATBM-XX-24V-95C-30K + #ZO-24V-96W
S	7 W/FT LED, UNV	SURFACE MOUNT	0-10V	SURFACE MOUNTED, LOW PROFILE PERFORMANCE LINEAR LED UPLIGHT ON TOP OF SOFFIT. 7W/FT, 80 CRI, 3000K CCT WITH 90 DEG FROSTED LENS.	ELECTRIX #L143-07-77-830-90F- HV-00-ZX
T	7W/FT LED, UNV	RECESSED	0-10V	6" APERTURE X VARIOUS LENGTH LINEAR LED LIGHT WITH DIRECT DISTRIBUTION AND FLUSH LENS, 750 LUMEN/FT, 90 CRI AND 3000K CCT. COMPATIBLE WITH ARMSTRONG DESIGN FLUX CEILINGS.	DAY-O-LITE #PRFL-64-D-FL-930-SO-VARIOUS-G (ARMSTRONG GRID)-W-DIM10
U	36 W LED, UNV	SURFACE/MULLION MTD	0-10V	SURFACE MOUNTED EXTERIOR WALL SCONCES WITH REMOTE BATTERY BACKUP. DOWN DISTRIBUTION WITH 3500 LUMENS, 4000K CCT.	FC LIGHTING #FCW1035R-UNV-4K- 36L-BK-DWFL-LD-BBUR
V	15 W LED, UNV	SURFACE	0-10V	8' LENGTH LED NARROW STRIP FIXTURE FOR UPLIGHT. ADJUSTED DOWN TO 1500 LUMEN, 90 CRI AND 30 CCT.	HE WILLIAMS #75R-8-(L15)-930- DIM-UNV
W	30 W LED, UNV	RECESSED	0-10V	2' x 2' CLEAN ROOM LED FLAT PANEL, ISO CLASS 5-9 WITH LENS, 3,700 LUMEN, 80 CRI AND 3500K CCT.	ADVANTAGE ENVIRON. LTG #CLQ-22-3500-25W-M-FK22

LIGHTING CONTROL MATRIX

ZONE	LOCATION	FIXTURE TYPE	QUANTITY	LOAD/ZONE (WATTS)	CONTROL TYPE
1	VEST 101	D1	4	100	0-10V
2	OFFICE 112	B1, B2, B3	3	162	0-10V
3	STORAGE 111	E	8	240	0-10V
4	CORR 110	D1	2	50	0-10V
5	CORR 105	D1	3	75	0-10V
6	FAMILY 109	D1, N	3	60	0-10V
7	JAN 106	E	1	30	0-10V
8	WOMENS 107	D1, D3	20	318	0-10V
9	WOMENS 107	N	4	40	0-10V
10	WOMENS 107	V	1	15	0-10V
11	MENS 108	D1, D3	15	245	0-10V
12	MENS 108	N	4	40	0-10V
13	MENS 108	V	1	15	0-10V
14	VEST 129	D1	4	100	0-10V
15	GREAT HALL 102	D1	6	150	0-10V
16	GREAT HALL 102	D2	2	50	0-10V
17	GREAT HALL 102	P	26	2470	0-10V
18	GREAT HALL 102	Q	7	1836	0-10V
19	GREAT HALL 102	R	1	1248	0-10V
20	GREAT HALL 102	S	24	1092	0-10V
21	GIFT SHOP 103	A1, A2, A3	4	180	0-10V
22	CAFÉ 104	D1	5	125	0-10V
23	CAFÉ 104	L1, L2, L3, L4	4	234	0-10V
24	CAFÉ 104	C	13	403	0-10V
25	KITCHEN 104A	W	4	120	0-10V
26	CLASSROOM 114	T	10	630	0-10V
27	MEETING ROOM 115	T	10	630	0-10V

28	AV 113	J	3	141	0-10V
29	TABLE STORAGE 116	J	3	141	0-10V
30	FOLDING PARTITION	J	1	47	0-10V
31	WARMING KITCHEN 128	G	10	400	0-10V
32	GALLERIES 118, 120, 121	F	18	1620	0-10V
33	VIEWING ROOM 122A	H	4	112	0-10V
34	COLLECTIONS STOR. 122B	J	4	188	0-10V
35	VEST 119	D1	3	75	0-10V
36	GALLERY ENTRIES EM LTG	M	4	100	0-10V
37	VEST STAGING 123	E	9	270	0-10V
38	ELECTRIC 124	E	2	60	0-10V
39	EMG DIST 125	E	2	60	0-10V
40	FIRE PUMP 126	E	2	60	0-10V
41	BOILER 127	E	19	570	0-10V
42	EXTERIOR ENTRANCES	U	15	540	0-10V
43	STAIR 100	K	4	260	0-10V
44	CUSTOM FRONT DESK	V	4	60	0-10V
45	RESERVE FOR SITE LTG				
46	RESERVE FOR SITE LTG				
47	RESERVE FOR SITE LTG				
48	RESERVE FOR SITE LTG				
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END OF SECTION 265000

SECTION 284600
ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE & RELATED DOCUMENTS

A. The work covered by this section of the specifications includes the furnishing of labor, equipment, materials, and performance of each operation in connection with the installation of the Fire Alarm System as shown on the drawings and as herein specified.

B. The requirements of the conditions of the Contract, Supplementary Conditions and General Requirements, apply to the work specified in this section.

C. The complete installation is to conform to the applicable sections of NFPA-72, Local Code Requirements and National Electrical Code with particular attention to Article 760.

D. The work covered by this section of the specifications is to be coordinated with the related work as specified elsewhere under the project specifications.

E. Regulatory Requirements - Air Sampling Smoke Detection System

1. Codes and Permits: Conform to the local code requirements applicable to this section. Obtain and pay any necessary permits prior to beginning work involved in this section.

2. The air sampling system shall be UL Listed and FM approved.

F. The air sampling system shall be U.L. listed. VESDA® as the PRIMARY DETECTION (e.g., no other detection in the space) - The VESDA® detector shall be U.L. 268 listed for Special Applications, also suitable for Open Area Protection.

1.2 QUALITY ASSURANCE

A. Each item of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. Equipment provided shall be listed under UL 864 9th Edition to insure the latest revision of control equipment. Equipment that does not have UL 864 9th Edition or has 9th Edition pending will not be approved. Manufacturer shall provide copy of UL 9th Authorization letter if requested. Control equipment is to be listed under UL category UOJZ as a single control unit. Partial listing shall not be acceptable.

B. The equipment and installation supervision furnished under this specification is to be provided by a manufacturer who has been engaged in production and/or installation of this type (software driven) of equipment for at least ten (10) years and has a fully-equipped service organization within fifty (50) miles of the installation.

C. Before commencing work, submit data showing that the contractor has successfully installed fire alarm system of the same type and design as specified or that they have a firm contractual agreement with a subcontractor having the required manufacture's training and experience. The contractor will include the names and location of at least two installations of similar size and complexity where the contractor, or his subcontractor have installed such systems.

D. Control equipment must have transient protection devices to comply with UL864 requirements. Provide an isolated loop protector device on any circuit including power, telephone, signal, initiating device, or notification appliance device circuit that extends beyond the main building by either aerial, underground, or other method.

E. Qualifications - Air Sampling Smoke Detection System

1. The manufacturer shall have a minimum of 15 years production experience in the manufacturer and design of high sensitivity aspiration-type smoke detection systems.

2. The manufacturer shall be certified as meeting ISO 9002 for manufacturing.

3. Technology

a. Both Light Scattering and Particle Counting shall be utilized in this device as follows:

The Laser Detection Chamber shall be of the mass Light Scattering type and capable of detecting a wide range of smoke particle types of varying size. A particle counting method shall be employed for the purposes of preventing large particles from affecting the true smoke reading monitoring contamination of the filter (dust & dirt etc.) to automatically notify when maintenance is required.

Note: The Particle counting circuitry shall not be used for the purpose of smoke density measurement.

The Laser Detection Chamber shall incorporate a separate secondary clean air feed from the filter; providing clean air barriers across critical detector optics to eliminate internal detector contamination.

The detector shall not use adaptive algorithms to adjust the sensitivity from that set during commissioning. A learning tool shall be provided to ensure the best selection of appropriate alarm thresholds during the commissioning process.

b. Equipment Supplier
The equipment supplier shall be authorized and trained by the manufacturer to calculate/design, install, test and maintain the air sampling system and shall provide a copy of the certificate with his quotation/proposal.

1.3 SHOP DRAWINGS

A. Prior to submittal of drawings:

1. First: Obtain Architect's approval for revisions to layouts shown on Contract Documents.
2. Second: Submit shop drawings to the local Fire Marshal or other Authority Having

Jurisdiction for review and approval prior to commencing construction.

B. Submit shop drawings for the following:

1. Intelligent addressable fire alarm control panel, manual pull stations, heat detectors, analog smoke detectors, alarm monitoring modules, supervised control modules and accessories.
2. Conventional non-addressable devices as required for performance to this specification.
3. Audible and visual evacuation signals and devices.
4. Wiring and conduit to include circuit load and spare capacity.
5. Detailed sequence of operation.
6. Detection layout showing location of VESDA air sampling detection system tubes, junction boxes, control panels, and interconnecting wiring.
7. Provide calculations for air transport time for each zone from the furthest head with no zone exceeding a 1-minute transport time. Provide a calculation to every test point indicated on riser and floor plans.

C. Data describing more than one type of item shall be clearly marked to indicate the type the contractor intends to provide for a given application. The reviewing authority will assume that options not crossed out in submittal material will be furnished for the project. Submittal material shall be complete. Partial submittals will not be accepted. Submit copies of UL listing or FM approval data showing compatibility of the proposed device or appliance and the panel being provided.

D. Complete drawings covering the following shall be submitted for the proposed system:

1. Floor plans showing initiating, end of line, supervisory, notification appliances, and output control devices.

2. Wiring diagrams showing points of connection and terminals used for electrical connections to the existing system devices and panels.

3. Submit project-specific, complete riser diagram showing interconnections of panels, modules, and point-to-point wiring between devices including wire types and major junction boxes required for the project. Reproduction of design drawings for use of shop drawings is not permitted.

4. A complete proposed system database including a description of logic strings, control by event programming and point identification labels on a compact disk (CD) and in a formatted printed form, required for off-site editing, uploading, and downloading shall be submitted for evaluation by the Owner. A programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system owner.

E. Submit a schedule of initiating devices, listing device type, location, zone (if applicable), and software address.

F. Submit a matrix or table listing each output control function (e.g., fan shutdown, door release) and its corresponding initiating addresses.

G. Submit calculations for the sizing of power supplies, batteries, and audio amplifiers (where applicable).

H. Submit a copy of the field installer's NICET Level 3 certificate in Fire Protection Engineering Technology, Fire Alarm Systems.

I. For use in system test, a complete operation and maintenance manual with two sets of proposed installation drawings shall be submitted.

1. The following information shall be inscribed on the cover:

a. "OPERATION AND MAINTENANCE MANUAL"
b. Building location.
c. The name of the contractor, system manufacturer and system subcontractor.
d. The name and phone number of the fire department required to respond to alarms at the project location.

2. The manual shall be legible and easily read with large drawings folded and contained in pockets. Included in the manual shall be circuit drawings, wiring and control diagrams with data to explain detailed operation and control of each item of equipment and a control sequence describing start up instructions. Included shall be installation instructions, maintenance instructions, safety precautions, test procedures, performance data, and software documentation.

J. Upon completion of the installation, "as-built" record drawings shall be submitted on each system before final acceptance of the work. Furnish to the Engineer a set of "as-built" record drawings including updated system riser diagrams for each system. The record drawings masters shall be on reproducible vellum uniformly sized as required for legibility and reproduction and on a compact disk (CD) in a DWG format suitable for use in a CAD drafting program. Record drawings shall additionally be annotated with the following:

1. Voltage drops calculations on a dedicated sheet.
2. Battery calculations on a dedicated sheet.

1.4 SUBMITTALS

A. Submit manufacturers' technical product data for fire alarm system equipment and devices, and including description of operation, specifications, dimensions, and finishes. Clearly mark options and features furnished, and strike out items, options, and features not being furnished.

B. Coordinate and submit components, necessary for Architect/Engineer to adequately review submittal for each system or like materials, as complete package.

C. Submit a minimum of (2) additional Factory Authorized Independent Distributors within 50 miles of the project that can maintain, service, and add to the proposed system.

1.5 GENERAL

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. The system shall be microprocessor-controlled, intelligent reporting, electrically supervised, low-voltage, power-limited, non-coded, utilizing one-way voice communication with individually addressable manual and automatic initiating devices and circuits, and individually addressable output control functions. The system shall use closed loop initiating device circuits with individual zone supervision, individual notification appliance circuit supervision, incoming and standby power supervision.

1. Include a control panel, manual pull stations, automatic fire detectors, audible devices, flashing lights, remote annunciator, remote control devices, conduit and wiring, connections to devices, outlet boxes, junction boxes, and other necessary material for a complete operating system.

2. The building shall have an emergency voice alarm communications system. The digitized voice message shall notify occupants that a fire condition has been reported. Provide emergency manual voice override.

3. The fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of on-site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes. Software operations are to be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.

B. To accommodate and facilitate job site changes, initiation circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit, or an alarm verification circuit. Design Requirements - Air Sampling Smoke Detection System

1. Shall consist of a highly sensitive LASER-based smoke detector, aspirator, and filter.

2. The detection unit shall also include a scanning valve mechanism to identify which sampling pipe is carrying smoke.

3. It shall be modular, with each detector optionally monitored by a Display featuring LED’s and a sounder. The system shall be configured by a Programmer that is either integral to the system, portable or PC based.

   The system shall allow programming of:

   - four smoke threshold alarm levels per pipe (sector).
   - time delays.
   - faults including airflow, detector, power, filter, and network as well as an indication of the urgency of the fault.
   - seven or twelve configurable relay outputs for remote indication of alarm and fault conditions.

4. It shall consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modeling tool.

5. Optional equipment may include intelligent remote displays and/or a high-level interface with the building fire alarm system, or a dedicated VESDA System Management (VSM) graphics package.

C. Performance Requirements

1. Shall be tested and approved to cover up to 20,000 sq. ft.
2. Shall be approved to provide very early smoke detection and provide four output levels corresponding to Alert, Action, Fire 1 and Fire 2 per pipe (sector). These levels shall be programmable and able to be set at sensitivities ranging from 0.0015–6% obsc/ft. For compliance to UL approval range is 0.0015-4% obsc/ft.
3. Shall report any fault on the unit by using configurable fault output relays or via VSM.

D. Shall be self-monitoring for filter contamination. Shall incorporate a flow sensor in each pipe and provide staged airflow faults.

E. Panels and peripheral devices shall be the standard product of a single manufacturer (unless otherwise specifically noted) and shall display the manufacturer's name on each component. The materials specified under this section constitute the type, product quality, material, and desired operating features.

F. If equipment of another manufacturer is submitted for approval, the contractor shall state what, if any, specific points of system operation differ from the specified points of the system operation. This differentiation report is to reference every paragraph of this specification. The following manufacturers are pre-approved for bidding purposes on this project:

1. Siemens Fire Safety
2. Honeywell/Notifier
3. Tyco/Simplex Grinnell
4. UTC Fire & Security/Edwards

1.6 OPERATION

A. Provide system with the following operation and control features:

1. Alarm reporting to remote supervising station (coordinate exact requirements with the Owner or local Fire Department).
2. Alarm verification for automatic smoke detectors.
3. Subsequent alarm (second zone in alarm re-sounds the audible signals after silencing of the first alarm).
4. Interface with air sampling systems.
5. Monitor fire pump controller (Per NFPA 20).
6. Monitor emergency generator per NFPA 110.
7. Control of auxiliary services:

a. Magnetic door holder release.
b. Release of magnetic door locks.
c. Operation of automatic smoke vents.
d. Close fire shutter doors and motorized fire-rated doors.
e. Interface with building fuel gas control panels and valves.

8. Detector sensitivity, status, adjustment, and testing from the control panel and day/night sensitivity control.
9. Alarm initiation and bell activation from sprinkler flow switches.
10. Alarm initiation from smoke detector operated doors and smoke hatches.
11. Supervisory indication from sprinkler valve tamper switches, with ring back upon correction.
12. Electrical supervision of output control circuits.
13. System status reports consisting of hard copy, English-language printout, with time and date stamp, of system input and output activity.
14. Digital alarm communication to remote station via telephone line.

B. Under normal condition the front panel shall display a "SYSTEM NORMAL" message and the current time and date.

C. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall sound steadily for alarm conditions and pulse for trouble and supervisory conditions.

D. The panel shall display the following information relative to the abnormal condition of a point in the system:

1. Custom location label (40 characters minimum)
2. Type of device (i.e., smoke, pull station, waterflow)
3. Point status (i.e., alarm, trouble)

4. These three characteristics relative to an abnormal condition of a point shall be displayed simultaneously.

E. Pressing the appropriate acknowledge button shall acknowledge the alarm or trouble condition. The acknowledge functions may be passcode protected. Systems not capable of password protected manual command operations shall provide key operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.

F. After all points have been acknowledged, the LEDs shall glow steady, and the panel audible signal will be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated. This feature shall be duplicated by the remote annunciator panel(s) with both the main fire alarm control panel and remote annunciator panel(s) responding the same way.

G. Alarm Silencing

1. Alarm silencing shall be duplicated by the remote annunciator panel(s) with both the main fire alarm control panel and remote annunciator panel(s) responding in like manner.
2. Should the "Alarm Silence" button be pressed alarm signals shall cease operation.

3. Signals shall not be silenced during alarm silence inhibit mode.

H. System Reset

1. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been acknowledged and cleared by authorized personnel. The display shall step the user through the reset process with simple English language messages. Messages shall provide operator assurance of the sequential steps (i.e.: "IN PROGRESS", "RESET COMPLETED", and "SYSTEM NORMAL") as they occur, should alarm conditions be cleared.

I. Fan Reset

1. The "Fan Reset" button shall be used to return the previously shutdown mechanical systems to their normal state after an alarm condition has been acknowledged and cleared by authorized personnel. The display shall step the user through the reset process with simple English language messages. Messages shall provide operator assurance of the sequential steps (i.e.: "FAN RESET IN PROGRESS", "FAN RESET COMPLETED", and "FAN SYSTEMS NORMAL") as they occur, should alarm conditions be cleared.

J. Function Keys

1. Additional function keys shall be provided to access status data for system points. As a minimum the status data shall include Disable/Enable Status, Verification Tallies of Initiating Devices, Acknowledge Status, etc.

K. History Logging

1. In addition to any required printer output, the control panel shall have the ability to store a minimum of three hundred (300) events in an alarm log plus a minimum of three hundred (300) events in a separate trouble log. These events shall be stored in a battery protected random access memory (RAM). Systems not having discrete alarm and trouble logging memory shall include an alternative supervised (eg: floppy drive, tape cassette, zip drive) historic recording method with battery backup. Real time and date shall accompany history event recording.

L. Walk Test with History Logging

1. The system shall be capable of being tested by one person. While in testing mode, the alarm activation of an initiating device shall be silent and logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm.

M. Access Levels

1. There shall be a minimum of four (4) access levels. Passcodes shall consist of up to ten (10) digits. Changes to passcodes shall only be made by authorized personnel. Systems not capable of password protected manual command operations shall provide key operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.

