

<b>AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT</b>			1. CONTRACT ID CODE	PAGE 1 OF 59 PAGES
2. AMENDMENT/MODIFICATION NO. AMENDMENT NO. 0001		3. EFFECTIVE DATE 07/29/19	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable) 18-0086
6. ISSUED BY NAVFAC Mid-Atlantic Resident Officer in Charge of Construction 1005 Michael Road Camp Lejeune, NC 28547-2521		CODE N40085	7. ADMINISTERED BY (If other than Item 6) See Item 6	
8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)			(X)	9A. AMENDMENT OF SOLICITATION NO. N40085-19-R-8090
			X	9B. DATED (SEE ITEM 11) 07/17/19
				10A. MODIFICATION OF CONTRACT/ORDER NO.
				10B. DATED (SEE ITEM 11)
CODE	FACILITY CODE			

**11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS**

The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers  is extended,  is not extended.  
 Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:  
 (a) By completing items 8 and 15, and returning \_\_\_\_\_ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted;  
 or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

**13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS.  
IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.**

CHECK ONE	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor  is not,  is required to sign this document and return \_\_\_\_\_ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

18-0086 Interior and Exterior Repairs, Bldg M116

The time and date for receipt of proposals remains unchanged.

This amendment should be acknowledged when your proposal is submitted. Failure to acknowledge the amendment may constitute grounds for rejection of a proposal.

SEE CONTINUATION PAGE

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
15B. CONTRACTOR/OFFEROR		16B. UNITED STATES OF AMERICA	
15C. DATE SIGNED		16C. DATE SIGNED	
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

CONTINUATION PAGE

1. Replace NAVFAC DWG # 60024577 with 60024577 REVISED.
2. Sheet A-3, Schedule of Renovated Doors and Frames, Room 120 – For the pair of 3-0 x 7-0 wood doors, in each door, remove the bottom two raised panels, leaving intact the rails and stiles. Install one louver on both the interior and exterior of each door, for a total of 4 louvers. Louvers shall cover the openings with an overhang of 1”+ fastened to the rails and stiles. Louvers shall be white.
3. Include Specification 33 82 00 - TELECOMMUNICATIONS OUTSIDE PLANT (OSP).
4. Specification Section 28 31 76 – References NFPA 72 shall be 2019 version in lieu of 2016.
5. Specification Section 28 31 76, Paragraph 2.3.1.a and Paragraph 2.3.1.b – Change Class “B” to Class “A”.
6. Sheet FA-3 - Install a Parts Box adjacent to fire alarm control panel: A steel cabinet with locking, hinge-mounted door where spare parts are securely stored. Contractor shall place manufacturer’s recommended spare parts and four fuses for each fused circuit inside cabinet. Parts Box shall be installed no higher than three feet above finish floor.
7. Sheet FP-3, Detail 2 Mounting Heights – 5” Storz connection shall be a 30 degree 5” Storz connection.
8. Sheet FP-3, Key Note 5 – 5” Storz connection shall be a 30 degree 5” Storz connection.
9. Specification Section 08 51 13, Paragraph 1.10.4 - Change Aluminum Windows energy/thermal performance requirements to:  
  
Glazed systems (including frames and glass) will be Energy Star labeled products as appropriate to climate zone and as applicable to window type, with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of .30 determined according to NFRC 200 procedures. Glazed systems must have a U-factor maximum of .35 Btu per square foot times hr times degree F in accordance with NFRC 100.
10. Specification Section 01 33 00 Paragraph 1.4.1.2 - Submittal review and approval – Provide a copy of submittal to base telephone through contracting office for sections 27 10 00 and 33 82 00.
11. Sheet E7: Remove reference to 1-circuit track on Type J and Type K lighting details, all tracks to be dual circuit.
12. Sheet E12: Symbol shown as \$D is the same as dimming switch symbol D\$ as shown in the legend on Sheet E1.
13. Sheet E-8 and E-11, Room 120: In lieu of enclosed floor mounted telecomm rack, use swing wall mounted rack. Coordinate with Base Telephone prior to installation.
14. Sheet E-11 – WAPs in Rooms 109, 110, 111, and 122 shall be truss mounted.

15. QUESTION: Please clarify that drawing sheet H-1 is for the “Interior and Exterior Repairs, Bldg M116” project, not the “Repair Indoor Training Pool, Bldg M139” as the plan sheet is labeled.
15. RESPONSE: Revise sheet title on Sheet H-1 to read Interior and Exterior Repairs, BLDG M116 in lieu of Repair Indoor Training Pool, Bldg M139.
16. QUESTION: Spec section 23 07 00 Insulation of Mechanical Systems, sub-paragraph 2.2.2 Duct Not in Concealed Spaces (exposed) implies this duct is to be externally wrapped. Is the exposed spiral duct to be galvanized, single wall as the metal duct spec (23 73 33 paragraph 2.3) implies and have external insulation? Or is the exposed spiral to be double wall, paint grip as is most often the case?
16. RESPONSE: For exposed ductwork provide double wall spiral.
17. QUESTION: Spec section 23 07 00 Insulation of Mechanical Systems, sub-paragraph 2.2.4.3 Duct Exposed to Weather indicates to refer to 23 73 33 for "Prefabricated Insulated Duct" but there's no such heading. Please clarify.
17. RESPONSE: See revised Specification Section 23 73 33.
18. QUESTION: Drawing M-5 has a "Branch Circuit Controller" schedule. Note 1 says to "Refer to Specification Section 23 73 33 - Heating, Ventilation, and Cooling Systems for Further Details." There is no VRF Equipment spec. Please clarify/provide.
18. RESPONSE: Sheet M-5, BC02 is associated with HP02, see sheet M-6, Detail 1 for further clarification. The unit designed is a mini split heat pump and not a VRF heat recovery unit. The branch controller on this basis of design system moves the ports from the outdoor unit to the interior. It is just an extension of the outdoor unit.
19. QUESTION: Wall Mounted Rack AV Data Closet R120, what is the height and depth required for the wall mounted rack?
19. RESPONSE: See Specification section 27 10 00, paragraph 2.5.2 for sizing; approximately 48”H x 36”D x 19”W is a typical wall mounted rack size. The rack sizing is dependent upon capacity and shall be approved by Base Telephone prior to purchase.
20. QUESTION: Wireless Access Point Print E-1, please confirm the wireless access points receive one (1) Category 6 cable?
20. RESPONSE: Install two (2) CAT6 cables.

21. QUESTION: Projector note 7 on print E-11, how many Category 6 cables are to be installed to the projector?

21. RESPONSE: Install two (2) CAT6 cables.

22. QUESTION: Floor Box note 1 on print E-11, please confirm the quantity of Category 6 cables to be installed to the 3-gang box.

22. RESPONSE: Install four (4) CAT6 cables.

23. QUESTION: Drawing A-3 shows all wood doors to be 6 panel doors. Specification section 08 21 00 describes flush wood doors. Please clarify.

23. RESPONSE: Solid wood, six panel, stain grade doors are required for the interior of the building.

24. Based on the estimated cost range, the following FAR Clause will apply to this project.

**52.225-9 -- Buy American--Construction Materials.**

As prescribed in [25.1102\(a\)](#), insert the following clause:

**Buy American--Construction Materials (May 2014)**

(a) *Definitions.* As used in this clause--

“Commercially available off-the-shelf (COTS) item” —

(1) Means any item of supply (including construction material) that is—

(i) A commercial item (as defined in paragraph (1) of the definition at FAR 2.101);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, under a contract or subcontract at any tier, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in 46 U.S.C. 40102(4), such as agricultural products and petroleum products.

“Component” means an article, material, or supply incorporated directly into a construction material.

“Construction material” means an article, material, or supply brought to the construction site by the Contractor or a subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety

systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

“Cost of components” means--

- (1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or
- (2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the construction material.

“Domestic construction material” means—

- (1) An unmanufactured construction material mined or produced in the United States;
- (2) A construction material manufactured in the United States, if—
  - (i) The cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic; or
  - (ii) The construction material is a COTS item.

“Foreign construction material” means a construction material other than a domestic construction material.

“United States” means the 50 States, the District of Columbia, and outlying areas.

(b) *Domestic preference.*

- (1) This clause implements the 41 U.S.C. chapter 83, Buy American, by providing a preference for domestic construction material. In accordance with 41 U.S.C. 1907, the component test of the Buy American statute is waived for construction material that is a COTS item. (See FAR 12.505(a)(2)). The Contractor shall use only domestic construction material in performing this contract, except as provided in paragraphs (b)(2) and (b)(3) of this clause.
- (2) This requirement does not apply to information technology that is a commercial item or to the construction materials or components listed by the Government as follows: \_\_\_\_\_  
[Contracting Officer to list applicable excepted materials or indicate “none”]

(3) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(2) of this clause if the Government determines that

(i) The cost of domestic construction material would be unreasonable. The cost of a particular domestic construction material subject to the requirements of the Buy American statute is unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent;

(ii) The application of the restriction of the Buy American statute to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

*(c) Request for determination of inapplicability of the Buy American statute.*

(1)

(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(3) of this clause shall include adequate information for Government evaluation of the request, including--

(A) A description of the foreign and domestic construction materials;

(B) Unit of measure;

(C) Quantity;

(D) Price;

(E) Time of delivery or availability;

(F) Location of the construction project;

(G) Name and address of the proposed supplier; and

(H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.

(ii) A request based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause.

(iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.

(2) If the Government determines after contract award that an exception to the Buy American statute applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(3)(i) of this clause.