2. The following keys/switches shall have access levels associated with them:
3. Alarm Silence
4. System Reset
5. Set Time/Date
6. Manual Control
7. On/Off/Auto Control
8. Disable/Enable
9. Clear Historical Alarm Log
10. Clear Historical Trouble Log
11. Walk Test
12. Change Alarm Verification

N. Detection Operation

1. Smoke sensors shall be smoke density measuring devices having no self-contained alarm set point (fixed threshold). The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to the stored values.

2. The control panel shall maintain a moving average of the sensors' smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. The smoke obscuration sensitivity shall be adjustable to within 0.3% of either limit of the UL window (0.5% to 4.0%) to compensate for any environment.

3. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value, a "DIRTY SENSOR" trouble condition shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. If a "DIRTY SENSOR" is left unattended, and its average value increases to a second predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel for the individual sensor. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. The control panel shall be listed to automatically perform the calibrated test requirements of NFPA 72.

4. The control panel shall continuously perform an automatic self-test routine on each sensor that will functionally check sensor electronics and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition with the sensor location at the control panel.

5. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each sensor:

6. primary status
7. device type
8. present average value
9. present sensitivity selected *
10. peak detection values *
11. sensor range (normal, dirty, etc.)

    a. *Values shall be in "percent of smoke obscuration" format so that no interpretation is required by the operator.

12. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:
13. clear peak detection values
14. enable or disable the point.
15. clear verification tally
16. control a sensor's relay driver output.
17. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week (for example, to be more sensitive during unoccupied times and less sensitive during occupied periods). There shall be a minimum of five (5) sensitivity settings available for each sensor.
18. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3% sensor reaches a threshold of 1.5% smoke obscuration.
19. For increased smoke detection assurance, individually addressed smoke sensors shall be provided with alarm verification. Only a verified alarm shall initiate the alarm sequence operation.

O. RS-232-C Output

1. The Fire Alarm Control Panel shall be capable of operating remote printers. The output shall be paralleled ASCII from an EIA RS-232-C connection.

P. Digital Alarm Communication

1. Provide a digital communicator mounted in the FACU capable of transmitting an alarm to a remote central supervising station via two monitored telephone lines. The communicator shall supervise both telephone lines, seize the lines, and send a signal on one or both lines without the need of any additional equipment. If one line fails for more than 90 seconds, transfer to the remaining line occurs or if both lines fail, a local trouble alert signal sounds and an auxiliary relay contact alert the BMS.

2. Provide a minimum of four (4) supervised channels, field configurable as either voltage inputs, active high or low inputs, or contact closure inputs programmed as follows:

    a. Channel 1 Alarm (Fire)
    b. Channel 2 Trouble (Fire)
    c. Channel 3 Sprinkler Supervisory
    d. Channel 4 Alarm (Undefined) [Fire Pump, CO, etc.

3. Provide an auto-test feature, 24-hour programmable, to a central station at a preset time including a manual test override and a ring detector for one call downloading/remote programming with remote PC software.

4. Provide 4-channel digital communicator with on-board Ethernet and plug-in LTE Digital Cellular Communicator for use on AT&T, T-Mobile, & Rogers cellular networks. Digital Monitoring Products, Inc. (DMP) latest version of #XR550N with #263LTE cellular communicator, or approved equivalent.

Q. Building Management System (BMS)/Temperature Control System Interface

1. The FACU shall be capable of transmitting trouble and alarm signals to the Owner's BMS. Coordinate with Section 230923 and provide any interfaces, modules, or contacts to communicate with the BMS.

1.7 ALARM SEQUENCE

A. The system alarm operation after the alarm activation of any manual station, automatic detection device, or sprinkler flow switch is to be as follows:

1. Audible alarm notification appliances shall sound a non-coded [perceptually repetitious signal] [digitized tone and voice message] until silenced by the alarm silence switch at the control panel or remote annunciator panel(s).

2. Visual alarm notification appliances (strobes) shall display a continuous pattern until extinguished by the Alarm Silence Switch.

3. Doors normally held open by door control devices shall release.

4. A supervised signal to notify an approved central station shall be activated. To accommodate and facilitate job site changes the type of "city connection circuit" is to be on site configurable to provide either a "reverse polarity", "local energy", "shunt" or dry contact connection.

5. Air handling systems (supply and return) larger than 2000 cfm, shall be automatically shutdown. Other systems and equipment shall also be shut down as indicated on the plans.

6. Alarms shall be displayed on the panel display. The alarm LED shall flash on the control panel until the alarm has been acknowledged at the control panel. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone after acknowledged shall flash the alarm LED on the control panel and the panel display shall show the new alarm information. A pulsing alarm tone shall occur within the control panel and the remote annunciator until acknowledged.

7. Dry contact outputs from the fire alarm control unit (FACU) shall disable museum sound, projection and house lighting systems upon any alarm condition. Museum sound and projection systems shall be silenced and disabled to allow audiences to understand the alarm message. Museum lighting levels shall return to egress brightness for safe evacuation.

B. The activation of any carbon monoxide detector shall initiate an audible alarm distinctive from a fire alarm signal and shall comply with the following:

1. Interconnections to the fire alarm system shall be via supervisory circuits only.

2. Operation of carbon monoxide detectors shall not cause the fire alarm to activate central station fire alarm signals.

3. A fire alarm signal shall take precedence over any other signal, even when the carbon monoxide signal is initiated first.

4. Short circuits, open circuits or any ground fault in this equipment or interconnection between the equipment and the fire alarm shall not prevent alarm or trouble signal transmissions.

C. The control panel is to have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.

1. The activation of any standpipe or sprinkler valve tamper switch shall activate the system supervisory service audible signal, illuminate the LED at the control panel and activate the electric sprinkler fire bell outside the building. Provide differentiation between valve tamper activation and opens and/or grounds on fire alarm initiation circuit wiring. Fire bells shall be furnished and installed by Section 210000 and wired by this contractor.

2. Activating the Supervisory Service Acknowledge Switch will silence the supervisory audible signal while maintaining the Supervisory Service LED on indicating the tamper contact is still in the off-normal state.

3. Restoring the valve to the normal position shall cause the Supervisory Service LED to extinguish thus indicating restoration to normal position.

D. Alarm and trouble conditions shall be immediately displayed on the control panel front alphanumeric display. If more alarms or troubles are in the system, the operator may scroll to display new alarms.

E. The system shall have an alarm list key that will allow the operator to display alarms, troubles, and supervisory service conditions with the time of occurrence. This shall allow for the determination of not only the most recent alarm but also may indicate the path that the fire is taking.

F. The control panel shall be capable of supplying sufficient 24VDC power output to suit job conditions and expansion capability for system growth. Include a minimum of 20 percent spare capacity for 24 VDC notification appliance circuits.

1.8 SUPERVISION

A. The system shall contain a minimum of 2000 Class 'A' independently supervised initiation circuits so that a fault in any one zone shall not affect any other zone. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.

B. There shall be sprinkler supervisory initiation device circuits for connection of sprinkler valve tamper switches to perform the Supervisory Service Operation. Wiring methods which affect any fire alarm initiation circuits to perform this function shall be deemed unacceptable, i.e.: sprinkler and standpipe tamper switches (N/C contacts) shall NOT be connected to circuits with fire alarm initiation devices (N/O contacts). This independent initiation circuit shall be labeled Supervisory Service and shall differentiate between tamper switch activation and wiring faults.

C. Provide independently supervised and independently fused notification appliance circuits for audible alarms and flashing alarm lamps. A trouble condition of any circuit shall not affect the operation of other circuits.

D. Auxiliary manual controls shall be supervised so that switches must be returned to the normal automatic position to clear system trouble.

E. Each independently supervised circuit shall include a dedicated panel readout to indicate trouble conditions per circuit.

F. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.

G. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel.

H. The System Expansion Modules shall be electrically supervised for module placement. Should a module become disconnected from the controls, the system trouble indicator must illuminate, and audible trouble signal must sound.

I. The system shall have provisions for disabling and enabling circuits individually for maintenance or testing purposes.

1.9 POWER REQUIREMENTS

A. The control panel shall receive 120 VAC emergency power (as noted on the plans) via dedicated circuit breakers with handle locks.

B. Speaker/Strobe Systems: During normal power failures, provide sufficient battery capacity to operate the entire system in a supervisory mode for a period of 24 hours with 15 minutes of entire system alarm operation at the end of this period. Systems shall meet these requirements, including those with an emergency generator. The system shall automatically transfer to the standby batteries upon power failure. Battery charging and recharging operations shall be automatic.

C. Circuits requiring system operating power shall be 24VDC and shall be individually fused at the control panel.

1.10 TRANSIENT & SURGE PROTECTION

A. Provide protection against voltage transients and surges as follows:

1. On AC Input: A feed-through (not a shunt-type) branch circuit transient arrestor such as the EFI HWM-120, Leviton OEM-120EFI, Northern Technologies TCS-HW, Transtector ACP100BWN3, or any approved equivalent UL Listed device. Install suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the arrestor in suppressing voltage transients.

2. On DC Circuits Extending Outside Building: Adjacent to the FACU, and near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrestor, series impedance, and a fast-acting secondary arrestor that clamps at 30v-40v. Acceptable models: Innovative Technology D2S33-2ML, Simplex 2081-9027 and 2081-9028, Transtector TSP8601, Ditek DTKxLVL series, Citel America B280-24V, and Northern Technologies DLP-42 or approved equivalent. UL 497B listing is a prerequisite for consideration of alternative products. Devices using only MOV active elements are not acceptable.

1.11 ADDRESSABLE NETWORK

A. Communication with addressable devices: The system must provide communication with initiating and control devices individually. These devices are to be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:

1. Alarm
2. Trouble
3. Open
4. Short
5. Ground
6. Device Fail/or Incorrect Device

B. Addressable devices are to have the capability of being disabled or enabled individually.

C. Up to 60 addressable devices may be connected to a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.

D. Format: The communication format must be a poll/response protocol to allow t-tapping of the wire to addressable devices and be completely digital. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission protocol. Systems that do not utilize full digital transmission protocol (i.e., that may use time pulse width methods to transmit data etc.) will not be acceptable since they are considered unreliable and prone to errors.

E. Identification of Addressable Devices: Each addressable device must be uniquely identified by an address code digitally entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.

F. Wiring Type, Distances, Survivability and Configurations: Wiring types will be approved by the equipment manufacturer. The system must allow up to 2,500 feet wire length to the furthest addressable device. Provide Class A signaling line circuits as defined by NFPA-72 for initiation with no “T” taps and Class A for notification appliance circuits with no “T” taps. The load connected to each notification appliance circuit shall not exceed 80% of rated module output. The voltage drop during alarm must not exceed 14% of the voltage measured across the batteries at that time. To achieve this, the installation shall consider wire size, length of circuit, device load, inherent voltage loss within the FACU's power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.

1.12 ONE-WAY VOICE COMMUNICATION

A. The system shall incorporate one-way voice communication and tone generating capabilities. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions. Provide two (2) amplifiers minimum and connect speakers to alternate circuits and arrange control equipment such that a loss of a portion of the wiring on a floor will not render more than 60% of the devices of each type inoperative, and the devices shall remain so connected to circuitry (i.e., by means of alternate circuits) as to maintain at least partial audibility/visibility throughout the entire floor.

B. A central audio control module shall be provided for the necessary alarm message/tone generation, main and remote microphone connections, music inputs, and mixer/pre-amplifier circuits. Continuous supervision shall be provided along with specific information as to the type of failure should a problem occur (i.e., main microphone trouble, tone trouble, etc.). Audio outputs shall have individual gain control.

C. A hand-held, push-to-talk microphone shall be provided, recessed within a protective panel-mounted enclosure. The microphone shall be a noise-canceling communication type with a frequency range of 200 Hz to 4000 Hz and shall be equipped with a self-winding five-foot coiled cable. An LED indicator shall be provided to indicate the microphone push-to-talk button has been pressed and speaker circuits are ready for transmission. The microphone shall be supervised for disconnection.

D. An audio control switch module shall be furnished to provide manual access to audio operations for authorized personnel. The module shall include an "ALL Circuits" switch, "Aux Tone 1" switch, "Aux Tone 2" switch, tone generator stop switch, and "Audio Trouble Reset" switch. These switches and associated LED indicators shall be supervised for trouble or failure.

E. Audio power amplifiers shall be furnished with a self-contained filtered 24VDC power supply, transformer, and amplifier monitor circuits. The amplifiers shall provide a 25 Volt or 70 Volt RMS output with a frequency response of 120 Hz to 12,000 Hz. Provide sufficient amplification to operate system speakers simultaneously plus ten (10) percent spare capacity. Size amplifiers based on 2 watts minimum per speaker with 100% of speakers adjusted to the 2 watts tap setting.

F. Automatic Voice Evacuation Sequence

1. The audio alarm signal shall consist of an alarm tone for a maximum of 15 seconds followed by automatic pre-selected voice evacuation messages. At the end of each voice evacuation message, the alarm tone shall resume. The alarm tones shall sound alternately until the alarm silence switch at the fire alarm control panel has been operated.

2. Audio alarm operations (speaker circuit selection and alarm tone/voice message timing variations) shall be activated by the system software so that any required future changes to the evacuation sequence can be facilitated by authorized personnel without any component rewiring.

G. Voice Evacuation Zones

1. Provide a minimum of two (2) independent audio circuits from independent amplifiers to each voice evacuation zone as scheduled on the drawings.

2. Each floor, stairway, and assembly space (>300 persons) shall be a separate communication zone.

3. Strobe lights shall not be installed in elevator cars, stairways, or photo darkrooms.

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL UNIT (FACU)

A. Subject to compliance with requirements, provide Fire Alarm Control Units manufactured by one of the following:

1. Siemens Fire Safety Model XLSV FireFinder
2. Tyco Simplex-Grinnell Model 4100ES Voice
3. UTC Fire & Security/Edwards Model EST 3/EXT 3X Audio
4. Honeywell Notifier Onyx DVC with Model NFS2-3030
5. Honeywell Gamewell-FCI E3 Series Broadband

B. Construction shall be modular with solid state, microprocessor-based electronics. The FACU shall display only those primary controls and displays essential to operation during a fire alarm condition. Although the keypad/keyboard can be used for control (firefighter/emergency) of the entire system, it shall only be used for maintenance purposes. Keyboards or keypads shall not be visible or required to operate the system during fire alarm conditions.

1. A local audible device shall sound during Alarm, Trouble, or Supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound differently during each keypress to provide audible feedback (chirp) to ensure that the key has been pressed properly.

C. Primary Keys & Panel Display

1. The Control Panel's display shall be backlit for enhanced readability. To conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there should be keypad activity. The display shall support both upper- and lower-case letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status Information. A cursor shall be visible when entering information. The display shall include a back-lit alphanumeric Liquid Crystal Display (LCD). It shall include LED indications for Power, Test, CPU Fail, Ground Fault, Disable, Reset, Alarm Silence, Panel Silence, Drill, as well as individual queues for alarm, trouble, supervisory, and monitor events.

D. Thermal Strip Printer

1. Provide permanent history logging of system events using a strip printer. Printouts shall be automatically spooled onto a take up reel to record system events including alarms, troubles, operator commands, detector sensitivities, thresholds, analog voltages, device type, and custom messages including time and date. The printer shall be locked and visible through an opening in the enclosure door.

2.2 PERIPHERAL DEVICES

A. Evacuation Signals, Conventional

1. Audible and visual alarm signals shall meet Americans with Disabilities Act (ADA) and UL Standard 1971 requirements shall have the following characteristics and capacities, with provisions for strobe only installations as required:

2. Peak audible output: 99 db at 10 feet.

3. Visual intensity: Field-selectable 15/30/75/110 candela, LED strobe for wall-mounted applications; field-selectable 15/30/60/75/95 candela, LED strobe for ceiling-mounted applications; synchronized repetition of 1-3 Hz, 0.2 second pulse duration, clear white light, white color housing, and back box. The LEXAN lens shall be pyramidal in shape to allow better visibility, labeled "FIRE" complying with ADA guidelines.

4. Signals to be suitable for installation in audible only, audible/visual, and visual only in combinations described above and below:

a. Wall or ceiling mount: Wheelock Exceder LED Series or approved equal. Flush mount with 4-inch square outlet boxes; surface mount with manufacturer's factory finished backbox. Set candela rating as indicated on plans. Appliances and associated wall plates shall be white.

2.3 ADDRESSABLE DEVICE TYPES

A. General: The system control panel, over its two wire multi-drop channel, must be capable of communicating with the types of addressable devices specified below. Each device shall be electronically addressed, tested, and programmed prior to installation using a UL-listed programmer/tester. Detectors shall be operational with relay bases, audible bases, and remote indicating LED's and programmable by the control panel. Devices shall be located as shown on the drawings. Devices shall be electronically addressed and not require mechanical means of setting individual addresses for ease of service and replacement.

B. Smoke Detector, Photoelectric: Pulsed infrared light source, photodiode, self-compensating for ambient temperature and humidity, in-place sensitivity readout from the control panel, two wire operation, dual LED alarm indication for 360° viewing angle, UL (UROX) Listed for open area coverage. Include sounder base for sleeping room installations. Notifier FSP series, Siemens Fire Safety FP-11 FirePrint series, Edwards Signature series, Simplex 4098-9714, Gamewell Velociti series or approved equal.

C. Smoke Detector, Photoelectric, External Duct Mounted: HVAC duct smoke detectors listed for installation in air duct sampling housings for the detection of smoke in HVAC system ducts with air velocities between 100 – 4,000 fpm, complete with compatible addressable photoelectric smoke detector, detector housing, sampling tube, and exhaust tube. Weatherproof housings shall be provided where indicated. Provide remote LED alarm indicators in accessible locations for each duct detector. Notifier DNR(A) series with RA100Z(A), Siemens FDBZ-series with FCBZ492-RTL, Edwards SIGA-SD with SIGA-LED, Simplex 4098-9686 with 4098-9835, Gamewell-FCI Velociti ASD-PL2FR-series with DNR and RTS151KEY or approved equal.

D. Heat Detector, Rate Compensated: Combination fixed temperature (135^{o}F) and rate of rise, LED alarm indication, automatically restorable, 900 square foot coverage. Provide higher fixed-temperature-only, 200^{o}F rated detectors where indicated on plans. Edwards Signature series, Siemens Fire Safety FPT-11 (for 135^{o}F) or DT-200F (for 200^{o}F), each with addressable CZM interface, Notifier FST series, Simplex 4098-9733 (for 135^{o}F) or Fire Detection Devices Model CR 200 (for 200^{o}F), Gamewell Velociti series or approved equal.

E. Heat Detector, Fixed Temperature, Non-addressable, Non-conditioned Spaces: Mechanical fixed temperature (135^{o}F) 625 square foot coverage. Provide higher fixed-temperature-only, 200^{o}F rated detectors where indicated on plans. System Sensor 5600 series, Edwards 104 series or approved equivalent. Connect to system interface module in conditioned space as indicated on plans.

F. Fire Detector Bases, Universal: Low profile twist lock type with screw clamp terminals and self-wiping contacts, with EMI and RFI immunization. Bases shall be installed on 4" square or octagonal electrical outlet box. Where selective localized control of electrical devices is required for system operation, provide software programmed addressable relay integral to the base. The relay shall switch electrical loads, as indicated on the drawings for controlled release of smoke hatches and shaft vents, and for shunt-trip of elevator power disconnect. Detector bases shall be compatible with, and allow the installation of, detectors operating on the flame, ionization, photoelectric, or rate compensated heat principles of detection. Siemens Fire Safety DB-11 and DB-X11RS, Simplex 4098-9792, Edwards SIGA-SB, Notifier B224RB or approved equal.

G. Carbon Monoxide Detector: Low-profile solid-state sensor with hard-wired SPDT trouble and alarm relays, buzzer, and visual status indicator, 24 VAC/DC, and audible base. Edwards SIGA2-COS and SIGA-AB4G audible base with SIGA-CRR relay, Macurco Model CM-E1, System Sensor CO1224T or approved equal. Provide system interface module to provide addressable interface with FACU and auxiliary power supply as required.

H. Manual Station: Double action and identifiable by the master fire alarm control panel. Manufactured from high impact red Lexan with white raised lettering, mechanical latch upon operation, FACU-key operated manual reset. Flush or surface mounted as required, include manufacturer's back box, red baked enamel finish. Siemens Fire Safety MSI-20, Edwards Model SIGA series, Simplex 2099 series, Notifier NBG-12, Gamewell Velociti series or approved equal.

I. Remote Zone Module: Zone modules shall be used to interface normally open direct contact (non-addressable) devices to an addressable signaling line circuit. The module shall be identifiable by the master fire alarm control panel and contain an on-board LED alarm indicator. Mounting: standard 4-inch outlet box, flush, surface and weatherproof as shown for the area indicated.

J. System Interface Module: Interface modules shall be used to interface normally open direct contact non-addressable devices to an addressable signaling line circuit to monitor alarm, trouble, supervisory or security devices. The module shall have Form C programmable control contacts for the management of specified electrical loads as shown on the drawings. The module shall be identifiable by the master fire alarm control panel and contain an on-board LED alarm indicator. Mounting: standard 4-inch outlet box, flush, surface and weatherproof as shown for the area indicated. Siemens Fire Safety TRI-B6 series, Simplex 4090-9001 or 4090-9101, Notifier FMM-1, Edwards Signature series, Gamewell Velociti series or approved equal.

K. Supervised Control Module: Control modules shall be used to supervise relays, contactors, audible signal circuits, visual signal circuits, distributed speaker circuits and two-way fire fighters' communication circuits. Controlled circuits shall be power limited at 1.5 amperes. The module shall be identifiable by the master fire alarm control panel and contain an on-board LED alarm indicator. Mounting: standard 4-inch x 2-inch deep or double gang x 3-inch-deep outlet box, semi-flush or surface.

L. Controllable Relay Module: Controllable relay modules shall be used to provide auxiliary control of building functions such as door holder release, elevator capture, smoke control, lock release, shunt trip, etc. Each relay shall be supervised and include one set of SPDT contacts rated at 2 amperes, 30 VDC/120 VAC resistive minimum. Siemens Fire Safety CRM-4, Edwards Signature series, Simplex 4090-9002, Notifier FCM-1 series, Gamewell Velociti series or approved equal.

M. Control Relay: Provide remote relays where required for relay contact requirements above the approved rating of addressable relay modules for remote control of fans, dampers, door releases, motor controls, or status feedback. Relay shall be SPDT contacts rated at 10 amperes, 24 VDC/115VAC. A red LED shall indicate the relay is energized. PAM series or approved equal.

2.4 AIR SAMPLING SMOKE DETECTION SYSTEM

A. Aspirating Smoke Detection System: Model – VESDA SCANNER.

B. Acceptable Manufacturer:

Vision Fire & Security – VESDA
700 Longwater Drive
Norwell, MA 02061
Toll Free: 1 800 229 4434
Telephone: +1 781 740 2223
Fax: +1 781 740 4433
Website: www.vesda.com

C. Detector Assembly

1. The Detector, Filter, Aspirator and Relay Outputs shall be housed in a mounting box and shall be arranged in such a way that air is drawn from the fire risk and a sample passed through the Dual Stage Filter and Detector by the Aspirator.

2. The detection unit shall also include a scanning valve mechanism to identify which sampling pipe is carrying smoke.

3. The valve mechanism shall:

- be integrated into the detector.
- begin to sample each pipe individually upon detection of smoke.
- be used to identify the level of smoke in each pipe.
- be used to indicate in which pipe an alarm was first detected.
- operate upon manual activation of the scan button on the LaserSCANNER display.
- be automatically tested daily to ensure uninterrupted protection.

4. The system shall utilize the principle of sampling all sectors simultaneously. When a scan smoke level is reached, an automatic sequence shall be initiated to sample each sector individually. If an alarm threshold level is reached a First Alarm Sector is indicated and signaled. The unit shall then continue its sequence monitoring until the smoke level signal reduces below the scan level.

5. The Detector shall be LASER-based type and shall have an obscuration sensitivity range of 0.0015%/ft – 6% obscuration/foot.

6. The Detector shall have four independent field programmable smoke alarm thresholds per pipe (sector) and a programmable scan time delay.

7. The Detector shall also incorporate facilities to transmit the following faults.

- Detector
- Air flow
- Filter
- System
- Zone
- Network
- Power
- Urgent and Minor faults. Minor faults shall be considered as servicing or maintenance signals. Urgent faults indicate the unit may not be able to detect smoke.

8. The detector shall have four in-line sample pipe inlets and must contain a flow sensor for each pipe inlet. Both Minor and Urgent flow faults can be reported.

9. The filter must be a two-stage disposable filter cartridge. The first stage shall be capable of filtering particles more than 20 microns from the air sample. The second stage shall be ultra- fine, removing more than 99% of contaminant particles of 0.3microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.

10. The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 600 ft. in total, (4 pipe runs per detector) with a transport time of less than 120 seconds or as appropriate codes dictate.

11. The Assembly must contain relays for alarm and fault conditions. The relays shall be software programmable to the required functions. The relays must be rated at 2 AMP at 30 VDC. Remote relays shall be offered as an option and either configured to replicate those on the detector or programmed differently.

12. The Assembly shall be able to be surface mounted to a wall or recessed in the wall cavity (the unit may be inverted in either option).

13. The assembly shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each even shall be recorded. Each detector (zone) shall be capable of storing up to 18,000 events and does not require the presence of a display to do so.

14. Displays

    a. When required, a detector Display module may be located within the detector, a remote mounting box or a 19-inch remote rack.

    b. Each Display shall provide the following features at a minimum:

- A 20 segment bargraph display.
- Four independent high intensity alarm indicators, Alert, Action, Fire 1 and Fire2, corresponding to the four alarm thresholds of the indicated sector.
- Alarm threshold indicators for Alert, Action, and Fire 1.
- LED indication that the First Alarm Sector is established.
- LED indication of which pipe(s) is carrying smoke.
- Detector fault and airflow fault indicators.
- Faults originating in the VLS zone (Zone Fault) shall be distinguished from those produced by the overall smoke detection system and from those resulting from network wiring errors (Network Fault). LED indicators shall be provided for each fault category.
- Minor and urgent fault LED indicators.
- A remotely mounted Display may be optionally equipped with 7 or 12 configurable relays for signaling alarm and fault conditions.
- Four buttons supporting the following features:

1) Mode/Test - Scrolls through the information on the Display's digital display: Sensitivity (Fire 1 Threshold setting), current smoke level, VLS Zone number and First Alarm Sector. When pressed and held initiates a lamp test on the individual display module.
2) Silence/Scan - Silences all devices on the system. When pressed and held initiates a manual scan test.
3) Reset - Unlatches all latched alarm conditions on the assigned VLS zone.
4) Isolate – Isolates the individual VLS zone (inhibits Alarm and Fault relays and initiates the Isolate relay).

15. Programmers

a. When required, a Programmer module may be located within the detector, a remote mounting box, a 19-inch remote rack, or in a portable hand-held unit. Alternatively, programming may be performed using a Windows® application running on a PC connected through a High-Level Interfacing unit (PC-Link HLI).

b. Each Programmer shall support the following features at a minimum:

- Programming of any device on the VESDAnet system.
- Viewing of the status of any device in the system.
- Adjustment of relative alarm thresholds for each pipe (sector factor)
- Adjustment of period of sampling for each pipe
- Software configuration for either 7 or 12 relays
- Setting of Day/night, weekend, and holiday sensitivity threshold settings.
- Initiation of AutoLearn™, to automatically configure the detector's alarm threshold settings to suit the current

environment.
- Multi-level password control.
- Programmable latching or non-latching relay operation.
- Programmable energized or de-energized relays.
- Programmable high and low flow settings for airflow supervision.
- Programmable aspirator speed control.
- Programmable maintenance intervals.
- Facilities for referencing with time dilution compensation.
- Testing of relays assigned to a specific zone to aid commissioning.

16. Device Networking Requirements

a. The devices in the smoke detection system shall be capable of communicating with each other via twisted pair RS485 cable. The network shall be able to support up to 250 devices (detectors, displays and programmers), of which at least 100 detectors can be supported.

b. The network shall be capable of being configured in a fault tolerant loop for both short circuit and open circuit. Any communication faults shall be reported unambiguously and shall be clearly attributable to an individual device or wire link in the fault messages.

c. PC based configuration tools shall be available to configure and manage the network of detectors.

17. Digital Communication Port: Shall comply with EIA RS485 Protocol.

18. Application

a. Detection Alarm Levels

The laser based aspirating detection system shall have four (4) alarm thresholds per pipe (sector). The four alarm levels may be used as follows:

- Alarm Level 1 (Alert)
  Activate a visual and audible alarm in the fire risk area.
- Alarm Level 2 (Action)
  Activate the electrical/electronic equipment shutdown relay and activate visual and audible alarms in the Security Office or other appropriate location.
- Alarm Level 3 (Fire 1)
  Activate an alarm condition in the Fire Alarm Control Panel to call the Fire Brigade and activate all warning systems.
- Alarm Level 4 (Fire 2)

Activate evacuation action or shut down of systems).

NOTE: The alarm level functions as listed are possible scenarios. Consideration should be given to the best utilization of these facilities for

each application and the requirements of local authorities (e.g., Authorities Having Jurisdiction in the US).

b. Initial Detection Alarm Settings

Initial settings for the alarm levels shall be determined by the requirements of the fire zone. However, the setting for Fire 1 (Alarm Level 3) shall always appear as 100% on the bar graph scale. Default settings of the unit shall be:

- Alarm Level 1 (Alert) 0.025% Obs/ft
- Alarm Level 2 (Action) 0.044% Obs/ft
- Alarm Level 3 (Fire 1) 0.062% Obs/ft
- Alarm Level 4 (Fire 2) 0.61% Obs/ft

Each pipe shall have its alarm thresholds set by a Sector Factor. The Sector Factor range shall be between 0.5 and 2.0 (where 2.0 doubles the normal alarm threshold settings).

c. Initial (factory default) Delays

Initial (factory default) settings:
- Scan Delay 10 seconds
- Fault Alarm 5 seconds

d. Fault Alarms

The Detector Fault relay shall be connected to the appropriate alarm zone on the Fire Alarm Control Panel in such a way that a Detector Fault would register a fault condition on the FACP. The Minor Fault and Isolate relays shall also be connected to the appropriate control system.
(Check local Codes, Standards or Regulations to determine whether compliance with this set-up is required).

e. Power Supply and Batteries

The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the relevant Codes, Standards or Regulations. Typically, 24 hours standby battery backup is required followed by 30 minutes in an alarm condition.

Local Power Supply Standards that may apply:
UL 1481 Listed (provided the power supply and standby batteries have been appropriately sized/rated to accommodate the system's power requirements).

2.5 SAMPLING PIPE DESIGN

A. Sampling Pipe

1. The sampling pipe shall be Vesda Pipe ¾-inch internal diameter CPVC

Piping, listed to UL 1887 (which includes use in plenum rated areas).

2. All joints in the sampling pipe must be airtight and made by using solvent cement, except at entry to the detector.

3. The pipe shall be identified as Aspirating Smoke Detector Pipe (or similar wording) along its entire length at regular intervals not exceeding the manufacturers recommendation or that of local codes and standards.

4. All pipes should be supported at not less than 5ft centers, or that of the local codes or standards.

5. The far end of each trunk or branch pipe shall be fitted with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.

B. Sampling Holes

1. Sampling holes of 5/64", or otherwise appropriately sized holes (see Section 3.05), shall not be separated by more than the maximum distance allowable for conventional point detectors as specified in the local code or standard. Intervals may vary according to calculations.

2. N.F.P.A. 72 (1996 Edition) the maximum allowable distance between sample points is 30 feet.

C. Each sampling point shall be identified in accordance with Codes or Standards.

D. Consideration shall be given to the manufacturers recommendations and standards in relation to the number of Sampling Points and the distance of the Sampling Points from the ceiling or roof structure and forced ventilation systems.

2.6 REMOTE ANNUNICATOR WITH VOICE EVAC CONTROLS

A. Where shown on the plans, provide supervised, remote local operator console / panel with features and characteristics as follows:

1. Any activity supported at the main control panel shall be enabled at the remote annunciator.

2. Active poll response communications with the master fire alarm control panel using the local system communications network.

3. Minimum 80-character alphanumeric display for fire alarms, supervisory reports, and system troubles. The number of characters shall mimic the number of characters on the main panel display.

4. Individual fire alarm, supervisory, security and trouble acknowledge momentary switches and power "ON", each with LED indicators showing acknowledgement status by flashing and steady states.

5. Remote paging capability consisting of dynamic push to talk microphone with enclosure.

6. Scroll switch for the alarm display. Switch shall enable scrolling backward or forward through the alarm queue.

7. Integral audible signal with audible signaling silence switch with LED indicating the state of the evacuation signals.

8. Key menu driven keypad for the entry of passcodes, request for reports, setting time, and bypassing points.

9. Twelve software programmable function key commands. These commands shall be capable of utilizing any and system logic functions resident within the system programming or of being an input into any of the logic functions.

10. Locked cabinet, factory finished enamel with viewing window.

11. Local operator panel shall be Siemens Fire Safety remote command center #RCC series or Edwards LSRA-C or 3-LCDANN series, Notifier ONYX Digital Voice Command (DVC), or Simplex 4603-9101 or approved equal.

2.7 WIRING

A. Fire alarm cable shall be "Teflon" jacketed, or the equivalent, conforming with the requirements for type FPLP "Power-Limited Fire Protective-Signaling Circuits," having a temperature rating of 60^{o}C or higher, solid conductor insulation with a minimum average thickness of 7 mils, protected with a sheath and an outer jacket of 15 mils minimum, colored red. Cable shall be labeled for its entire length per UL 1424, size, voltage, and temperature rating.

B. Provide and install two #14 AWG minimum twisted pair, shielded for initiating device analog loop circuits.

C. Provide and install two #14 AWG minimum twisted pair, shielded for strobes, and non-shielded for [speakers and] analog audible device loop circuits.

D. Provide and install two #14 AWG minimum twisted pair, non-shielded for each waterflow alarm bell.

E. Provide and install two #16 AWG minimum twisted pair, shielded for each remote annunciator.

F. Verify conductor sizes and quantities with system manufacturer, prior to installation.

G. Increase wire size to accommodate voltage drop per manufacturer's recommendations. Design circuits to a maximum of 75% rated capacity to accommodate future device additions and sound level changes. Do not exceed manufacturer's maximum circuit lengths.

H. Provide permanent wire markers to identify connections at the FACU and other control equipment, at power supplies, and in terminal cabinets.

I. In multi-story buildings, circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

J. Notification appliance circuit booster ("ADA") power supplies shall be individually monitored by the FACU and protected by a smoke detector per NFPA 72. Do not locate above ceilings or in non-conditioned space. Note: A 24VDC power circuit service addressable control relays shall also be monitored for integrity.

2.8 ISOLATOR MODULE

A. Provide isolator modules to automatically isolate wire-to-wire short circuits on a signaling line circuit (SLC) loop at termination of circuit unless built-in to FACU. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop after each 25 initiating devices and control points or a lesser number where recommended by the manufacturer. Modules must be readily accessible (not above ceiling) and clearly labeled.

B. Operation: Isolator modules shall operate such that if a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

C. Mounting: The isolator module shall mount in standard 4-inch square, 2-1/8" deep electrical boxes. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

D. Labeling: Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling) and shown on "as-built" record system drawings.

2.9 SPARE PARTS

A. Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping, or tagging. Furnish the following spare parts, in the quantities listed:

1. Automatic Detectors of each type installed: [5]
2. Manual pull stations: [2]
3. Fire alarm notification devices of each type: [5]
4. Fuses for each fused circuit: [10]
5. Lamps for each lamp type furnished: [10]
6. Sets of keys, wrenches or special tools required to gain access to lockable equipment: [5]

B. In addition to the above, the FACU shall have sufficient internal space for the future addition of at least 5 additional multiplex loop cards and associated power supplies, hardware, etc.

PART 3 - EXECUTION

3.1 DESIGN AND INSTALLATION DRAWINGS

A. Show a general layout of the complete system including equipment arrangement. Verify dimensions and assure compatibility with other systems interfacing with the fire alarm system.

1. Identify on the drawings, conduit and conductor sizes and types with number of conductors in each conduit. Provide each conduit and device with a unique identification.

2. For addressable alarm initiation devices, the system identifier shall be, as minimum, the system address for that device. Signals shall be sequentially numbered as the address of the controlling module. Provide additional identification labels, room name, number, and area, etc., as required by the Owner and coordinated with the Owner prior to final programming of the FACU.

3. Indicate on the point-to-point wiring diagrams, interconnecting wiring within the panel between modules, and connecting wiring to the field device terminals.

3.2 INSTALLATION

A. Field installer shall be NICET Level 3 certified in Fire Protection Engineering Technology, Fire Alarm Systems. Perform work in accordance with the requirements of NFPA 70, NFPA 72, and other requirements of local authority having jurisdiction.

B. Supports & anchors: Refer to Section 260500.

C. Install equipment and devices per manufacturer's instructions and where indicated; refer to architectural drawings for exact locations and mounting heights.

D. Refer to HVAC drawings and specifications (Division 23) for exact locations of duct-mounted smoke detectors. Coordinate with appropriate trade for the cutting of ducts and mounting of housings and sampling tubes.

E. Provide remote indicators for concealed smoke detectors and install in a readily visible location as close as possible to the location of the associated detector, either flush wall mounted 5'-0" AFF, or flush ceiling mounted. Provide remote indicators for duct smoke detectors located outside of mechanical equipment rooms. Coordinate exact mounting locations of remote indicators with architect in field.

F. Smoke detectors shall not be in a direct air flow nor be closer than three (3) feet from an air supply diffuser or return air opening. Increase separation as required per NFPA 72.

G. Provide a separate raceway system for fire alarm wiring [where exposed to physical damage and below 8 feet mounting height]. Power shall not be installed in raceways with low voltage wiring. Raceway shall be electrical metallic tubing (EMT), minimum ¾-inch size, maximum 40% fill and as indicated on drawings. Refer to Section 260500 for raceway and installation requirements.

H. Unless otherwise indicated, backboxes shall be recessed, and conduits and cable shall be concealed.

I. "Fire alarm system" decal shall be applied to junction box covers. Junction box covers shall be painted “fire department red”.

J. Each conductor shall be identified with wire markers at every splice and terminal point. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.

K. Splices shall not be made other than at terminal blocks or on terminal blocks at cabinets. Wire nuts and crimp splices shall not be permitted. Connectors shall be installed in conformance with the manufacturer's recommendations.

L. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

M. Permanently label or mark each conductor at both ends with permanent alpha-numeric wire markers.

N. Use a consistent color code for fire alarm system conductors throughout the installation.

O. Smoke detectors shall not be installed until final construction clean-up has been completed. Replace detectors contaminated during construction. Caution: Covers supplied with smoke detector head do not provide protection against heavy construction dust, spray painting, etc., and shall not be used for that purpose. Covers are suitable only during final, minor clean-up or touch-up operations.

P. The contractor shall clean dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.

Q. The manufacturer's authorized representative shall provide on-site supervision of installation. Power shall not be applied to the system until a manufacturer’s factory trained representative is present.

R. Identify individual devices. Assign each a unique number as follows, in sequence starting at the FACU: (Addressable Loop # -- Device # -- Room/Space #). Show on the record drawings, and permanently mount on each device’s base so that the identification is readable standing on the floor below without having to remove the device. Exception: For

S. Detectors with housings (air duct, projected beam, air sampling) apply the identification to a suitable location on the exterior of the device housing. Addressable device descriptors shall utilize room/space designations and numbers that will be used by the facility after occupancy. Descriptors shall be approved by the architect.

T. For each duct/plenum detector provide remote alarm indicator lamp/test switch installed in the nearest corridor or as shown on plans. Identify each location by an engraved label affixed to the wall or ceiling.

U. The contractor shall provide up to three fire alarm system reprogramming revisions as directed by the Owner.

V. Provide supervisory alarm wiring from the fire pump controller to the fire alarm system. Supervisory alarms to be wired are power failure alarm, phase reversal alarm, and pump running alarm. Coordinate all alarm contact voltages, ratings, and types (NO/NC) with the equipment being supplied.

W. The fire alarm voice evacuation system messages shall be as approved by the architect and custom messages shall be provided as directed.

X. Label locations of duct smoke detectors to indicate “Duct Smoke Detector Access”.

Y. Air Sampling Pipe and Sampling Point Network:

1. Where false ceilings are installed, the sampling pipe shall be installed above the ceiling, and Capillary Sampling Points shall be installed on the ceiling and connected by means of a capillary tube.

2. The minimum internal diameter of the Capillary tube shall be 3/8 in, the maximum length of the Capillary tube shall be 7ft unless the manufacturer in consultation with the engineer have specified otherwise.

3. The Capillary tube shall terminate at a Ceiling Sampling Point specifically designed and approved by the manufacturer. The performance characteristics of the Sampling Points shall be considered during the system design.

4. Air Sampling Pipe Network Calculations shall be provided by a sampling pipe aspiration modeling program such as ASPIRE2. Pipework calculations shall be supplied with the proposed pipe layout design to indicate the following performance criteria:

a. Transport Time

The manufacturers recommended transport time (time taken for the smoke to enter the pipe and reach the detector) for the least favorable sampling point is 60 seconds or less.
Local codes or end users’ standards may also apply. For example:
NFPA72 US: 120 Seconds

b. Balance %

The sample point balance for the pipe shall not be less than 70% as indicated by ASPIRE. That is, the volume of air drawn from the last sampling point shall not be less than 70% of the average volume of air through the other holes.

c. Share %

The sample hole share for the pipe shall not be less than 70% as indicated by ASPIRE. That is, the sum volume of air drawn through the sampling holes must always be greater than 70% of the total volume of air entering the pipe (i.e., the End Vent must not exceed 30% of the total flow).

d. Maximum number of sampling holes
   1) 100 per detector.
   2) 25 per pipe inlet.

3.3 FIELD QUALITY CONTROL

A. General Testing

1. Intelligent analog devices shall be tested for correct address and sensitivity using test equipment specifically designed for that purpose. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the system address, initials of the installing technician and date.

2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.

   a. A systematic record shall be maintained of readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates, and witnesses.

   b. The acceptance inspector shall be notified before the start of the required tests. Items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.

   c. Test reports shall be delivered to the acceptance inspector as completed.

3. Test equipment, instruments, tools, and labor required to conduct the system tests shall be made available by the contractor. The following equipment shall be a minimum for conducting the tests:

   a. Ladders and scaffolds as required for access to installed equipment.

   b. Multi-meter for reading voltage (current and resistance).

   c. Intelligent device programmer/tester (if required to set device addresses).

   d. Laptop computer with programming software for any required program revisions.

   e. Two-way radios, flashlights, smoke generation devices and supplies.

   f. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.

g. Decibel meter.

h. Provide a testing kit for testing CO detectors in accordance with manufacturer's requirements.

4. In addition to the testing specified to be performed by the contractor, the installation shall be subject to test by the acceptance inspector.

5. System wiring: Fire alarm circuits shall be tested for continuity, grounds, and short circuits.

B. Air Sampling System Testing

1. Commissioning Tests

a. The contractor shall allow for the manufacturer's representative to attend commissioning of the entire installation in the presence of the owner and/or its representative.

b. All necessary instrumentation, equipment, materials, and labor shall be provided by the Contractor.

c. The Contractor shall record all tests and system calibrations and a copy of these results shall be retained on site in the System Logbook.

2. System Checks

a. Visually check all pipes to ensure that all joints, fittings, bends, sampling points, etc., comply with the Specification.

b. Check the system to ensure the following features are operational and programmed in accordance with the specification.

- Alarm threshold levels (for both day and night settings),
- Pipes in use,
- Detector address,
- Display address,
- Clock and date,
- Time delays,
- Air flow fault thresholds,
- Display buttons operable (Mode, Silence, Reset, Isolate),
- Referencing
- Units set to U.S./S.I.,

c. Check to ensure that all ancillary warning devices operate as specified.

d. Check interconnection with Fire Alarm Control Panel to ensure correct operation.

3. Tests

a. Introduce Smoke into the Detector Assembly to provide a basic functional test.

b. Introduce smoke to the least favourable Sampling Point in each Sampling Pipe. Transport time is not to exceed the local codes (see 3.03).

c. If more than two bar graph divisions illuminate under normal conditions (no smoke test), review event log for two (2) weeks from date of commissioning and make appropriate adjustments to the alarm and delay thresholds.

c. Activate the appropriate Fire Alarm zones and advise all concerned that the system is fully operational. Fill out the logbook and commissioning report accordingly.

C. Acceptance Testing

1. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the manufacturer in accordance with NFPA 72, and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of system components, circuits, and programming.

2. The contractor shall prepare a program matrix referencing each alarm input to every output function affected because of an alarm condition on that input. In the case of outputs programmed using more complex logic functions involving "any", "or", "not", "count", "time", and "timer" statements; the complete output equation shall be referenced in the matrix.

3. A complete listing of device labels for alpha-numeric annunciator displays [and logging printers] shall be prepared by the contractor prior to the ATP.

4. The acceptance inspector shall use the system record drawings in combination with the documents specified under paragraph 3.01 during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or input and output functions. The items tested shall include but not be limited to the following:

a. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:

1) Open, shorted, and grounded intelligent analog signaling circuit.
2) Open, shorted, and grounded network signaling circuit.
3) Open and grounded conventional zone circuits.
4) Open and grounded signal and telephone circuits.
5) Intelligent device removal.
6) Primary power or battery disconnected.
7) Incorrect device at address.

b. System evacuation alarm notification appliances shall be demonstrated as follows:

1) Alarm notification appliances actuate as programmed.
2) Audibility and visibility at required levels.

c. System indications shall be demonstrated as follows:

1) Correct message display for each alarm input at the base building control panel and each remote alpha-numeric display [and each video display terminal].
2) Correct annunciator light for each alarm input at each annunciator [and color graphic terminal] as shown on the drawings.

5. After the Contractor has completed his own acceptance test following the ATP procedure, and after the authorized fire alarm equipment representative has performed a 100% complete test of the system, an acceptance test of the fire alarm system will be conducted by the Contractor as directed by the Owner or his authorized representative.

6. In the event of system failure to perform as specified and programmed during the ATP procedure, at the discretion of the acceptance inspector, the test shall be terminated.

a. The contractor shall retest the system, correcting deficiencies and providing test documentation to the acceptance inspector.

b. The acceptance inspector may elect to require the complete ATP to be preformed again if, in his opinion, modifications to the system hardware or software warrant complete re-testing.

7. Before Final payment, the System Supplier shall turn over, to the owner, a disc copy and hard copy of the approved system custom program. Information shall be complete to allow for an alternate Factory Authorized Distributor to service, maintain, add, or delete devices as required.

8. Maintain all fire alarm system devices clean and free of dust and any construction debris. Provide report showing that all sensors are below 15% level of smoke obstruction sensitivity after end of construction. After successful fire alarm system acceptance test by the owner, the electrical contractor shall perform an automatic fire alarm system self-test on each sensor. A report shall be provided to the owner clearly listing all sensors in the building and results of the automatic self-test on each sensor with clearly indicating “percent of smoke obstruction” at each sensor. Report shall also list condition of notification devices to ensure they are clean and free of dust and any construction debris.

3.4 SERVICES

A. The contractor shall warrant the entire system against mechanical and electrical defects for a period described in the contract general conditions. This period shall begin upon completed certification and test of the system or upon first beneficial use of the system, whichever is earlier.

B. The contractor or manufacturer shall offer for the owner’s consideration at the time of

system submittal a priced inspection, maintenance, test, and repair contract in full compliance with the requirements of NFPA 72.

1. The services offered under this contract shall be performed at no charge during the first year after system acceptance and the owner shall have the option of renewing for single or multiple years up to five years at the price quoted upon completion of the warranty period.

2. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification of the completed system to the UL for specific installed system listing.

C. Furnish training as follows for a minimum of four employees of the system user:

1. Training in the receipt, handling, and acknowledgement of alarms.

2. Training in the system operation including manual control of output functions from the system control panel.

3. Training in the testing of the system including logging of detector sensitivity, field test of devices and response to common troubles.

4. The total training requirement shall be a minimum of 24 hours or as required by the Owner, conducted on three successive days, but shall be sufficient to cover the items specified.

D. Prepare and start systems as directed by the Architect.

1. Include services of a certified technician to supervise adjustments and final connections, if required by the local authority having jurisdiction, to include: [speaker][horn] volume setting, strobe intensity, detector sensitivity and door release adjustment.

3.5 WARRANTY

A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

B. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72 guidelines.

END OF SECTION 284600

SECTION 27 0500
COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Specifications, Standards, and Codes
   1. All work shall be in accordance with the following:
      a. This Technical Specification and Associated Drawings
      b. TIA/EIA 568-C.0 Generic Telecommunications Cabling for Customer Premises
      c. TIA/EIA 568-C.1 Commercial Building Telecommunications Cabling Standard
      d. TIA/EIA 568-C.2 Balanced Twisted Pair Cabling Components Standard
      e. TIA/EIA 568-C.3 Optical Fiber Cabling Components Standard
      f. TIA/EIA 942 Telecommunications Infrastructure for Data Centers
      g. TIA/TIA 569-A Commercial Building Standard for Telecommunications Pathways and Spaces
      h. TIA/EIA 606-A Administration Standard for the Telecommunications Infrastructure of Commercial
      i. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
      j. ANSI/TIA-758-A Customer Owned Outside Plant Telecommunications Infrastructure Standard
      k. National Fire Protection Agency (NFPA)-70 National Electric Code (NEC)
      l. UL 50 Enclosures for Electrical Equipment
      m. Current design and installation contractor agreement with single solution manufacturer.
   2. If a conflict exists between applicable documents that cannot be verbally negotiated between the contractor and the owner, then the order in the list above starting with #1 above shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency. If a conflict is found, it shall be the discovering party's responsibility to notify the Architect of these specifications for clarification and resolution.
   3. The contractor shall comply with all requirements for permits and tests, shall provide all certificates, and shall pay all costs for same.

B. SCOPE
   1. The work to be done under this Section of the Specifications shall include the furnishing of labor, material, equipment, and tools required for the complete installation of the work indicated on the Drawings or as specified herein.
   2. All materials, obviously a part of the Telecommunications Infrastructures and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.
   3. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the architect shall be notified of the discrepancy.

1.02 WORK INCLUDED

A. The Communications Infrastructures installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:
   1. Horizontal and Backbone Cabling Infrastructure
   2. Telecommunications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards as indicated on the Drawings.
   3. Grounding and Bonding

4. Concrete work for wall and floor penetration.

1.03 DEFINITIONS

A. Terms: The following definitions of terms supplement those of the GENERAL REQUIREMENTS and are applicable to the TELECOMMUNICATIONS WORK SCOPE.

B. Provide: As used herein shall mean "furnish, install and test (if applicable) complete".

C. Infrastructure: As used herein shall mean cable, installed in conduit, raceway, or cable tray with all required boxes, fittings, connectors, and accessories; completely installed."

D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.

1.04 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop Drawings, equipment location Drawings, foundation Drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

C. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.

E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.

F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Technology plans.

H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.

I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.

J. Review all architectural Drawings for modular furniture.

K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as indicated on the Drawings", "In accordance with", "a", "the" and "all are intended" shall be supplied by inference.

1.05 SUBMITTALS

A. Before installation of any cable or support equipment the contractor shall submit shop drawings and product data for the RCDD and designer for review and approval. The contractor shall indicate installation details, cable routing, system configurations, and outlet numbering on all drawings. The contractor shall submit all appropriate product data for each component to be

supplied. The contractor shall also submit manufacturer installation instructions. Three (3) copies of all the above and following shall be submitted.

B. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.

C. Immediately after reward, the contractor shall submit a construction schedule listing construction milestones including: delivery of construction materials, staffing, backbone installations, equipment room fit-out, horizontal cable installation, testing, and pre-final and final construction observations.

D. Also after reward, contractor to submit Schedule of Value that coincides with construction schedule. This schedule of values shall be used for evaluation of pay requests. Schedule of Values to include all labor and material costs.

E. Project Record Documents: The record documents shall be bound and consist of the following:
   1. Product cut sheets for all products supplied.
   2. Test reports for horizontal cabling.
   3. Test reports for backbone cabling.
   4. Manufacturer Warranties
   5. “D-Size” As-Built drawings.

F. As-Built drawings should accurately record location of service entrance conduit, termination backboards, outlet boxes, cable raceways, cable trays, pull boxes, and equipment racks electronically using AutoCAD 2022 or later version and on minimum “D” size reproducible paper prints.

G. The contractor shall prepare 11” x 17” as-built serving zone drawings for each Telecommunication Room. The drawing shall be laminated, framed, and secured to the wall in the Telecom Room.

1.06 QUALITY ASSURANCE

A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.

B. Equipment shall bear labels attesting to Underwriters Laboratories or certification by other recognized laboratory, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

C. The Owner reserves the right to send its RCDD as a representative to inspect the job site during construction to ensure compliance with the Contract Documents.

1.07 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated telecommunications systems.

B. Telecommunications Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Project Engineer of the following:
   1. List of three (3) reference accounts at which similar work, both in scope and design, have been completed by the contractor with the last two (2) years.
   2. The credentials (current BICSI certification stamp) of the responsible RCDD must be attached to the contractor’s response for evaluation by the Project Engineer.

C. Contractor must be licensed in the State of North Carolina as a Telecommunications Class or Unrestricted Class Low-Voltage Contractor (LVL).

D. The Licensed Low-Voltage Telecommunications Contractor (LVLTC) must be based in the State of North Carolina.

E. The installation of all cable, equipment, terminations, & associated services should be performed by a company that is currently a Manufacturer's Certified Structured Cabling System installer in good standing with minimum of three (3) years of experience on similar systems.

F. The installation company must have an RCDD on staff performing the role of Project Manager and be available for consultation and to attend project meetings.

G. A BICSI certified installer shall be employed by the contractor and be on site as the installation manager.

H. Installer's Qualifications:
   1. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.
   2. General electric trade staff shall not be used for the installation of the premises' distribution system cables and associated hardware.
   3. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified copper and fiber optic cable and components.
   4. Installer must be a current Certified Installer and must submit the current certificate with their proposal

1.08 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate telecommunications work with that of other Sections as required to ensure that the entire telecommunications work will be carried out in an orderly, complete and coordinated fashion.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – COPPER CONNECTIVITY SYSTEM

A. All copper cables and components shall be provided and installed by manufacturer certified installers that shall provide an extended warranty of 25 years for certified installations. Manufacturer shall provide warranties and contractor shall provide documentation of certification by manufacturer. Acceptable copper solution manufacturers shall be the products of the following manufacturers:
   1. Panduit
   2. Siemon
   3. Leviton
   4. Belden
   5. CommScope

B. The contractor shall maintain a current status with the manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel in accordance with their current contract agreement to support the 25-Year System Warranty requirements. After installation, the Contractor shall submit all documentation to support the requirements of the Warranty and to obtain said warranty on behalf of the owner. The warranty will cover the components and labor associated with the repair/replacement of any defective link within the warranty period when the defect is a valid warranty claim.

2.02 ACCEPTABLE MANUFACTURERS – FIBER OPTIC CONNECTIVITY SYSTEM

A. All fiber optic cables and components shall be provided and installed by manufacturer certified installers that shall provide an extended warranty of 25 years for certified installations. Manufacturer shall provide warranties and contractor shall provide documentation of certification

by manufacturer. Acceptable fiber optic solution manufacturers shall be the products of the following manufacturers:

1. Panduit
2. Siemon
3. Leviton
4. Belden
5. CommScope
6. OCC

B. The contractor shall maintain a current status with the manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel in accordance with their current contract agreement to support the 25-Year System Warranty requirements. After installation, the Contractor shall submit all documentation to support the requirements of the Warranty and to obtain said warranty on behalf of the owner. The warranty will cover the components and labor associated with the repair/replacement of any defective link within the warranty period when the defect is a valid warranty claim.

2.03 MATERIALS

A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.

B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.

C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.

D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.

E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.

F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 - EXECUTION

3.01 EXAMINATION OF SURFACE CONDITIONS

A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.

B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.

C. In the event of a discrepancy, immediately notify the Project Manager.

D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.

B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.

C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.

D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Project Manager shall be final.

E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.

B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.

C. Where the Project Manager determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Project Manager, at no additional cost to the Owner. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.04 CLEANING

A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by telecommunications work.

B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

3.05 COMPLETION

A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.

B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.

C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

A. See specific Low Voltage sections for testing parameters of sub-systems.

B. The Contractor shall verify that requirements of this specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.

C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.

D. The Contractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the telecommunications systems, components and subsystems meet specification requirements in the "as-installed" operating environment during the "System Operation Test". Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the "System Operation Test".

E. The Contractor shall carefully plan and coordinate the final acceptance tests so that tests can be satisfactorily completed. The Contractor shall provide necessary instruments, labor and materials required for tests, including the equipment manufacturer's technical representative and qualified technicians in sufficient numbers to perform the tests within a reasonable time period.

F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.

G. After the Contractor systems have been installed and tested, the completed test plan shall be signed by the Telecommunications Contractor Project Manager and submitted for approval.

END OF SECTION

SECTION 27 0526
GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Grounding & Bonding for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document.

D. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Grounding Conductors.
   2. Furnish and install all Grounding Lugs and Hardware.

C. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Grounding Conductor manufacturer(s):
   1. Southwire
   2. West Penn
   3. Belden

B. Approved Grounding Lug manufacturer(s):
   1. Burndy
   2. Thomas & Betts
   3. Chatsworth Products, Inc.
   4. Harger

C. Approved Grounding Busbar manufacturer(s):
   1. Burndy
   2. Thomas & Betts
   3. Chatsworth Products, Inc.
   4. Harger

2.02 GROUNDING CONDUCTORS

A. Grounding Conductor
   1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL listed jacket is applied.
   2. Jacket color shall be green. Jacketed cable shall be identified at each termination point with a wrap of green tape.