(3) Unless the Government determines that an exception to the Buy American statute applies, use of foreign construction material is noncompliant with the Buy American statute.

(d) *Data*. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

Foreign and Domestic Construction Materials Price Comparison

Construction material description	Unit of measure	Quantity	Price (dollars) *
<i>Item 1</i>			
<b>Foreign construction material</b>			
<b>Domestic construction material</b>			
<i>Item 2</i>			
<b>Foreign construction material</b>			
<b>Domestic construction material</b>			

[List name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.]

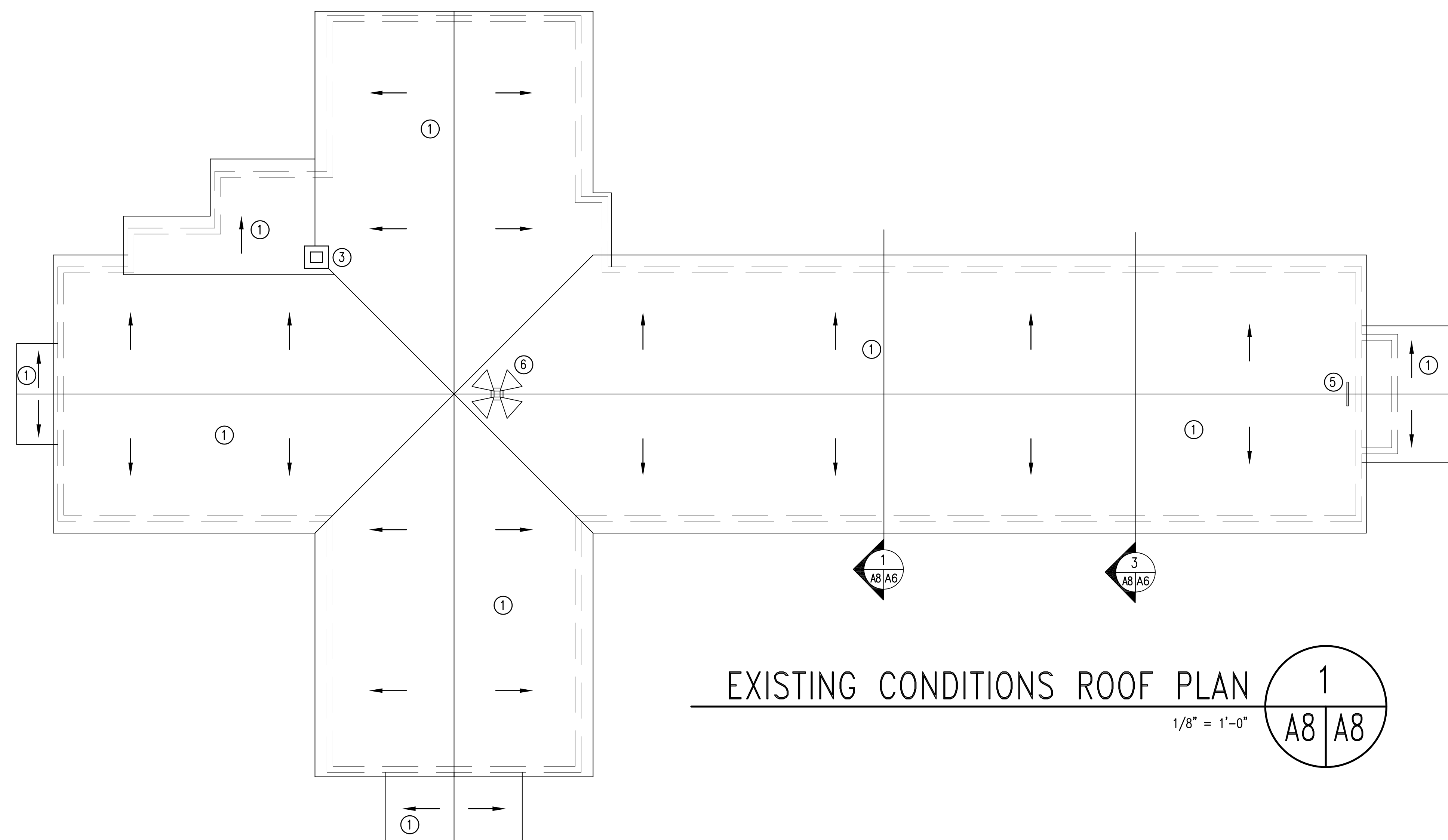
[Include other applicable supporting information.]

[\*Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).]