2.03 GROUNDING LUGS

A. Grounding Lugs and Hardware
   1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

PART 3 - EXECUTION

3.01 GROUNDING

A. All equipment, racks, cabinets, enclosures, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MC/IC/TC shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.

B. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap or green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA/EIA-606-A.

C. The ground/earth system must be designed for high reliability. Therefore, the grounding/earthing system shall meet following criteria:
   1. Local electrical codes shall be adhered to.
   2. The grounding/earthing system shall comply with ANSI/TIA-942 and J-STD-607-A.
   3. All grounding/earthing conductors shall be copper.
   4. Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.

D. The gauge of the connecting ground/earth cable, known as the Telecommunications Bonding Backbone (TBB) will follow J-STD-607-A guidelines, as is shown in the table below.

E.

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
Greater than 20 (66)	3/0

F. Ladder racks shall be bonded per the manufacturer's installation instructions. To provide electrical continuity between ladder rack segments drill holes in rack and use a #6 AWG code cable with green/yellow stripe to jumper between segments. The jumper shall be made with 2-hole copper compression connectors terminated on both ends. Attach jumpers as required to ladder rack and then bond the entire assembly to the TGB.

G. Equipment and racks shall be bonded in accordance with the methods prescribed in ANSI/TIA-942. To provide electrical continuity between rack elements, paint piercing grounding washers shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack. All racks shall utilize a full-length rack ground strip attached to the rear of the side rail with thread-forming screws to ensure metal-to-metal contact. Patch panels will be bonded to racks using bonding screws for racks having #12-24 equipment mounting holes.

H. Reference low voltage drawing package for additional requirements.

3.02 IDENTIFICATION

A. Refer to section 27 0553 for labeling details.

END OF SECTION

SECTION 27 0528
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Pathways for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of interior telecommunications pathways and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install complete Conduit System – Reference Electrical Specifications.
   2. Furnish and install all Telecommunications Outlet Boxes.
   3. Furnish and install all Pull Boxes.
   4. Furnish and install complete Cable Tray System.
   5. Furnish and install all Velcro Straps.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Velcro Strap manufacturer(s):
   1. Panduit
   2. Tyco
   3. Hubbell
   4. Or Approved Equal

B. Innerduct
   1. Exposed innerduct shall be rated CMP (plenum), corrugated plastic equipped with pull-string or mule tape.
   2. Sizes shall be 2”, 1-1/4” & 1” inside diameter.
   3. See Drawings for innerduct details.

2.02 PULL BOXES

A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.

B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.

C. Pull boxes shall have provisions for grounding.

2.03 CABLE TRAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chalfant Manufacturing Company.

2. Cooper B-Line, Inc.
3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
4. GS Metals Corp.; GLOBETRAY Products.
5. MONO-SYSTEMS, Inc.
6. MPHusky.
7. PW Industries.

B. Material & Finishes - Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
1. Factory-standard primer, ready for field painting; with cadmium-plated hardware according to ASTM B 766.
2. Mill galvanized before fabrication, complying with ASTM A 653/A 653M, G90 (Z275) coating; with hardware galvanized according to ASTM B 633. Electrogalvanized before fabrication, complying with ASTM B 633; with hardware galvanized according to ASTM B 633.
3. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, hardware.
4. Epoxy-resin paint over paint manufacturer's recommended primer and corrosion-inhibiting treatment; with cadmium-plated hardware according to ASTM B 766.

C. Sizes and Configurations: Refer to Drawings for specific requirements for types, materials, sizes, and configurations.

D. Center-hanger supports may be used only when specifically indicated.

E. Cable Tray Accessories:
1. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
2. Barrier Strips: Same materials and finishes as cable tray.
3. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

F. Warning - Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

G. Materials and fastening are specified in Division 26 Section "Electrical Identification."

H. Source Quality Control - Perform design and production tests according to NEMA VE 1.

2.04 VELCRO STRAPS

A. Velcro Straps
1. Cables shall be fastened to support structures with Velcro straps.
2. Velcro straps installed in air handling spaces must be plenum rated.
3. Plenum Velcro strap color shall be red.
4. Use 1-inch wide Velcro to secure cables to all support structures.

PART 3 - EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports to building structure.
1. Design each fastener and support to carry load indicated by seismic requirements.
2. Place supports so that spans do not exceed maximum spans on schedules.
3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
4. Support bus assembly to prevent twisting from eccentric loading.

5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA VE 1.

D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.

F. Make changes in direction and elevation using standard fittings.

G. Make cable tray connections using standard fittings.

H. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

I. Workspace: Install cable trays with enough space to permit access for installing cables.

J. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

K. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.02 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

3.03 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.04 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.05 PROTECTION

A. Protect installed cable trays.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
   3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

3.06 PENETRATIONS

A. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base of building. Impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the Project Manager as required by limited working space. X-ray all floor penetrations accordingly.

B. Holes shall be located so as not to affect structural sections such as ribs or beams.

C. Holes shall be laid out in advance. The Project Manager shall be advised prior to drilling through structural sections, for determination of proper layout.

D. Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors provide a code compliant effective barrier against the spread of fire, smoke and gases.

E. All penetrations where conduit is not used shall be sleeved.

F. No gaps or rough edges shall be allowed between wall and conduit/sleeve.

3.07 CONDUIT SYSTEM

A. All conduit shall not be less than 3/4” trade size.

B. No more than two 90 degree sweep bends or the equivalent shall be permitted between junction boxes, pull boxes, cabinets, or cable access points.

C. Conduit shall be provided as a continuous run perpendicular from the cable tray to the work area outlet. All cables shall be enclosed in conduit or cable tray for protection.

D. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the Drawings.

E. Leave all empty conduits with a 200 pound test nylon cord pull line.

F. A 200 pound test nylon cord pull line shall be co-installed with all cable installed in any conduit.

G. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.

H. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.

I. Install conduit with wiring, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.

J. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.

K. Attach backbone conduits larger than one-inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.

L. Where conduits must pass through structural members obtain approval of Architect.

M. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.

N. Provide expansion and deflection coupling where conduit passes over a building expansion joint.

O. All other conduit, unless specified herein, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas. PVC to be installed below concrete in grade. Contractor to utilize Rigid Galvanized Steel (RGS) elbows for all slab penetrations and stub-ups.

P. Telecommunications cables shall not occupy conduits with power cables.

Q. Metallic conduits shall be grounded in accordance with J-STD-607-A.

R. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.

S. Conduit runs shall not have more than two (2) 90-degree bends between pull points.

T. Telecommunications conduit system shall contain no condulets (also known as an LB).

U. Horizontal Conduits
   1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

3.08 TELECOMMUNICATIONS OUTLET BOXES

A. Exact locations of the outlet boxes shall be coordinated with the electrical contractor and other trades.

B. The approximate locations of the outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

C. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on the architectural elevations.

D. Install all outlet boxes in finished areas flush with the wall. Maintain 1/4" or less space between outlet box front and finished wall surface.

E. Outlet boxes shall be firmly anchored in place and shall not depend on the cover plate to hold it secure to the wall.

F. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

3.09 PULL BOXES

A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.

B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.

C. Pull boxes shall be free from burrs, dirt and debris.

D. Pull boxes shall be installed in accordance with ANSI/TIA/EIA-569-A.

E. Pull boxes shall be grounded in accordance with J-STD-607-A.

3.10 CABLE TRAY SYSTEM

A. Install trays in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of the NEC.

B. All open trays shall be installed a minimum of six (6) inches away from any light fixture.

C. Provide external grounding strap at expansion joints, sleeves, crossover and other locations where tray continuity is interrupted.

D. Support all pathways from building construction. Do not support pathways from ductwork, piping or equipment hangers.

E. Install cable tray level and straight.

F. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete cable tray system.

G. Cable trays shall not be used to house both low voltage and power cables unless cables are separated by a grounded physical barrier.

H. Cable tray system shall be grounded in accordance with J-STD-607-A.

I. Bundle horizontal distribution cables in groups not greater than 50 cables.

3.11 VELCRO STRAPS

A. Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Do not over-cinch cables.

END OF SECTION

SECTION 27 0553
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Administration & Labeling for Communications Systems.

C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide the following submittals:
   1. Product data
   2. Product samples
   3. Label sample showing example and text size for each item
   4. Software program sample

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Perform all Labeling.

PART 2 - PRODUCTS

2.01 LABELS

A. All labels shall be vinyl.

B. All labels shall have an adhesive backing for permanent attachment.

C. All labels shall be of sufficient size. Minimum sizes shall be as follows:
   1. 1-1/2"W x 3/16"H for:
      a. Outlets
      b. Outlet cables
      c. Patch panels
      d. Ground wires
      e. Backbone cable pairs
   2. 4"W x 1"H for:
      a. Backbone cables
      b. Equipment racks
      c. MDF frames
      d. Active hardware and multiplexers
   3. 3” Square Tag mechanically stamped, legible, and permanent affixed. Tag shall be copper, brass, or 1/16” plastic.
      a. Cable Tray
      b. Riser Backbone Conduits
      c. Backbone Conduits

2.02 LABEL HOLDERS

A. Labels attached to backbone cable bundles shall be installed on a label holder of sufficient size. Label holder to be plastic and have tie wrapping provisions.

2.03 SOFTWARE PROGRAM

A. Software program shall be of the following types or similar:
   1. PANDUIT labeling program
   2. Brady labeling program
   3. Thomas & Betts labeling program
   4. Excel, customized

2.04 TEMPORARY LABELS

A. Vinyl labels, hand written, with permanent marker.

2.05 CHARTS

A. Provide printed charts containing required punch down and cross-connect information. Charts to be computer generated. File information shall be turned over to owner in printed and electronic format four (4) weeks prior to job completion.

2.06 AS-BUILT PLAN

A. Description: At the completion of the project, provide an "as-built" floor plan of each floor to the Project Engineer for approval.

PART 3 - EXECUTION

3.01 LABELING REQUIREMENTS

A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA/EIA-606 document, manufacturer's recommendations and best industry practices.

B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.

C. All labels shall be clear with black text.

D. All cables shall be labeled with machine generated, wrap around labels.

E. A total of three (3) labels per horizontal cable are required at the following intervals: 6" from outlet; 18" from outlet' 12" from termination block/patch panel.

F. Labeling scheme shall be alphanumeric.

G. Provide and generate all labeling (no labels will be furnished by the owner).

H. Labels shall be developed and printed using a software program.

I. Software program and all in-puts shall be turned over to the owner at the end of the project.

3.02 INSTALLATION

A. All labels shall be installed straight.

B. Provide labels at locations as indicated on the Drawings and as follows:
   1. Outlet face plates
   2. Inside of outlet boxes
   3. Outlet cable inside box
   4. Outlet cable in ceiling above outlet
   5. Outlet cables at poke through entrance on both sides
   6. Outlet cable at rear of patch panel.
   7. Port at rear of patch panel
   8. Port on front of patch panel
   9. Individual fiber strands at rear of patch panel
   10. Backbone cables & conduits whenever exposed on minimum 10' intervals
   11. Backbone cable & conduit at point of termination
   12. Ends of any cored cable put in place that is not terminated
   13. On front of racks, cabinets frames, active hardware, multiplexers
   14. Cable tray.

3.03 LABELING SCHEME

A. In general the following items shall receive labeling:
   1. Outlets:
      a. Top Label: Present Room–Telecom Room–Box Designation in Room. Ex: 112-119-3
      b. Bottom Label: Port Designation: D=Data Jack; T=Voice Jack – Ex. D1, D2, T1
   2. Outlet cables
   3. Backbone cables - (CVR=139) copper backbone to room 139, 1-25, 26-50, 51-75, etc - 200)
   4. Patch panels - (ex. PP#1, PP#2, etc)
   5. Patch panel ports (each) - Station room #, Box Designation in Room, Port Designation in Room. Ex – 112-3-4. Note – If Telecom Room serves 100 jacks, labels would start at 001 and go to 100.
   6. Equipment racks and cabinets - (EX. Rack 1, rack 2, etc)
   7. Ground wires
   8. Active hardware and multiplexers (by owner)

      Note – Contractor to obtain approval from owner/engineer before beginning labeling task.

B. Patch Panel labeling strip colors:
   1. Voice patch panels shall have port labels in “light blue” strips.
   2. Data patch panels shall have port labels in yellow” strips.

3.04 TEMPORARY LABELS

A. Provide temporary labels on all outlet cable as it is roughed-in. The bid documents will not show outlet/cable labeling at the time of the cable rough-in. Replace temporary labels with permanent labels after contract documents have been revised.

3.05 TEXT SIZE AND INFORMATION

A. Text size should be as large and as bold as possible.

B. Exact text required information is shown on the Drawings.

C. Refer to Drawings for all outlet, outlet cables, and backbone cables labels.

D. Refer to the Cover Drawing for exact labeling coding schemes, where applicable.

3.06 LABELING AND REFERENCE CHARTS

A. Contractor to provide a labeling reference chart(s) indicating the following:
   1. Backbone termination of pairs at the local telecommunication room (TR) and main telecommunications room (MR).
   2. Horizontal outlet cable pair termination at the TR.
   3. Data patch panel outlet port termination.

3.07 AS-BUILT PLAN & FRAME

A. Provide and mount frame with "as-built" on TR wall near the data racks, or as indicated on the plans.

END OF SECTION

SECTION 27 0800
COMMISSIONING FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Commissioning of Communications.

C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Perform all Copper Cabling Testing.
   2. Provide all Documentation, As-Builts, Training and Warranty.

PART 2 - TESTING

2.01 TESTING REQUIREMENTS

A. General
   1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B.1-3. All pairs/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.
   2. Copper Testing
      a. All twisted pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category 6 and Category 6A performance. Horizontal balanced twisted pair cabling shall be tested using a level III test unit for category 6 & 6A compliance (data) and category 6 compliance (voice) and performance up to 350 MHz.
   3. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
   4. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B.1-3 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

B. Fiber Testing
   1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests also include continuity checking of each fiber.

2. Test set-up and performance shall be conducted in accordance with ANSI/TIA/EIA-526-7 and/or ANSI/TIA/EIA-526-14 Standards, and to the manufacturer's application guides.
3. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.
4. Multimode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 850nm and 1300nm. Maximum attenuation dB/Km @ 850nm/1300nm shall be 3.5/1.5. Maximum attenuation per connector pair shall be .75 dB.
5. Singlemode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 1310nm and 1550nm. Maximum attenuation dB/Km @ 1310nm/1550nm shall be 0.5/0.5 for outside plant and 1.0/1.0 for inside plant. Maximum attenuation per connector pair shall be .75 dB.

C. Test Results
1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
2. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B.1-3.
3. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. Alternately, the contractor may furnish this information in electronic form (CD). These diskettes or CDs shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable from Microsoft Word.
4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

PART 3 - DOCUMENTATION, AS-BUILTS, TRAINING AND RECORDS

3.01 DOCUMENTATION & AS-BUILTS

A. As-Built record documentation for telecommunications work shall include:
1. Cable routing and identification
2. System function diagrams
3. Manufacturers' description literature for equipment
4. Connection and programming schedules as appropriate
5. Equipment material list including quantities
6. Spare parts list with quantities
7. Details not on original Contract Documents
8. Test Results
9. Warranties
10. Release of Liens

B. The Contractor shall provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract Drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.

C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of Telecommunications infrastructure work.

D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.

E. Furnish as-built drawings and documentation to the Project Engineer for review and approval. As-built drawings shall be generated in AutoCad 2022 or later. Submit as-built drawings electronically on C.D. and hard copy.

3.02 OPERATIONS AND MAINTENANCE MANUAL

A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.

B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate specification sections.

C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.
   1. Operations manuals for components and for systems as a whole.
   2. Maintenance manuals for components and for system as a whole.
   3. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details.
   4. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
   5. Emergency instructions for operational and maintenance requirements.
   6. Delivery time frame for replacement of component parts from suppliers.
   7. Recommended inspection schedule and procedures for components and for system as a whole.
   8. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
   9. Complete "Reviewed" shop drawings and product data for components and system as a whole.
   10. Troubleshooting procedures for each system and for each major system component.

3.03 TRAINING

A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be for not more than ten (10) people, shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

3.04 WARRANTY

A. General
   1. All equipment is to be new and warranted free of faulty workmanship and damage.
   2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the owner.
   3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Horizontal Structured Cabling
   1. Low voltage contractor shall provide a 25-year manufacturer warranty for components used in the installed Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

C. Pathway & Support Infrastructure
   1. Manufacturer(s) shall provide a 1-year warranty for components used in the installed Pathway & Support Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION

SECTION 27 1100
EQUIPMENT ROOM COMPONENTS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cabinets, Racks & Enclosures.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Equipment Racks.
   2. Furnish and install all Equipment Cabinets.
   3. Furnish and install all Equipment Shelves.
   4. Furnish and install all Backboards.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Rack manufacturer(s):
   1. Panduit
   2. Middle Atlantic
   3. CPI

B. Equipment Racks
   1. The equipment rack shall be constructed of high strength, lightweight aluminum.
   2. The vertical rails of the equipment rack shall be equipped with the EIA hole pattern.
   3. Rack shall be: 7’ tall, standard 19" width floor mounted or wall mount racks, as required by contract documents.
   4. Racks shall provide a minimum 20” interior depth for rack mount equipment and front mount cable management.
   5. Floor mount equipment racks and cabinets shall be provided with adjustable height leveling feet or casters.

C. Cable Guides
   1. Between patch panels - Panduit (front & back channels)
   2. Between racks - Panduit (front & back channels)

PART 3 - EXECUTION

3.01 EQUIPMENT RACKS/CABINETS/SHELVES

A. Where mounted to structure, equipment racks shall be securely attached to the floor or structural wall using four (4) 1/2" diameter bolts and associated hardware (anchors & washers) or as required by local codes.

B. Wall mounted equipment racks shall be provided with fire rated plywood backboard for additional mounting support. Backboard shall be mechanically fastened to CMU wall or framing stud. It shall not be acceptable to support wall mount equipment racks using only drywall or gypsum board.

C. Equipment racks/cabinets/shelves shall be installed as per the requirements specified by the manufacturer's installation guidelines.

D. Equipment racks/cabinets shall be placed with a minimum clearance of 30 inches in the front and 30 inches in the rear or as indicated on Drawings.

E. All equipment racks/cabinets shall be grounded to the telecommunications ground bus bar.

F. Mounting screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

3.02 BACKBOARDS

A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 8' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint (Additive Acceptable).

END OF SECTION

SECTION 27 1123
CABLE MANAGEMENT & LADDER RACK

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cable Management & Ladder Rack.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this specification.

1.02 SUBMITTALS

A. Product data.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Horizontal Cable Management.
   2. Furnish and install all Vertical Cable Management.
   3. Furnish and install Ladder Rack System.
   4. Furnish and install all Velcro Straps.

PART 2 - PRODUCTS

2.01 CABLE MANAGEMENT – HORIZONTAL

A. Horizontal Cable Management
   1. The horizontal wire manager shall be compatible with 19-inch equipment racks and cabinets.
   2. The horizontal cable manager shall provide support for patch cords at the front of the panel.
   3. The horizontal wire manager shall be equipped with management fingers and covers.
   4. The horizontal cable manager shall be 2 rack-units in height and shall be 2-sided.

2.02 CABLE MANAGEMENT – VERTICAL

A. Vertical Cable Management
   1. The vertical cable manger shall be double-sided.
   2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
   3. The vertical cable manager shall be a minimum width of 6".
      a. Vertical Cable Manager color shall be black.

2.03 TELECOM ROOM LADDER RACKS

A. Ladder Rack System
   1. See Drawings for ladder rack system details.
   2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
   3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.

a. Ladder Rack System color shall be black.

4. Acceptable Manufacturers include:
   a. Hoffman
   b. Chatsworth

2.04 VELCRO STRAPS

A. Velcro Straps
   1. All cables shall be fastened to support structures with Velcro straps.
      a. Velcro Strap color shall be black.

2.05 LADDER RACK DROP-OUT SHIELD

A. Ladder Rack Drop-Out Shield
   1. Ladder rack drop-out shields shall be required to protect cables as they are routed from ladder rack to all vertical wire managers on equipment racks.

B. Acceptable Manufacturers & Products include:
   1. Hoffman #LRD12BLK or LSRDBLK
   2. Chatsworth #12100-712 or 12100-701

PART 3 - EXECUTION

3.01 CABLE MANAGEMENT – HORIZONTAL

A. Horizontal cable managers shall be installed below patch panels in a 1:1 ratio (one horizontal cable manager per patch panel) or as indicated on Drawings.

3.02 CABLE MANAGEMENT – VERTICAL

A. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.

3.03 LADDER RACKS

A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.

B. Ladder racks shall be supported at 5' intervals maximum.

C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.

D. See Drawings for ladder rack system details.

3.04 VELCRO STRAPS

A. Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Do not over-cinch cables.

3.05 LADDER RACK DROP-OUT SHIELD

A. Install in ladder rack above equipment racks to support cables as they are routed from the ladder rack to the equipment rack.

END OF SECTION

SECTION 27 1126
COMMUNICATIONS RACK MOUNTED POWER STRIPS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Rack Mounted Power Strips.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

D. Provide one (1) power strip for each equipment rack. See rack elevation drawings.

1.02 SUBMITTALS

A. Provide product data

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Power Strips.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Power Strip manufacturer(s):
   1. Chatsworth Products, Inc.
   2. Ditek
   3. Geist
   4. ITW Linx

2.02 POWER STRIPS

A. Power Strip
   1. The power strip shall be equipped with a minimum of six (6) 3-prong, 120 VAC outlets, 6' cord and an on/off switch. Outlets shall accept side pole neutral plugs.
   2. The power strip shall be equipped with surge protection with a 20 Amp current limit.
   3. The power strip shall be equipped with a bracket that enables it to be mounted on a 19" rack, cabinet or wall mount bracket without modification.

PART 3 - EXECUTION

3.01 POWER STRIPS

A. Power strips shall be installed as per the requirements specified by the manufacturer's installation guidelines.

B. See Drawings for installation location on rack(s)/cabinet(s).

END OF SECTION

SECTION 27 1500
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Structured Communications Copper Horizontal Cabling.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of horizontal cabling and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Contractor shall provide submittals indicating the following:
   1. Cable description
   2. Use of cable
   3. Product data
   4. Specifications outlining cable
   5. Testing and qualification data
   6. Samples, approximately 12” in length

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Horizontal Copper Cable.

PART 2 - PRODUCTS

2.01 HORIZONTAL DATA, VOICE, & WIRELESS DATA COPPER CABLE

A. CATEGORY 6 BALANCED TWISTED PAIR CABLE – VOICE & DATA
   1. Description: 100-ohm, 4-pair UTP, 350 MHz certified cable, covered with a Blue thermoplastic jacket or as directed by the Owner Representative.
      a. Comply with ICEA S-90-661 for mechanical properties.
      b. Comply with ANSI/TIA/EIA-568-B.1 for performance specifications.
      c. Comply with ANSI/TIA/EIA-568-B.2, Category 6.
      d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types: Communications, Plenum Rated: Type CMP.

B. CATEGORY 6A BALANCED TWISTED PAIR CABLE – WIRELESS DATA
   1. Description: 100-ohm, 4-pair UTP, 500 MHz certified cable, covered with a Blue thermoplastic jacket or as directed by the Owner Representative.
      a. Comply with ICEA S-90-661 for mechanical properties.
      b. Comply with ANSI/TIA/EIA-568-C.1 for performance specifications.
      c. Comply with ANSI/TIA/EIA-568-C.2, Category 6A.
      d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types: Communications, Plenum Rated: Type CMP.

2.02 COPPER PATCH CABLES

A. Provide one patch cable for each terminated Category 6 and Category 6A cable.

B. 50% of patch cables shall be approximately 2 meters in length, 25% of patch cables shall be approximately 3 meters in length, and 25% of patch cables shall be approximately 1 meters in length. Cable used for the construction of patch cables shall be UL or ETL verified to meet Category 6 and Category 6A requirements and the cable jacket shall be labeled to indicate verification.

C. Patch cords shall be color coded by system type to match the Owner's requirements. Basis of design shall be as follows:
   1. Voice/Data Communications:: Blue
   2. Wifi Communications: Green

D. Provide the following:
   1. One RJ45 to RJ45 jacketed Cat 6 patch cable for each data patch panel port.
   2. One RJ45 to RJ45 jacketed Cat 6A patch cable for each white wireless data patch panel port.
   3. For all voice services, provide ten (10) 3-meter hybrid patch cords. Patch cords to be RJ-45 to 2-pin straight connector.
   4. One set of two factory made fiber patch cords of a length and type to be specified by the owner (typically 3 meter Single Mode and Multimode SC-LC) for each fiber run.
   5. Three (3) 500' spools of pair one, 24AWG, cross connect wire for the entire project.

PART 3 - EXECUTION

3.01 HORIZONTAL CABLES

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-A maximum fill for the particular raceway type.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

E. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

G. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

H. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

I. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

J. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

K. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.2 document, manufacturer's recommendations and best industry practices.

L. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow-wall

installations where box-eliminators are used, excess wire can be stored in the wall. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

M. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

N. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support straps. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

O. When creating service loops for copper cables, they should be coiled in a Figure-eight configuration to eliminate adding to the problems of Return Loss and NEXT.

END OF SECTION

SECTION 27 1543

FACEPLATES & CONNECTORS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Faceplates & Connectors.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of horizontal cabling and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 SUBMITTALS

A. Provide the following submittals:
   1. Product data
   2. Sample of each outlet correctly configured.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Copper Connectivity.
   2. Furnish and install all Faceplates.
   3. Furnish and install all Surface Mount Boxes.

PART 2 - PRODUCTS

2.01 COPPER CONNECTIVITY

A. Horizontal Module
   1. The horizontal module shall accommodate up to four (4) Category 6, 8-position, 8-contact modular jacks.
      a. Each jack shall be power sum rated, with a power sum NEXT performance equal to or better than the ANSI/TIA/EIA-568-C-2 Category 6 pair-to-pair NEXT performance specifications.
      b. Each jack shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
      c. The connector module shall be designed for use at the Work Area, Telecommunications Room and/or Equipment Room without modification.
      d. Each jack shall be T568B wiring configuration.
      e. Each jack shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
      f. Jack colors shall be confirmed by the owner. Unique jack colors shall be required for voice, data, spare and wireless access point outlets. Basis of design for color codes shall be as follows:
         1) Faceplates and Blanks: Electric Ivory
         2) Telephone Communications: Electric Ivory
         3) Data Communications: Blue
         4) Wifi Communication: Green

2. For Category 6A wireless access point circuits, the horizontal module shall accommodate up to four (4) Category 6a, 8-position, 8-contact modular jacks.
    a. Each jack shall be power sum rated, with a power sum NEXT performance equal to or better than the ANSI/TIA/EIA-568-C-1 Category 6A pair-to-pair NEXT performance specifications.
    b. Each jack shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
    c. The connector module shall be designed for use at the Work Area, Telecommunications Room and/or Equipment Room without modification.
    d. Each jack shall be T568B wiring configuration.
    e. Each jack shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
    f. Jack colors shall be confirmed by the owner. Unique jack colors shall be required for voice, data, spare and wireless access point outlets. Basis of design shall be Electric Ivory.

B. F-connectors shall be By Thomas & Betts and of the “Snap N Seal” type model.

2.02 FACEPLATES

A. Faceplates – Straight-Type
1. The faceplate housing the connector modules shall have no visible mounting screws.
2. It shall be possible to install the connector modules in wall-mounted single-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters.
3. The faceplate housing the connector modules shall have the option of being mounted on adapter boxes for surface mount installation.
4. The faceplate housing the connector modules shall have a labeling capability using built-in labeling windows to facilitate outlet identification and ease network management.
5. The faceplate housing the connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present of future network needs.
6. Blank inserts shall be used on faceplates for all unused ports.
7. Basis of design shall be Panduit CFPL4EIY with CMBEI-C blank modules.

2.03 SURFACE MOUNT BOXES

A. The surface mount box shall accommodate horizontal and video connections.

B. The surface mount box shall have internal storage space for slack cabling and a built-in spool for controlling cable bend radius.

C. Color shall be Electric Ivory.

PART 3 - EXECUTION

3.01 COPPER CONNECTIVITY

A. 8-position, 8-contact modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

3.02 FACEPLATES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

C. Faceplates shall be installed straight and level.

D. Faceplates shall be installed at heights as noted on the Drawings.

3.03 SURFACE MOUNT BOXES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

C. Surface mount boxes shall be installed straight and level.

D. Surface mount shall be installed at heights as noted on the Drawings.

END OF SECTION

SECTION 28 1300
SECURITY & ACCESS CONTROL

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Contract drawings, specifications, and general provisions of the Contract, including General and Supplementary Conditions, apply to this section.

1.02 SUMMARY

A. This section of the specifications requires the addition of An Access Control System (ACS), herein referred to as the ACS. All ACS off-line wire-free locks, card readers, control units, access cards shall be purchased and installed by the Security Contractor. Hardwired electric door hardware is being provided and installed by the General Contractor. Loading of software, programming and training will be performed by the Security Contractor. The ACS will monitor controlled doors for forced entry and held open statuses and monitor intrusion detection devices including glass break detectors.

B. The electronic security contractor shall be responsible for all cabling, hardware and miscellaneous equipment required to provide a fully functional residential ACS.

C. The electronic security contractor shall coordinate with the owner for each system's requirements for notifying security personnel or proper authorities.

1.03 ACCEPTABLE MANUFACTURERS

A. ACS equipment shall be S2, Keyscan, Avigilon, Genetec, or approved equal.

1.04 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by reference.
   1. FCC compliance
   2. UL compliance
   3. NEC compliance
   4. IBC 2006

1.05 INSTALLER'S QUALIFICATIONS:

A. Firm with at least 3 years of successful application, installation, and testing experience on specified systems and equipment. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General Electric trade staff shall not be used for the installation of the electronic security system and associated hardware. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified equipment.
   1. The responsibilities of the contractor shall include but not be limited to the following:
      a. Shop drawings for all electronic security equipment.
      b. Installation of all new electronic security equipment as documented in the drawings and specifications.
      c. Wire and wiring termination for all electronic security equipment.
      d. Assisting in the testing and check-out of ACS security equipment.
      e. Training for all electronic security equipment.
      f. Warranty for all electronic security equipment.
      g. As-Built drawings, operations and maintenance for the complete electronic security.

1.06 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of system equipment. Include drawings that contain complete wiring and schematic diagrams and other details required to demonstrate that the

system has been coordinated and will function properly as a system. Drawings shall include floor plan layouts showing device locations, vertical riser diagrams, equipment rack details, elevation drawings of equipment racks, sizes and type of all cables and conduits.

B. Test Plan: Contractor shall submit a test plan that defines the tests required to ensure that the system meets technical, operational, and performance specifications, 30 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

C. Manufacturer Certification: Submit a letter from the manufacturer's representative stating the proposed systems being submitted for review are in accordance with the recommendations of the manufacturer.

D. It is the responsibility of the contractor to meet with the appropriate Owner’s representative to compare the placement and installation of proper devices with the drawings and specifications. A 100% device by device test will be conducted by the vendor under the supervision of the Architect / Engineer representative. Punch lists will be developed at that time and furnished to the contractor. All punch list items must be corrected and verified prior to acceptance of the system.

1.07 CONTRACT DRAWINGS

A. The Contract Drawings indicate the arrangement of the access control system doors and electronic security devices. Coordinate installation of equipment with the structural, mechanical, and electrical equipment and access thereto. Coordinate installation of recessed equipment with concealed ductwork and piping, and wall thickness.

B. All raceways required for the electronic security System are not shown on the Contract Drawings.

1.08 RECORD DOCUMENTS

A. At the time of final inspection, provide four (4) sets of complete data on the electronic security equipment used in this project. This data shall be in bound, hard copy form and shall include all as-built drawings required for this project. One (1) CD with complete data and drawings must also be provided. This complete data shall include the following.
   1. Warranty statement (include warranty start date, service provider contact phone number and address)
   2. Letters of certification from system manufacturers
   3. Maintenance and operating instructions on all systems
   4. As-built drawings for all systems with color code to show the actual as-built conditions.

B. All record drawings shall include "as built" system interconnection diagrams with major components identified, along with number and type of interconnecting conductors. Drawings must be submitted as full-size, bound sets as well as electronic files on CD.

C. Binders with maintenance and operating instructions on all systems. These binders must incorporate a cover with project name, an index and sections for each major component.

D. Certification from system manufacturers that systems are installed in accordance with manufacturer's recommendations and are functioning correctly at the time of final inspection.

E. Submit four (4) sets of full size (30” x 42”) of as-built drawings to show wiring for all installed equipment and one (1) electronic copy on CD. Electronic drawings must be AutoCAD “DWG” files.

F. As-built drawings must incorporate point-to-point drawings for all systems with color code to show the actual as-built conditions. Copies of the contract document drawings, without modifications showing actual as-built conditions will not be accepted.

G. The final payment will not be approved until all of the aforementioned requirements for Record Documents have been satisfied.

1.09 WARRANTY

A. The Contractor shall warrant the electronic security system for one year from date of Owner's Acceptance against defects in equipment or workmanship. Failed equipment shall be replaced by the contractor at no cost to the owner. Owner's personnel may perform initial trouble investigation, but replacement of failed equipment and escalated problem support will be handled by the contractor.

B. The warranty period shall not start until the Owner has provided a written Letter of Acceptance. It shall be the Contractor's responsibility to request and obtain the Letter of Acceptance from the Owner.

C. Once the Contractor has obtained a Letter of Acceptance from the Owner, the Contractor must provide a Warranty Letter to the Owner. The Warranty Letter must state the start date of the Warranty, instructions that explain how warranty request are to be made and contact name / phone number for service.

1.10 DESCRIPTION

A. The work included under this section of the specifications consists of the installation of a complete ACS and IDS systems. Provide all labor, equipment, materials, and supervision to install, calibrate, adjust, document, and test the total system as required herein and on the drawings.

B. The contractor shall provide all documentation and shall perform all duties involved in obtaining permits and inspections as required to complete the project. All permitting shall be within the associated city or jurisdiction.

C. The work shall consist of the installation of a complete electronic security system consisting essentially of, but not limited to, the following major components:
   1. Installation of Control Panels, control modules and keypads
   2. Field Peripheral Devices (i.e., duress switches, keypads, door position switches, card readers, glass break detectors, and door sounder hardware, etc.)
   3. Power supplies, Batteries & Uninterruptible Power Supplies (UPS)
   4. Low Voltage Cable and Raceway
   5. Access control components

PART 2 - PRODUCTS

2.01 ELECTRIC DOOR HARDWARE

A. Electrified door hardware shall be provided and installed by the Door Hardware Contractor with the exception of the offline access-controlled door system.

B. Security Contractor shall be responsible for the interface with and connection to any built-in door position switches within the electrified door hardware.

2.02 BULDING HARDWIRED CARD READERS

A. Contractor to provide proximity technology cards readers that shall operate with 13.56MHz proximity card technology and provide mobile access.
   1. Read range shall not be less than 5.5 inches.
   2. Card readers shall be equipped with multi-color LED's and internal beeper. Control of the LED's and beeper shall be internal or from the host.
   3. Card reader must be housed in a weatherproof and secure potted enclosure.
   4. A minimum of two (2) color options must be provided to the Owner.
   5. A low profile version, as well as a surface mounted mid-range device with / without keypad and a surface mounted long range device.
   6. Card readers must be compatible with OSDP/OSDP-SC Communication Protocol.
   7. Card reader to be provided with low energy bluetooth radio.

2.03 SECURITY CREDENTIALS

A. The access card shall be standard 13.56 MHz prox/smart cards or keyfobs.

B. The card must be provided with external card number, slot punched and sequentially numbered.

C. The Contractor shall provide the necessary labor to program the initial, start-up card holder database. This includes the necessary coordination with the Owner to establish access levels, obtain card holder names and assign cards for the first 100 card holders.

D. The contractor shall provide a total of 50 cards or keyfobs.

E. The contractor shall provide 24 months of mobile access licenses for 20 users.

2.04 CENTRAL SYSTEM

A. The ACS System's Central System equipment shall be comprised of but not limited to the following minimum components/equipment:
1. Network File Server shall be provided by owner. Contractor to coordinate with Owner's IT department for system requirements.
2. Client Workstation/Enrollment Workstations shall be provided by owner. Contractor to coordinate with owner for system requirements. Provide 5-client licenses.

2.05 DOOR CONTROL PANELS

A. The ACS control panels shall be intelligent and fully stand-alone processor capable, making all local access control and alarm monitoring decisions without host server dependency. Control panels shall support and provide the following:
1.
2. UL listed under UL 294 and UL 1076; FCC Part 15 and CE compliant.
3. Direct on-board support for industry standard RS232, RS422, Dial-up modem AT command set, and 10/100Mb Ethernet communications interfaces to ACS hosting server or operator workstations.
4. Support for redundant communications to ACS hosting server or operator workstations; primary communications via 10/100Mb Ethernet with automatic switchover to secondary communications via dial-up modem when detecting network failure.
5. The ACS shall use DES/3DES encryption algorithms for the protocol between network based control
6. RS232 and RS422 communications ports for cascading/clustering multiple control panels via a single communications port interface to ACS hosting server or operator workstations.
7. Flash able memory support for facilitating remote firmware updates from ACS host server and operator workstations; control panels shall remain on-line and operational during firmware update process.
8. Persistent Memory: The database memory downloaded to the ACS control panel shall be written to FLASH memory for permanent retention during the event of total power failure. The database shall automatically recover after power is restored without requiring any connection to the ACS server.
9. Control panel cabinet shall be of an industrial grade enclosure with knockouts for field wiring and have a key-locked and tamper protected door.
10. Low voltage power supply with uninterruptible battery backup allowing continued operations for a minimum of 2 hours at full load.

B. Control Panel Interfaces: The ACS control panels shall support on board and/or expansion interface boards for access control readers, alarm monitoring, and input/output control. Control panels shall support and provide the following as required:
1. Access Control Reader Interfaces:
h. Shall support hard-wired connections to readers, including power and communications. Connections shall be supported at a minimum distance of 2,000ft. (610m) utilizing 22AWG 2-pair shielded and unshielded cabling.
i. Shall support supervision, monitoring, and processing of the following:
1) Reader tamper and communications.
2) Status changes from locally wired door sensor and request to exit device.

j. Shall support card only and card-plus-keypad style readers of the following technologies:
   1) Proximity.
   2) Smart Card.
   3) OSDP/OSDP-SC

k. Input / Output Point Interfaces:
   1) Shall support 4-State supervised alarm inputs.
   2) Shall support relay and TTL level output points.