(End of Clause)

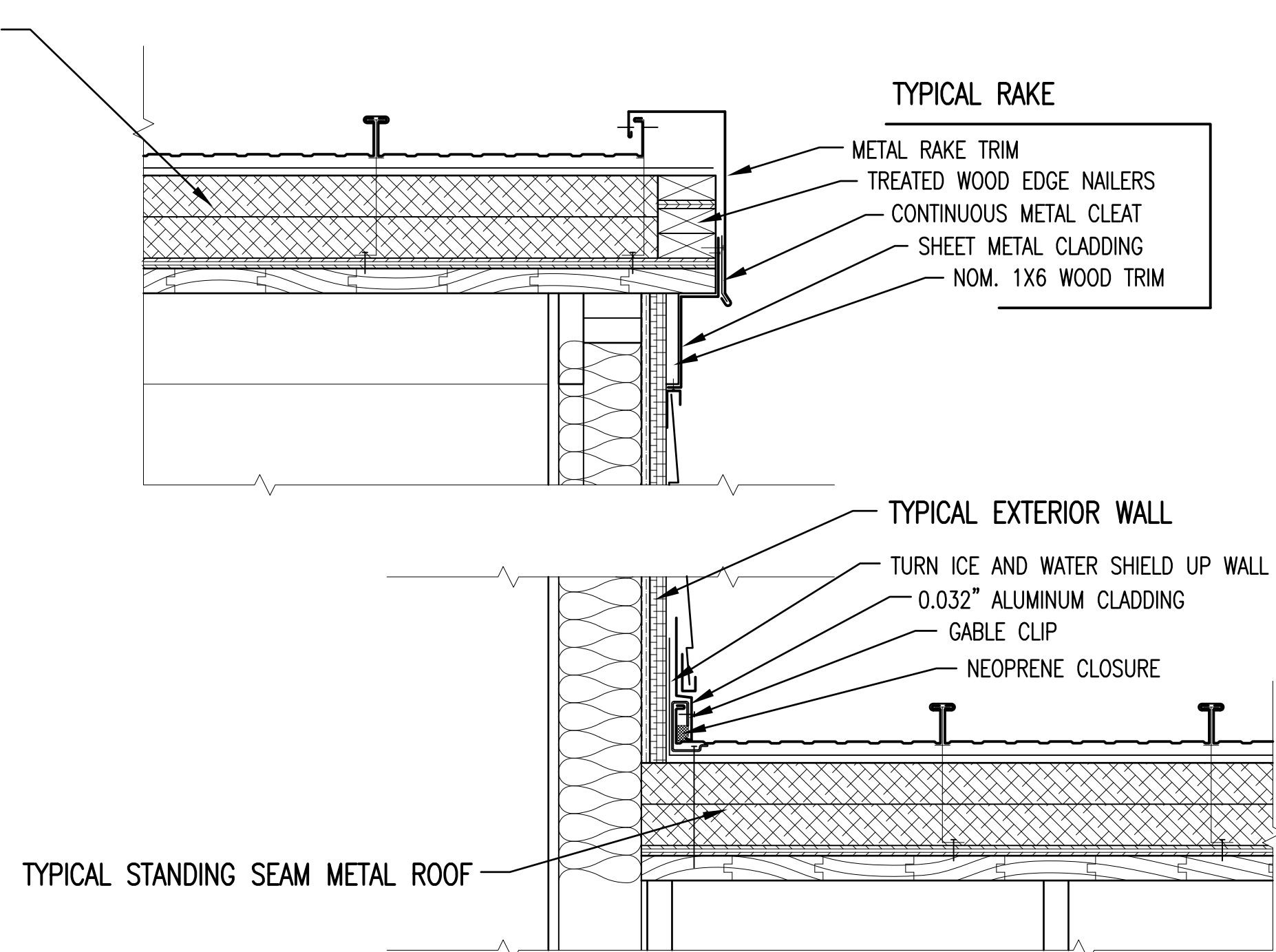


REVISIONS		
SYMBOL	DESCRIPTION	DATE
△	DETAILS 3, 4, AND 5/A8/A8 HAVE BEEN ADDED TO THE DRAWINGS	2019-07-23
		APPROVED

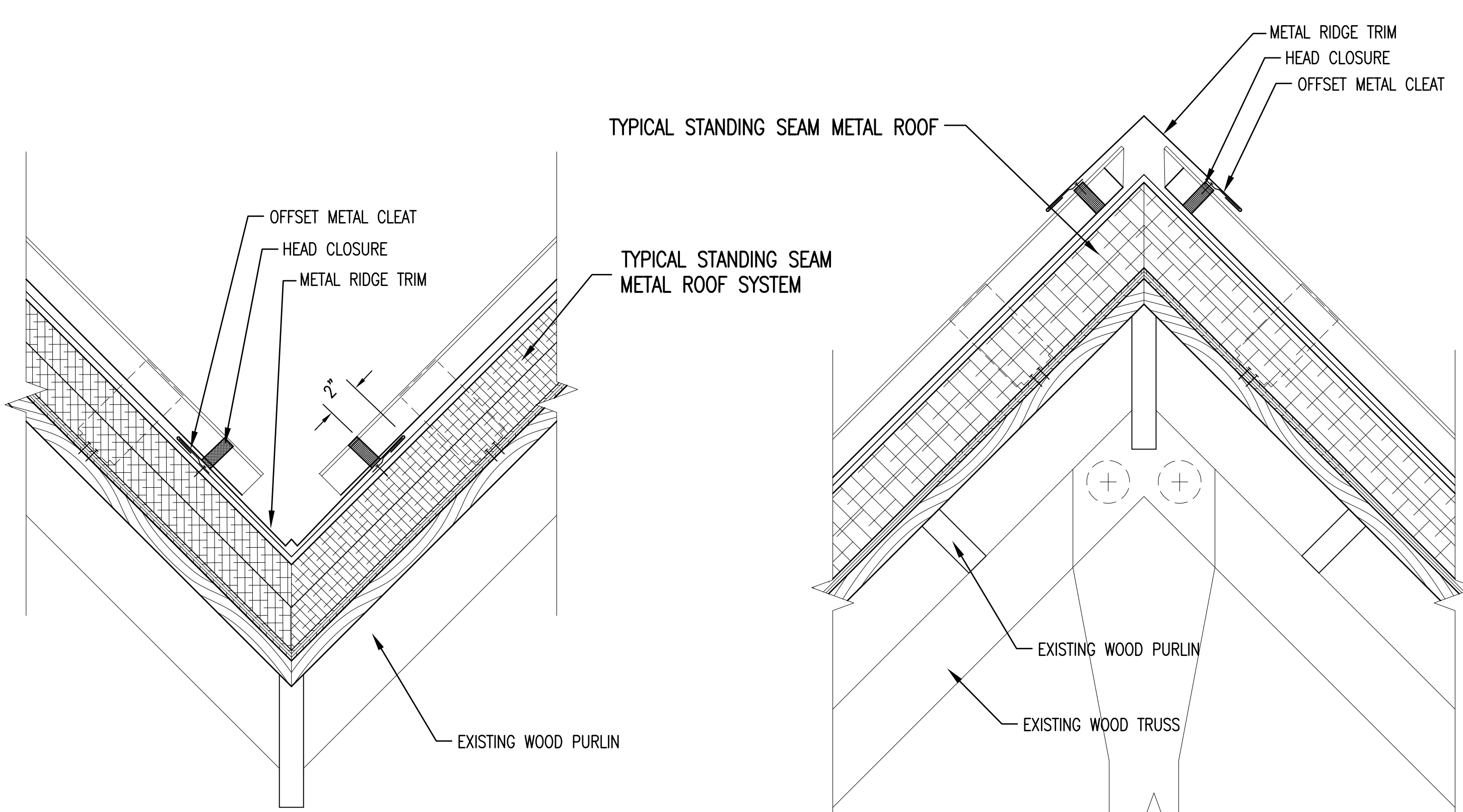


EXISTING CONDITIONS ROOF PLAN  
1/8" = 1'-0"  
1  
A8 | A8

- NUMBERED NOTES ON THIS SHEET:
- REMOVE EXISTING SHINGLE ROOF AND WOOD DECK DOWN TO THE TOP OF THE WOOD STRUCTURE.
  - PROVIDE NEW STANDING SEAM METAL ROOF SYSTEM OVER T&G WOOD DECK WITH PLYWOOD ATTACHMENT SURFACE.
  - REMOVE BRICK CHIMNEY.
  - ROOFING CONTRACTOR SHALL COORDINATE WITH ELECTRICAL CONTRACTOR CONCERNING CONDUIT PLACEMENT FOR THE LIGHT FIXTURES IN AREAS WITH EXPOSED ROOF DECK CEILINGS.
  - CROSS ON ROOF - SEE BUILDING ELEVATIONS.
  - REMOVE EXISTING ROOF MOUNTED SPEAKER ARRAY AND PROVIDE NEW - SEE ELECTRICAL DRAWINGS. PROVIDE MOUNTING SYSTEM BRACKETS AS RECOMMENDED BY METAL ROOFING MANUFACTURER.

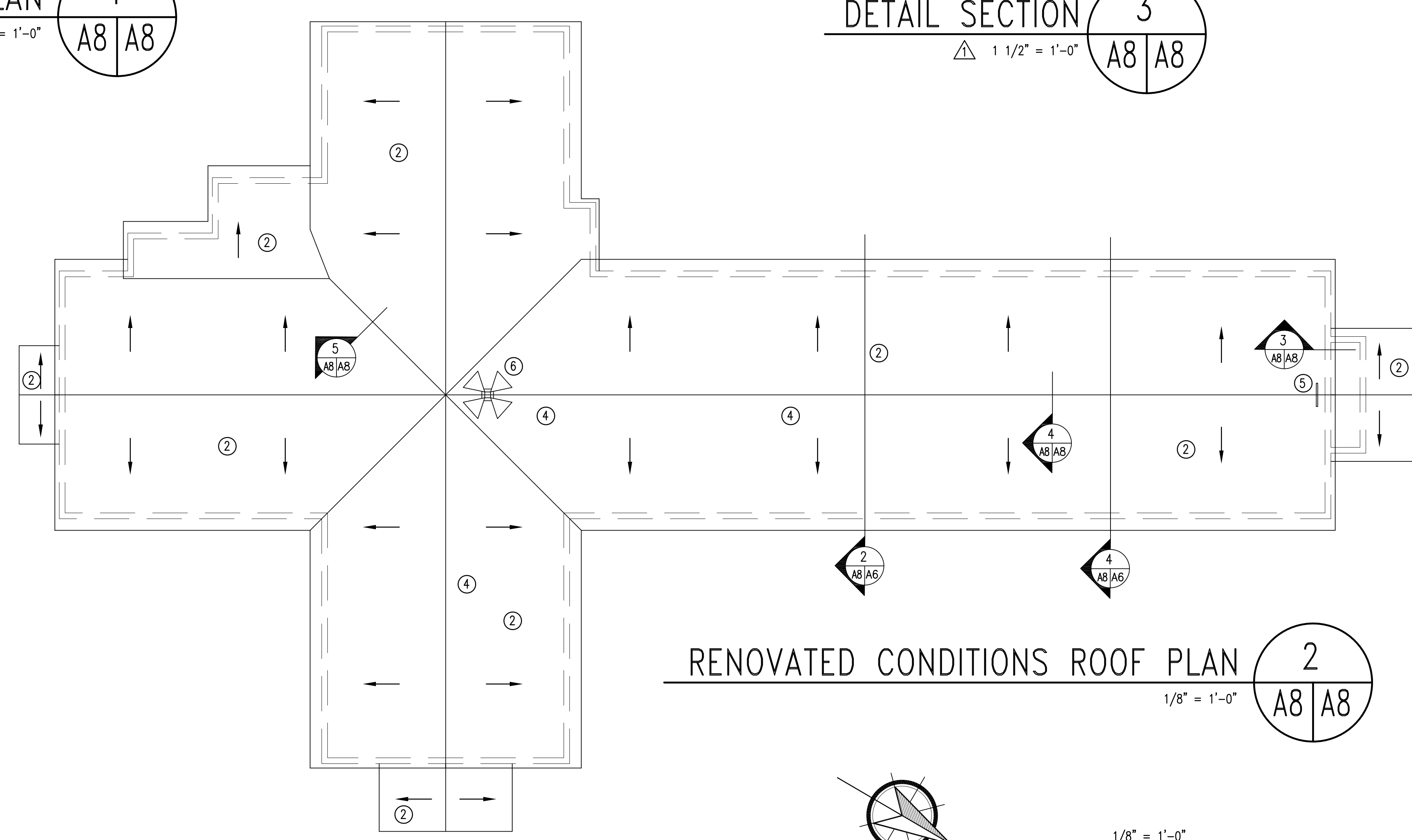


DETAIL SECTION 3  
1 1/2" = 1'-0"  
3  
A8 | A8

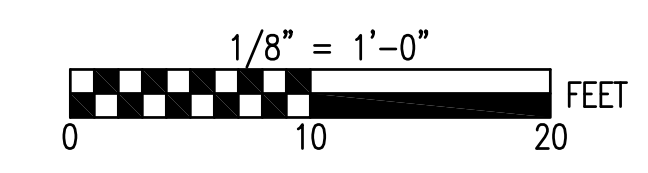
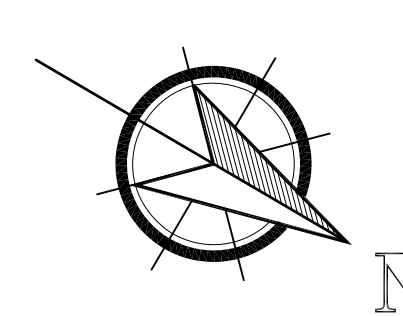


RENOVATED VALLEY DETAIL SECTION  
1 1/2" = 1'-0"  
4  
A8 | A8

RENOVATED RIDGE DETAIL SECTION  
1 1/2" = 1'-0"  
5  
A8 | A8



RENOVATED CONDITIONS ROOF PLAN  
1/8" = 1'-0"  
2  
A8 | A8



SEE DISCLOSURE OF INFORMATION STATEMENT ON SHEET T-1

	SHEET TITLE: ROOF PLANS		A-8	
	TALLEY & SMITH ARCHITECTURE INC. P.O. BOX 518 SHELBY, NC 28151-0518 409 EAST MARION ST. SHELBY, NC 28150 SHELBY, N.C.		DEPARTMENT OF THE NAVY <b>MARINE CORPS BASE</b> CAMP LEJEUNE, NORTH CAROLINA	
DES. Robert L. Smith III DR. Steven C. Fender CHK. Robert L. Smith III		INTERIOR AND EXTERIOR REPAIRS BLDG. M116 CAMP LEJEUNE, NORTH CAROLINA		
SUBMITTED BY: DESIGN DIR. APPROVED:		DATE	SIZE: F	CODE IDENT. NO.: 80091
SATISFACTORY TO:		DATE	SCALE: NOTED	NAVFAC DRAWING NO.: 60024577
06/24/2019			SPEC: 05-18-0086	CONST. CONTR. NO. N40085-18-B-0086
				SHEET 15 OF 50



SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

06/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

- ASTM B1 (2013) Standard Specification for Hard-Drawn Copper Wire
- ASTM B8 (2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM D1557 (2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>) (2700 kN-m/m<sup>3</sup>)
- ASTM D709 (2016) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
- IEEE C2 (2017) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

- ICEA S-87-640 (2016) Optical Fiber Outside Plant Communications Cable; 4th Edition
- ICEA S-98-688 (2012) Broadband Twisted Pair Telecommunication Cable, Aircore, Polyolefin Insulated, Copper Conductors Technical Requirements
- ICEA S-99-689 (2012) Broadband Twisted Pair Telecommunication Cable Filled, Polyolefin Insulated, Copper Conductors Technical Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- ANSI C62.61 (1993) American National Standard for Gas Tube Surge Arresters on Wire Line

## Telephone Circuits

### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017) National Electrical Code

### SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

### TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-107 (1999a) FOTP-107 Determination of Component Reflectance or Link/System Return Loss using a Loss Test Set

TIA-455-46A (1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers

TIA-455-78-B (2002) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation

TIA-472D000 (2007b) Fiber Optic Communications Cable for Outside Plant Use

TIA-492AAAA (2009b) 62.5-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers

TIA-492AAAB (2009a) 50-Um Core Diameter/125-Um Cladding Diameter Class IA Graded-Index Multimode Optical Fibers

TIA-492CAAA (1998; R 2002) Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers

TIA-492E000 (1996; R 2002) Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1550 nm Window

TIA-526-14 (2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA-526-7 (2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-568-C.1 (2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard

TIA-568-C.2 (2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair

Telecommunications Cabling and Components Standards

TIA-568-C.3	(2008; Add 1 2011) Optical Fiber Cabling Components Standard
TIA-569	(2015d) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-590	(1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA-606	(2012b; Add 1 2015) Administration Standard for the Telecommunications Infrastructure
TIA-607	(2011b) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-758	(2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-455-204	(2000) Standard for Measurement of Bandwidth on Multimode Fiber
TIA/EIA-598	(2014d) Optical Fiber Cable Color Coding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755	Telecommunications Standards and Specifications for Materials, Equipment and Construction
RUS Bull 1751F-630	(1996) Design of Aerial Plant
RUS Bull 1751F-640	(1995) Design of Buried Plant, Physical Considerations
RUS Bull 1751F-643	(2002) Underground Plant Design
RUS Bull 1751F-815	(1979) Electrical Protection of Outside Plant
RUS Bull 1753F-201	(1997) Acceptance Tests of Telecommunications Plant (PC-4)
RUS Bull 1753F-401	(1995) Splicing Copper and Fiber Optic Cables (PC-2)
RUS Bull 345-50	(1979) Trunk Carrier Systems (PE-60)

RUS Bull 345-65	(1985) Shield Bonding Connectors (PE-65)
RUS Bull 345-72	(1985) Filled Splice Closures (PE-74)
RUS Bull 345-83	(1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)

UNDERWRITERS LABORATORIES (UL)

UL 497	(2001; Reprint Jul 2013) Protectors for Paired Conductor Communication Circuits
UL 510	(2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 83	(2014) Thermoplastic-Insulated Wires and Cables

1.2 RELATED REQUIREMENTS

Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM, Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION, and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA-606, and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect - (MC).) On Camp Lejeune the main cross-connect is established in Area Distribution Nodes (ADN), network operation centers (NOC), or telephone central office serving predesignated areas of the base. Designers should not design any new main cross-connects without approval from TSD (Telecommunications Support Division aka Base Telephone). The campus backbone is outside plant (OSP) back to TSD and a network operations center.

1.3.2 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae, CATV, CCTV, IDS) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.3 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity but could be combined within the communications room if additional space needed is allotted.

#### 1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect - (IC).)

#### 1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

### 1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, splices, protection, riser points, load coils, etc. required to provide signal paths from the closest point of presence (demarcation) to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at one or both ends of the cable, installed from the entrance facility in building to designated demarcation point. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use. The telecommunications contractor must coordinate with TSD concerning layout and configuration of the EF telecommunications and OSP. The telecommunications contractor may be required to coordinate work effort for access to the EF telecommunications and OSP with TSD.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- a. Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph "Regulatory Requirements" and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.
- b. Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the communications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs "Telecommunications Outside Plant Shop Drawings" and "Telecommunications Entrance Facility Drawings".

SD-02 Shop Drawings

Telecommunications Outside Plant; G

Telecommunications Entrance Facility Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Wire and cable; G

Cable splices, and connectors; G

Closures; G

Building protector assemblies; G

Protector modules; G

Cross-connect terminal cabinets; G

Spare Parts; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation tests; G

Acceptance tests; G

Outside Plant Test Plan; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Minimum Manufacturer's Qualifications; G

SD-08 Manufacturer's Instructions

Building protector assembly installation; G

Cable tensions; G

Fiber Optic Splices; G

Submit instructions prior to installation.

## SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G

## SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5; G

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

## SD-11 Closeout Submittals

Record Documentation; G

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

### 1.5.1 ADDITIONAL SUBMITTAL REQUIREMENTS

All submittals of material, equipment and design must be approved by the TSD Office prior to installing any telecommunications cabling and equipment.

## 1.6 QUALITY ASSURANCE

Ensure compliance with Section 01 45 00.00 20 QUALITY CONTROL.

### 1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

#### 1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with TIA-758, RUS Bull 1751F-630 for aerial system design, and RUS Bull 1751F-643 for underground duct system design and for direct buried system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in



accordance with TIA-606. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, load coils, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the telecommunications outside plant. Update existing telecommunication Outside Plant T0 drawings to include information modified, deleted or added as a result of this installation in accordance with TIA-606. The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

#### 1.6.1.2 Telecommunications Entrance Facility Drawings

Provide T3 drawings for EF Telecommunications in accordance with TIA-606 that include telecommunications entrance facility plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Drawings shall show layout of applicable equipment including incoming cable connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings. Provide T3 drawings for EF Telecommunications as specified in the paragraph TELECOMMUNICATIONS SPACE DRAWINGS of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS. The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

#### 1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

##### 1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758 within the past 3 years.

#### 1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques, shall be Building Industry Consulting Services International (BICSI) Certified Cabling Installation Technicians, Installer Level 2, or have a minimum of 3 years current consecutive experience in the installation of the specified copper and fiber optic cable and components for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from the Contracting Officer.

#### 1.6.2.3 Minimum Manufacturer's Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with, [TIA-568-C.1](#), [TIA-568-C.2](#) and [TIA-568-C.3](#). In addition, cabling manufacturers shall have a minimum of 3 years experience in the manufacturing and factory testing of cabling which comply with [ICEA S-87-640](#), [ICEA S-98-688](#), and [ICEA S-99-689](#).

#### 1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the copper conductor and optical fiber cables, components, and accessories for approval by [Telecommunications Support Division \(aka Base Telephone\)](#) via the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least 30 days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with [TIA-568-C.1](#) and [RUS Bull 1753F-201](#). Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

#### 1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. [Product submission must be approved for use by TSD via Contracting Officer prior to install.](#)

##### 1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

##### 1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in

these publications to the "authority having jurisdiction," or words of similar meaning, to mean the TSD via the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated by references or AHJ. Because references are living documents use of most current version shall be enforced.

#### 1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in 5000 feet length with a minimum overage of 10 percent for 25, 50 or 100 pair configuration and 1250 feet length for larger cables. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

#### 1.8 MAINTENANCE

##### 1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration (TSD via the Contracting Officer) a single complete and accurate set of record documentation for the entire telecommunications system for each structure with respect to this project.

Provide record documentation as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in both hard copy format and on electronic media using Windows based computer cable management software. A licensed copy of the cable management software including documentation, shall be provided. Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation. Provide the following

T5 drawing documentation as a minimum:

- a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility for the soft copy in accordance with TIA-606. Include manufacture date of cable with submittal.
- b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

Provide record documentation as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

#### 1.8.2 Spare Parts

In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking. Spare parts shall be provided no later than the start of field testing.

#### 1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. All product data must be supplied in the submittal process and no product can be used without approval from TSD via the Contracting Officer.

#### 2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

##### 2.2.1 Building Protector Assemblies

Building protector assembly (BEP) shall be self-contained and have interconnecting hardware (710 input and 66 output) for connection to all Outside Plant rated cabling at full capacity. Provide and follow manufacturers instructions for building protector assembly installation. If Multiple BEPs are used, arrange and connect with lowest count high and to left and highest to bottom right. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. There will be no service loops or splicing of copper cable outside of the building protector assembly within the telecommunications room (pigtail BEPs are not authorized).

### 2.2.2 Protector Modules

Provide in accordance with [UL 497](#) three-electrode gas tube type, 5 pin, rated for the application. Provide gas tube protection modules in accordance with [RUS Bull 345-83](#) and shall be heavy duty, A>10kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current in accordance with [ANSI C62.61](#). The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils in accordance with [UL 497](#). Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly. [Recommend 4B