2.06 ALARM COMMUNICATOR

A. The system shall be capable of reporting system events and supervisory reports including alarm, trouble, system supervisory, system restore, and test functions to primary and secondary off-site monitoring services. The method of communication shall be IP-based and cellular communication-based.

2.07 D.C. POWER SUPPLY

A. Provide low voltage power supply units associated with Local Interface Units and Door Control Panels and as required to provide 24 volt regulated, filtered D.C. power for locking controls, D.C. locks and signal devices. Output power shall be12 or 24 volt D.C. with ampere rating not less than 150% of load imposed on power supply under most severe conditions of load. D.C. output shall be fused. Output voltage shall be regulated within plus or minus 5% from no load to full load. Power supply shall be UL listed.

B. Contractor to provide power supplies for all electric and electro-magnetic door hardware not furnished with its own power supply. Contractor responsible for coordinating with project door hardware schedule.

2.08 DOOR POSITION SWITCH CONTACTS

A. Provide magnetic door position switch contacts where shown on the contract drawing.

B. Door contacts for recessed mounted swing or sliding door locations shall be GRI 180-12 or equal.

C. Overhead Doors - Overhead door contacts shall be provided with armored cable and be surface mounted. The floor mount units shall be constructed with a low-profile heavy cast aluminum housing. The reed switch assembly shall be fully encased in polyurethane potting material to prevent damage due to moisture or humidity. A wide operation gap distance of up to three inches shall be required to prevent false alarms caused by door movement or damaged and loose fitting doors. Door contacts shall be GRI 200 series or equal.

D. Surface Mount - Door contacts shall be provided with supervised loop and shall have a flexible armored cable with total encapsulation to protect against moisture. Door contact shall have anodized aluminum finish, with stainless steel flexible cable. Door contacts shall be UL Listed and be warrantied for two years. Door contact for surface mount swing door locations shall be GRI 4400 series or approved equal.

E. All security hardware inputs shall be provided and configured as ‘Normally Closed’.

2.09 REQUEST TO EXIT DEVICES

A. Provide request to exit (REX) devices where request to exit signal is not available from door hardware.

B. Door hardware shall provide free egress. REX device shall be used to shunt DPS alarm only, and shall not unlock door hardware.

C. REX (PIR) devices shall have wide angle, long range lenses (adjustable) to detect motion of personnel desiring to exit through the door. Coordinate exact field mounting location to provide best operation of (PIR) type (REX) device. (PIR) device shall operate at 9.0 to 16.0 VDC and have form-C output contacts rated at minimum 24 VDC/0.5 amps.

D. Any doors requiring magnetic locking hardware will require REX push-to-exit buttons for door release. Push-to-exit buttons shall be equipped with an integrated 30 second timer and meet the Americans With Disabilities Act (ADA) and all applicable codes. Push-to-exit buttons shall be Securitron EEB-2 or approved equal.

2.10 GLASS BREAK SENSORS

A. Glass break sensors shall utilize an acoustical sensor with integrated pattern recognition for breaking glass up to ¼ inch thickness for plate, tempered, laminated, or wired glass.

B. Glass break sensor shall support Omni-directional 360° microphone with selectable sensitivity.

C. Acceptable manufacturers shall be Bosch, Honeywell, DSC, UTC or approved alternate.

2.11 SYSTEM WIRING

A. Cable must meet minimum NEC requirements for Class 2 wiring. Power wiring for door sounders shall not be smaller than No. 18 AWG.

B. All wiring shall be in accordance with the manufacturers written recommendations. All cabling/wiring shall be submitted in a detailed spreadsheet including cut sheets and samples to the Owner prior to any installation.

C. All conductors within junction boxes, pull boxes, and equipment cabinets shall be grouped and laced with nylon tie straps with identification tab, for individual lock sets.

2.12 DOOR SOUNDERS

A. Door Alarm sounders shall be audible signaling device mounted at 80” AFF. Sounders shall be white in color.

B. Temporal sounders shall be typical to Honeywell WAVE2 series or approved equal.

2.13 TRANSIENT VOLTAGE SURGE SUPPRESSION

A. Protect all equipment against surges induced on all control and power cables. All copper cables and conductors that serve as 120V power and control conductors shall have surge protection circuits installed at each end and locations where conductors enter or exit a building. Fuses shall not be used for surge protection.

B. Surge suppression devices shall meet the following standards/publications:
   1. UL 497B
   2. UL 1449 (must meet 330 Volt suppression rating)

C. IEEE Category B impulse and ring wave tests

D. Acceptable Manufacturers: Northern Technologies, Inc., EDCO. Product shall be warranted against defect for a period of not less than five (5) years.

E. All power connections, including 24 VDC and 24 VAC power supplies and direct wired or plug-in 120 VAC power connections, for all systems and components specified herein, shall be equipped with surge suppression devices. Devices shall be bonded to building grounding system in accordance with Article 250 of the National Electric Code.

F. Grounding: Provide a dedicated, separate No. 6 AWG copper conductor from true earth ground (grounding rod) to all security equipment rooms, security equipment cabinets, and control rooms. Connect all lightning protection devices and security equipment non-current carrying metal parts to grounding conductor in accordance with Article 250 of the National Electric Code. Provide ground bus bar in each equipment room and control room with dedicated ground conductor to each cabinet, enclosure, pull/junction box and all equipment.

G. Ground Resistance Measurement: Each signal ground system D.C. resistance shall be measured between any point on the signal ground bus and the earth ground. An instrument designed specifically to measure the resistance of a point to each earth ground shall be used. The systems subcontractor shall measure ground resistance in accordance with the procedure as outlined by the test equipment manufacturer.

PART 3 - EXECUTION

3.01 WIRING SYSTEMS

A. Protect all communication and data equipment against surge induced on all control, sensor and data cables. All cables and conductors which serve as control, sensor, or data conductors shall have surge protection circuits installed at each end that meet the IEEE 472 surge withstand capability test and the electrical transient tests established in UL365. Fuses shall not be used for surge protection.

3.02 TESTING

A. Testing requirements apply to all new construction.

B. Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the access control system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.03 TRAINING

A. The Contractor shall include in the base Contract all costs required to train Owner designated operating and maintenance personnel in the use and maintenance of systems provided under this section of the Specifications. Training sessions shall be conducted by instructors certified in writing by the manufacturer of the specific system.

B. Sessions shall be conducted for not more than four hour periods during normal working hours, i.e., Monday through Friday, 8:00 AM to 5:00 PM. Training session schedules shall conform to the requirements of the Owner; therefore such schedules shall be submitted to the Owner for approval not less than two weeks prior to the training session. All training sessions shall be video-taped and saved to digital disk as well as the server hard drive for future reference.

C. Time to be included in base Contracts for the Access Control System shall be 8 hours.

END OF SECTION

SECTION 28 2000
VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Specifications, Standards and Codes
   1. All work shall be in accordance with the following codes (specific editions defined by state or local authorities):
      a. The National Electrical Code (NFPA 70) with any applicable State Amendments.
      b. The International Building Code with Amendments.
      c. The Life Safety Code (NFPA 101).
      d. The National Electrical Safety Code (ANSI C-2).
      e. Americans with Disabilities Act (ADA)
      f. Local city and county ordinances governing electrical work.

B. In the event of conflicts, the more stringent provisions shall apply.

1.02 DESCRIPTION

A. This section includes furnishing and installing all materials and providing all labor and supervision pertaining to the installation of an IP Video Surveillance System.

B. The requirements of the Security Surveillance System shall include all raceway, cabling, and equipment required to provide a fully functional system. Provide all labor, materials, equipment and supervision to install, check out, adjust, and calibrate the total system. Reference contract drawings for complete requirements.

C. The requirements of the Video Surveillance System shall include all power supplies, proper sizing of power conductors, connection to electrical panels for power circuits, conduit for power circuits and step-down transformers as necessary for complete and fully operational system.

D. This division of the Specifications covers the complete Video Surveillance system as indicated on the Drawings and specified herein. The contractor shall provide all labor, materials, equipment, and supervision to install the specified system. The installation of all equipment shall be the full responsibility of the Security Surveillance Contractor for this project.

E. The Contractor shall be responsible for configuring the IP Address for the Network Video Recorders (NVRs), servers, workstations, cameras and any other components that are installed as part of this project. The Contractor shall coordinate with I.T. for provision of IP addresses.

F. A minimum of one (1) CD with client monitoring software backup and one (1) Operating Instruction Manual (for the software) must be provided. Additional copies of client monitoring software with loading and operating instructions on CD must be available upon Owner’s request at no charge for the duration of the warranty period.

G. All conflicts between the drawings and specifications shall be brought to the attention of the owner as soon as possible.

1.03 INSTALLER’S QUALIFICATIONS:

A. Firm with at least 5 years of successful application, installation, and testing experience on specified systems and equipment. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electric trade staff shall not be used for the installation of the Video Surveillance System and associated hardware. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years’ experience in the installation of the specified equipment.

B. Video Surveillance Contractor must be a certified installer of the manufacturer of the specified NVR and Network Video Monitoring Software (NVMS).

C. The Contractor must be licensed to perform Low Voltage/Telecommunications installations.

D. The responsibilities of the Video Surveillance Contractor shall include but not be limited to the following:
   1. Shop drawings on all Video Surveillance Systems and equipment.
   2. Installation of all new Video Surveillance Systems and equipment as documented in the drawings and specifications.
   3. Wire and wiring termination for all Video Surveillance and control systems and equipment.
   4. Testing and check-out of all Video Surveillance systems and equipment.
   5. Training for all Video Surveillance systems and equipment.
   6. Warranty for all Video Surveillance systems and equipment.
   7. As-Built drawings, operations and maintenance manuals for the complete Video Surveillance System.

1.04 RELATED DOCUMENTS

A. Contract drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section and shall be considered a part of this section and shall have the same force as if specified herein full.

1.05 SUBMITTALS

A. Within 30 days of notice to proceed, contractor shall deliver all required submittals.

B. All submittals shall be prepared in a line by line format corresponding to these specifications and shall indicate compliance with each requirement specified herein and indicated in the contract drawings.

C. Contractor shall complete the equipment submittal form (see last page of this specification) and attach to each item submitted. Awarded contractor may request the equipment submittal form in word format.

D. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of system equipment.

E. Shop Drawings: Submit shop drawings that contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been fully coordinated and will function properly as a system. All drawings shall be produced with Autodesk AutoCAD compatible with version 2022 or later. All floor plans, large scales and elevations are to be scaled. Drawings shall include but not be limited to the following:
   1. Site plan layout identifying all exterior mounted devices, outdoor / underground cable routing.
   2. Floor plan layouts showing device, equipment locations and cable / conduit routing.
   3. Functional one-line diagrams showing all devices and cable infrastructure.
   4. Equipment rack / cabinet details and elevations identifying sizes and type. Identify equipment placement in equipment racks / cabinets and enclosures.
   5. Elevations for wall mounted equipment racks, cabinets, and enclosures.
   6. Device mounting details identifying mounting procedures / requirements.

F. Contractor is responsible to maintain a full-size set of drawings on site throughout the project. These drawings shall be updated daily identifying installation progress and any changes to work.

G. Test Plan: Contractor shall submit a test plan that defines the tests required to ensure that the system meets technical, operational, and performance specifications. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested and include detailed instructions for the setup and execution of each test and procedure for evaluation and documentation of the results.

H. It is the responsibility of the contractor to meet with the appropriate Owner’s representative to compare the placement and installation of proper devices with the drawings and specifications. A 100% device by device test will be conducted by the vendor under the supervision of the

Architect / Engineer representative. Punch lists will be developed at that time and furnished to the contractor. All punch list items must be corrected and verified prior to acceptance of the system.

1.06 CONTRACT DRAWINGS

A. The Contract Drawings indicate the arrangement of Video Surveillance equipment. Coordinate installation of equipment with the structural, mechanical, and electrical equipment and access thereto.

B. Raceway home runs as shown on the security and Security Surveillance System shall be installed as shown on the Drawings, and as required by the associated equipment manufacturers.

C. All raceways required for the Security Surveillance System are not shown on the Contract Drawings. It shall be the responsibility of the Contractor to provide raceway fit for the application and sized to meet all NEC requirements.

1.07 RECORD DRAWINGS (AS-BUILTS)

A. Contractor shall submit as built / record documentation for approval 30 days prior to final inspection. Provide three (3) sets of complete data on the video surveillance system equipment used in this project. This data shall be in bound form and shall include all shop drawings on 11 x 17 tri folded. Provide three (3) copies of the Operation and Maintenance Manuals including any equipment provided under this contract that can be operated or maintained by the customer.

B. All record drawings shall include "as built" system interconnection diagrams with major components identified by manufacturer and part number and the system wiring identified by number and type of interconnecting conductors. As-built drawings are to show wiring for all installed equipment. Head end equipment details shall be included with wiring interconnection properly identified as the system has been installed. Three (3) sets of full size (30"x42") As-built drawings must be provided. Corrected point-to-point drawings for all systems to show the actual as-built conditions. Original content from the contract documents (key notes, one-lines, device details) will not be accepted.

C. The As-built drawings must be provided with the Contractor’s title block on all sheets identifying the installation company and the project specific details.

D. All drawings shall be produced with Autodesk AutoCAD compatible with version 2022. Provide two (2) CD/DVD with all drawings in electronic format.

E. Provide a Warranty Letter in each O&M Manual Binder (2 copies total).

F. Provide two (2) copies on DVD of the training session. Manufactures training CD’s will not be accepted in place of recorded training sessions at the facility.

G. Document and provide two (2) copies of network configuration (such as a list of IP addresses and the devices the addresses belong to, line diagram demonstrating network topology, etc.).

H. The final pay application will not be approved until the post final inspection is completed, all Construction Observation items have been satisfied, and all the above requirements for record documents are submitted and approved.

1.08 ACCEPTABLE MANUFACTURERS

A. Reference products section of specifications for acceptable manufacturers.

1.09 WARRANTY

A. The contractor shall warrant the Video Surveillance System for one year from date of start-up against defects in equipment or workmanship. Failed equipment shall be replaced by the contractor at no cost to the owner. Owner's personnel may perform initial trouble investigation, but replacement of failed equipment and escalated problem support will be handled by the contractor.

B. The Contractor shall provide a Warranty Letter indicating the start date of the warranty. The Warranty Letter shall also provide contact information (Company name, Service Supervisor's name and phone numbers for normal working hours and Emergency Service request). The warranty period will not start until Warranty Letter has been reviewed, approved, and agreed upon by the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials or equipment specified by manufacturer's name shall be provided unless approval of other manufacturers is listed in addendum to these Specifications. Any materials or equipment approved in addendum shall function the same as the equipment specified.

2.02 VIDEO SURVEILLANCE CAMERAS

A. All cameras shall be U.L. listed and shall be the standard product of one manufacturer complying with not less than the specifications contained herein. Installation of each camera shall include mounting brackets and/or camera housings fully compatible with the camera provided and as required by Security Surveillance System camera schedule.

B. All camera installations shall be securely attached to the mounting surface. Use lead shields on solid masonry, toggle bolts for hollow masonry, and machine bolts for steel. All anchoring devices shall be rated to support not less than five times the total equipment weight. Reference mounting details in contract documents.

2.03 DAY/NIGHT IP / POE FIXED, WDR INDOOR MINI DOME CAMERA (2 MEGA-PIXEL)

A. Camera type shall be AXIS P3265-LV or approved equal.

B. The camera shall provide simultaneous Motion JPEG and H.264 video streams and shall support at least two individually configured video streams of resolutions up to 2048X1536 pixels in 20 frames per second or 1920x1080 in 30 frames per second

C. The camera shall support both static IP addresses and addresses from a DHCP-server, and shall support IPv4.

D. For secure access to the camera as well as provided content, the camera shall support HTTPS, and 802.1X authentication. The camera shall also support IP address filtering and include at least three different levels of password security.

E. All firmware shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management System (VMS) or Network Video Recorder (NVR) being provided.

F. The camera shall meet or exceed the following requirements:
   1. Use a high quality IR-sensitive 1/2.5" progressive scan sensor.
   2. Be equipped with day/night functionality and Wide Dynamic Range
   3. Be equipped with a high quality 3-6mm varifocal DC-iris lens providing remote zoom and focus functionality.
   4. Provide pictures down to 0.26 lux while in day mode and down to 0.05 lux while in night mode.
   5. Power over Ethernet compatible. Power over Ethernet according to IEEE 802.3af-class3.
   6. The camera shall be able to deliver at least two individually configurable full resolution full frame rate video streams over IP networks.
   7. Encoding:
      a. Provide configurable compression levels.
   8. Acceptable manufacturers for Cameras shall include Axis, Avigilon, & Hanwha

2.04 DAY/NIGHT IP / POE FIXED, MULTISENSOR (4) CAMERA 15 MEGA-PIXEL)

A. Camera type shall be AXIS P3719-PLE or approved equal.

B. The camera shall support both static IP addresses and addresses from a DHCP-server, and shall support IPv4.

C. For secure access to the camera as well as provided content, the camera shall support HTTPS, and 802.1X authentication. The camera shall also support IP address filtering and include at least three different levels of password security.

D. All firmware shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management System (VMS) or Network Video Recorder (NVR) being provided.

E. The camera shall meet or exceed the following requirements:
   1. Use a high quality IR-sensitive 1/2.5” progressive scan sensor.
   2. Be equipped with day/night functionality and Wide Dynamic Range
   3. Be equipped with a high quality 3-6mm varifocal DC-iris lens providing remote zoom and focus functionality.
   4. Provide pictures down to 0.26 lux while in day mode and down to 0.05 lux while in night mode.
   5. Power over Ethernet compatible. Power over Ethernet according to IEEE 802.3af-class3.
   6. The camera shall be able to deliver at least two individually configurable full resolution full frame rate video streams over IP networks.
   7. Encoding:
      a. Provide configurable compression levels.
   8. Acceptable manufacturers for Cameras shall include Axis, Avigilon, & Hanwha.

2.05 DAY/NIGHT IP / POE FIXED PANORAMIC CAMERA (12 MEGA-PIXEL)

A. Camera type shall be AXIS M4308-PLE or approved equal.

B. The camera shall support both static IP addresses and addresses from a DHCP-server, and shall support IPv4.

C. For secure access to the camera as well as provided content, the camera shall support HTTPS, and 802.1X authentication. The camera shall also support IP address filtering and include at least three different levels of password security.

D. All firmware shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management System (VMS) or Network Video Recorder (NVR) being provided.

E. The camera shall meet or exceed the following requirements:
   1. Use a high quality IR-sensitive 1/1.7” progressive scan sensor.
   2. Be equipped with day/night functionality and Wide Dynamic Range
   3. Provide pictures down to 0.19 lux while in day mode and down to 0.05 lux while in night mode.
   4. Power over Ethernet compatible. Power over Ethernet according to IEEE 802.3af-class3.
   5. The camera shall be able to deliver at least two individually configurable full resolution full frame rate video streams over IP networks.
   6. Encoding:
      a. Provide configurable compression levels.
   7. Acceptable manufacturers for Cameras shall include Axis, Avigilon, & Hanwha.

2.06 DAY/NIGHT IP / POE FIXED, WDR INDOOR/OUTDOOR DOME CAMERA (5 MEGA-PIXEL)

A. Camera type shall be AXIS P3267-LVE or approved equal.

B. The camera shall provide simultaneous Motion JPEG and H.264 video streams and shall support at least two individually configured video streams of resolutions up to 3072X1728 pixels in 20 frames per second or 1920x1080 in 30 frames per second

C. The camera shall support both static IP addresses and addresses from a DHCP-server, and shall support IPv4.

D. For secure access to the camera as well as provided content, the camera shall support HTTPS, and 802.1X authentication. The camera shall also support IP address filtering and include at least three different levels of password security.

E. All firmware shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management System (VMS) or Network Video Recorder (NVR) being provided.

F. The camera shall meet or exceed the following requirements:
   1. Use a high quality IR-sensitive 1/2.5" progressive scan sensor.
   2. Be equipped with day/night functionality and Wide Dynamic Range
   3. Be equipped with a high quality 3-9mm varifocal DC-iris lens providing remote zoom and focus functionality.
   4. Provide pictures down to 0.18 lux while in day mode and down to 0.04 lux while in night mode.
   5. Power over Ethernet compatible. Power over Ethernet according to IEEE 802.3af-class3.
   6. The camera shall be able to deliver at least two individually configurable full resolution full frame rate video streams over IP networks.
   7. Encoding:
      a. Provide configurable compression levels.
   8. Provide built-in infrared illumination where specified on contract drawings.
   9. Acceptable manufacturers for Cameras shall include Axis, Avigilon, & Hanwha.

2.07 CAMERA LENSES

A. Camera lenses shall be compatible with the camera construction and iris control circuit. The lenses shall be compatible with remote control devices as specified herein. The lenses shall be supplied by the same camera manufacturer.

B. All lenses shall be auto iris type driven by the camera iris control circuit. Additionally, all exterior lenses shall be equipped with spot filters giving the lens a minimum effective aperture of f/360.

2.08 CAMERA HOUSINGS AND SUPPORTS FOR FIXED CAMERAS

A. All camera housings and support brackets shall be compatible with camera specified herein. Housings shall be provided with cable entrance facilities for camera control and power and shall be adaptable to mounting devices used with cameras. All mounts shall be "Feed Through" type to ensure that power, signal, and data cables are concealed. All camera housings and support brackets shall be securely attached to mounting surfaces. Escutcheon plates attached with security screws shall be used to conceal holes in walls or ceilings. Manufacturer guidelines for mounting devices and support brackets shall be adhered with unless contract details exceed manufacturer guidelines.

B. The camera housings or unitized camera housing assemblies must incorporate the following as a minimum:
   1. Mounting hardware with security screws that allow access into the camera housings or units with only special tools.
   2. Impact resistant domes or viewing ports.
   3. Cable routing for power and video signal routed through the mount or back of the camera so that no cable is exposed after the installation.

C. Exterior Housing: Housings shall be medium-sized "Dome" environmental housings designed for wall mount applications. Domes shall be rated as vandal proof, impact resistant type. Housing shall be provided with mounting hardware. An internally mounted thermostatically-controlled heater-defogger shall be provided. Liquid-tight fittings shall be used for cable routing. All exterior housings shall be provided with tamper resistant kit, and mounting hardware. Reference manufacturer guidelines for mounting requirements.

D. Interior Domes: All mini-dome style cameras, installed in lay-in tile ceilings, shall be supported by Manufacturer approved mount or T-bar Support Kits. Devices supported by ceiling tile shall not be acceptable.

2.09 NETWORK VIDEO RECORDER

A. The Network Video Recorder (NVR) shall be a software-based, open platform solution that functions as an appliance server and operates on a 64-bit Linux based Operating System supporting the following features:
   1. All minimal operating system functions shall be installed with the NVR software.
   2. The NVR software shall be available as an independent installation compatible with any hardware platform meeting the minimum requirements and supported by the integrated Operating System.

B. The NVR shall natively support the following video compression technologies:
   1. MJPEG
   2. MPEG4
   3. H.264/ H.264+
   4. Zipstream

C. The NVR shall natively support the following audio compression technologies:
   1. AAC
   2. G.711
   3. G.726

D. The NVR shall be available as a preinstalled, preconfigured appliance server solution and shall operate in standard server-client architecture as a network appliance.

E. Device shall support simultaneous live viewing, recording, and playback of video while managing all alarms, alerts, analytics generation, and system management. Live Viewing and playback of video shall be supported with dynamic bandwidth management that provides video format (CODEC), and resolution transcoding to clients and mobile devices.

F. The NVR shall support IP cameras and encoders capable of supporting dual video streams utilizing an integrated 10/100Base-T POE switch to directly connect up to 16 IP cameras and shall support additional IP camera connections through a compatible network switch.

G. Network Video Recorder shall have the following minimum hardware configuration:
   1. 1U rack mount configuration
   2. 8GB RAM
   3. Two 10/100/1000 Base-T (Gbit) Network Interface Ports
   4. Minimum 4TB storage capacity
   5. Minimum One DVI/HDMI monitor Output at 1080p resolution
   6. Integrated 16 port POE camera connections.

2.10 NETWORK VIDEO MANAGEMENT SOFTWARE (NVMS)

A. General:
   1. The Video Management System approved for this project shall be one of the following:
      a. S2
      b. Genetec
      c. Exacq
      d. Hanwha
      e. Avigilon

B. A software serial number shall be associated with the software and will support the pre-defined license configuration. At any time, additional add-on features and SSA can be purchased for the software license.

C. Number of online cameras or encoders based on IP address allowing for multi-sensor or multi-channel devices to occupy a single camera license.

D. Number of IP addresses of supported camera/encoder devices, up to the maximum number of purchased that can be supported by the specified recorder model platform. The license shall not be tied to individual camera or encoder MAC address to enable ability to easily add, remove or exchange devices.

E. Number of analytic video channels, up to the maximum number of purchased analytic channels supported by the specified recorder model platform. The license shall not be tied to individual camera or encoder MAC address to enable ability to easily add, remove or exchange devices.

F. Number of face verification video channels, up to the maximum number of purchased face verification channels supported by the specified recorder model platform. The license shall not be tied to individual camera or encoder MAC address to enable ability to easily add, remove or exchange devices.

G. Number of face recognition video channels, up to the maximum number of purchased face recognition channels supported by the specified recorder model platform. The license shall not be tied to individual camera or encoder MAC address to enable ability to easily add, remove or exchange devices.

H. Number of licensed camera devices, video analytic channels, face verification channels and/or face recognition channels shall be easily increased, and the license version can easily be updated. The online registration shall auto-generate the updated license for the applicable server and email the file.

I. SSA expiration email notifications shall be configurable.

J. The detailed license status shall be easily accessible and clearly stated in the software interface.

K. Major software releases will require an updated compatible license file. An automated online registration shall be available from the manufacturer to support generation of new or update licenses upon demand and delivered electronically via email.

2.11 NVR STORAGE REQUIREMENTS

A. NVRs and any server-based storage for video shall be sized for a minimum of **30** days at full resolution, a minimum of 15 frames per second and 50% motion. NVR shall be provided with RAID 10 capabilities. Additionally, servers and storage units must be licensed and sized for the number of cameras plus 15% spare capacity. Furnish calculations with shop drawings verifying storage sizing in compliance with these specifications.

2.12 POE NETWORK SWITCH

A. POE Network switches shall provide the following Ethernet switching capabilities:
   1. 802.1p Quality of Service, 8 queues
   2. 802.1w, 802.1D Rapid Spanning Tree Protocol (RSTP, STP)
   3. 802.1ab Link Layer Discovery Protocol (LLDP) and Cisco Discovery Protocol (CDP)
   4. MAC forwarding entries: 16K on 24-port models, 32K on 48-port models

B. General POE network switch features include:
   1. Port visibility and remote troubleshooting tools
   2. Ability to apply bulk settings to ports
   3. Ability to enable and disable PoE on each port
   4. All updates and tech support included

C. Approved manufacturers include:
   1. Meraki Go
   2. JetStream
   3. UniFi

2.13 HORIZONTAL DATA & VOICE COPPER CABLE

A. CATEGORY 6 BALANCED TWISTED PAIR CABLE – VIDEO SURVEILLANCE

B. Description: 100-ohm, 4-pair UTP, 350 MHz certified cable, covered with a yellow thermoplastic jacket or as directed by the Owner Representative.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with ANSI/TIA/EIA-568-B.1 for performance specifications.
   3. Comply with ANSI/TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types: Communications, Plenum Rated: Type CMP.
5. Reference Specifications Section 270100 – Communications General for manufacturer and warranty requirements.

2.14 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Furnish and install 1.2 KVA minimum uninterruptable power supply (UPS) at the location of the video surveillance head end equipment. UPS system to provide battery backup for a minimum of 30 minutes and be rack mounted in the active components system rack.
The UPS shall be an on-line double conversion UPS which shall have the following minimum features:
1. Audible Alarms
2. Automatic Self Test
3. Automatic Voltage Regulation (AVR)
4. Building wiring fault indicator
5. Hot Swap Batteries with Intelligent Battery Management
6. Lightning and Surge Protection
7. Line-interactive
8. Load Meter
9. Network-grade line conditioning
10. Overload Indicator
11. Rack Mount
12. Replace Battery Indicator
13. Sine-wave output
14. Status Indicator LED's
15. UPS shall have the ability to handle crest factor ratios of 2.5 or above.
16. UPS shall provide continuous (no-break power) during momentary or complete blackouts.
17. UPS shall have the ability to recharge the battery to 90 percent capacity within a reasonable period of time (5 to 10 times the discharge time).
18. The UPS output shall be regulated with maximum deviations from nominal of +6 percent to –13 percent over the full input range, both AC and DC.
19. UPS shall meet ANSI C84.1 requirements.

B. UPS and batteries shall be sized to 150% output VA required and shall be valve regulated (sealed or maintenance free) lead-acid cell type. Batteries shall be installed within the UPS enclosure or in a standard enclosure provided for that purpose by the UPS manufacturer.

C. Furnish calculations with shop drawings verifying UPS sizing in compliance with these specifications.

2.15 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

A. Protect all equipment against surges induced on all control, video, and power cables. All copper cables and conductors which serve as 120V power, control, or video conductors shall have surge protection circuits installed at each end and locations where conductors enter or exit a building. Fuses shall not be used for surge protection. On board surge suppression will not be acceptable. External surge suppression, as described in this section, is required.

B. Protect all devices mounted on the exterior of the building with surge suppression devices mounted at the device and grounded per manufacture’s recommendations.

C. Surge suppression devices shall meet the following standards/publications:
1. UL 497B
2. UL 1449 (must meet 330 Volt suppression rating)
3. IEEE Category B impulse and ring wave tests

D. Acceptable Manufacturers: Northern Technologies Inc., Ditek Corporation, and EDCO. Product shall be warranted against defect for a period of not less than five (5) years.

E. All power connections, including 24 VDC and 24 VAC power supplies and direct wired or plug-in 120 VAC power connections, for all systems and components specified herein, shall be equipped with surge suppression devices. Devices shall be bonded to building grounding system in accordance with Article 250 of the National Electric Code.

F. Grounding: Provide a dedicated, separate No. 6 AWG copper conductor from building grounding system to the video equipment room, video equipment cabinets, and central control room. Connect all lightning protection devices and video equipment non-current carrying metal parts to grounding conductor in accordance with Article 250 of the National Electric Code. Provide ground bus bar in equipment room and control room with dedicated ground conductor to each cabinet, enclosure, pull/junction box and all equipment.

G. Ground Resistance Measurement: Each signal ground system D.C. resistance shall be measured between any point on the signal ground bus and the earth ground. An instrument designed specifically to measure the resistance of a point to each earth ground shall be used. The systems subcontractor shall measure ground resistance in accordance with the procedure as outlined by the test equipment manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions, and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Penetrations in fire-rated construction shall be fire-stopped in accordance with specifications. Conduits and raceways shall be installed in accordance with the National Electric Code (NEC). Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with AC power cables. Metal conduits shall not be continuous between buildings. Contractor to provide ground isolation between buildings by breaking continuous copper cabling and metal conduit runs.

B. Equipment: All monitor support brackets shall be securely attached to mounting surfaces. Use lead shields on solid masonry, wood screws on wood, and machine bolts on structural steel. All anchoring devices shall be rated to support not less than five times the total equipment weight.

C. Surge Protection:
   1. All copper cables and conductors which serve as control, power, or data conductors shall have surge protection devices installed at each end that complies with electrical and security specifications.
   2. Protect all video and data equipment from surges induced on all control, power and data cables. All cooper cables and conductors which serve as control, power, or data conductors shall have surge protection circuits installed at each end that meet the IEEE 472 surge withstand capability test. Fuses shall not be used for surge protection.
   3. All low voltage cabling routed to exterior cameras not attached to the building structure, must be protected with TVSS surge suppression devices located at both the building penetration and at the device

D. Power:
   1. All interior and exterior fixed cameras shall be powered from centralized, UL Listed, low-voltage power supplies in the designated equipment rooms.
   2. 120 VAC power circuits utilized to power the cameras, power supplies and controls must be dedicated and un-switched.

E. At all exterior cameras, seal tight (flexible, vinyl coated, weatherproof, metallic raceway) conduit and fittings must be provided between the camera enclosure and exterior wall penetration and / or junction box. All exterior penetrations must be sealed.

F. All holes in ceilings and walls resulting from this project must be weather sealed and fireproofed by the Contractor.

3.02 TESTING

A. Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the Video distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.03 LABELING

A. Cable labeling:
   1. All cable and wire installed for Video Surveillance Systems shall be properly tagged. Use the following standard labeling scheme to identify the physical location of both ends of each cable.
      a. A100 –C1
      b. | |
      c. | Camera #: Use one number per cable.
      d. |
      e. Room number where camera is installed.
      f.
      g. Room Camera
      h. Number Number
      i. A100 C-1
      j.
      k. Format Example
      l. A100-C1
   2. Complete two (2) labels for each cable, one for each end. Secure label to end of cable, within view of the termination of the cable at each end. Labels shall be white with a protective wrap-around plastic transparent cover that will serve to protect the ink from smearing and secure the label to the cable. All labels shall be typed with black ink.

3.04 TRAINING

A. The Contractor shall include in the base Contract all costs required to train operating and maintenance personnel in the use and maintenance of systems provided under this section of the Specifications. Training sessions shall be conducted by instructors certified in writing by the manufacturer of the specific system.

B. Sessions shall be conducted for not less than four hour periods during normal working hours, i.e., Monday through Friday, 8:00 AM to 5:00 PM. Training session schedules shall conform to the requirements of the owner; therefore such schedules shall be submitted to the owner for approval not less than two weeks prior to the training session. All training sessions shall be video-taped for future use. At the owner's discretion, provisions shall be made to allow up to 2 owner personnel to participate in final system check out of all systems.

C. Video tapes shall be of professional quality both for video and audio and must be approved by the Owner/User. Provide two copies to Owner/User. Time to be included in base Contracts for specific systems shall be as follows:
   1. Video Surveillance System - 4 hour.

END OF SECTION

SECTION 31 1000
SITE CLEARING

PART 1 GENERAL

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SITE CLEARING

A. Comply with other requirements specified in Section 01 7000.

B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 VEGETATION

A. Do not remove or damage vegetation beyond the limits indicated on drawings.

B. Install substantial, highly visible fences at least 3 feet (1 m) high to prevent inadvertent damage to vegetation to remain:
   1. At vegetation removal limits.

C. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

D. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
   1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
   2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
   3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.

E. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.03 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 3116
TERMITE CONTROL

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.

1.02 REFERENCE STANDARDS

A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2019.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.

C. Manufacturer's Instructions: Indicate caution requirement.

D. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.04 QUALITY ASSURANCE

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

A. Toxicant Chemical: EPA (Title 7, United States Code, 136 through 136y) approved; synthetically color dyed to permit visual identification of treated soil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Spray apply toxicant in accordance with manufacturer's instructions.

C. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.

D. Re-treat disturbed treated soil with same toxicant as original treatment.

E. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 INSTALLATION - SITE-APPLIED TERMITICIDE

A. Comply with manufacturer's written instructions.

3.04 PROTECTION

A. Do not permit soil grading over treated work.

B. Protect sheet materials from damage after completed installation. Repair damage with manufacturer's recommended products and according to the manufacturer's written instructions.

END OF SECTION

SECTION 32 3300
SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bollards.

B. Waste receptacles.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Bollard infill and underground encasement.

1.03 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.

C. Shop Drawings: Indicate plans for each unit or group of units, elevations with model number, overall dimensions, construction, and anchorage details.

1.05 QUALITY ASSURANCE

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 METAL FURNISHINGS

A. Waste Receptacles: Steel frame with steel slats and removable lid.
   1. Capacity: Not less than 11.8 gallons (____ liters).
   2. Products:
      a. Basis-Of-Design: Hess America: Model PUNTO PN 700 with side access..
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BOLLARDS

A. Steel Pipe Bollards: Hollow steel pipe with plain shaft.
   1. Shape: Round.
   2. Diameter: Outer dimension: 6 inches (____ mm).
   3. Diameter and Finish:
      a. Bollard A: 8" outside diamater; Stainless steel, No. 6, Bushed satin.
      b. Bollard A: 6" outside diamater; OHSA Yellow.
   4. Height and Depth as indicated.
   5. Materials:
      a. Steel Pipe: ASTM A53/A53M, standard weight.
      b. Factory Finish: Primed.
      c. Color: As selected by Architect from manufacturer's standard range.
   6. Mounting: as indicated.
   7. Key Box at bollards:
      a. IMPORTANT: Contact City of Jacksonville Fire Department- before ordering key box unit to coordinate master key system.
      b. Key Box Construction: heavy duty, with hinged door and with fittings that accomodate mounting to galvanized steel post.
      c. Color of houseing: Black.
      d. Mounting: Attach with manufactuer's brack to a galvanized steel post as indicated on Drawings. All hardware to be tamperproof.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices; and ready to receive site furnishing items.

B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.

B. Provide level mounting surfaces for site furnishing items.

END OF SECTION

SECTION 33 4100
SUBDRAINAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building Perimeter, Retaining Wall, and Under-Slab Drainage Systems.

B. Filter aggregate and fabric and bedding.

1.02 REFERENCE STANDARDS

A. ASTM D1603 - Standard Test Method for Carbon Black Content in Olefin Plastics; 2020.

B. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe drainage products, pipe accessories, and _____.

C. Project Record Documents: Record location of pipe runs, connections, cleanouts and principal invert elevations.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with applicable code for materials and installation of the work of this section.

2.02 PIPE MATERIALS

A. Corrugated Plastic Tubing: Flexible type; 4 inch (100 mm) diameter, with required fittings.

B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.03 AGGREGATE AND BEDDING

A. Filter Aggregate and Bedding Material: Fill Type clean gravel as specified in Section 31 2323.

2.04 ACCESSORIES

A. Pipe Couplings: Solid plastic.

B. Joint Covers: No. 15 asphalt saturated roofing felt.

C. Filter Fabric: Water pervious type, black polyolefin. Provide _____ manufactured by _____.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

3.02 PREPARATION

A. Hand trim excavations to required elevations. Correct over-excavation with _____.

B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.

B. Place drainage pipe on clean cut subsoil.

C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 10 feet (3 m).

D. Install pipe couplings.

E. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches (300 mm).

F. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.

G. Place aggregate in maximum 6 inch (150 mm) lifts, consolidating each lift.

H. Connect to storm sewer system with unperforated pipe, through installed sleeves.

I. Coordinate the Work with connection to municipal sewer utility service, and trenching.

3.04 FIELD QUALITY CONTROL

A. Section 01 4000 - Quality Requirements: Field inspection and testing.

B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.05 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION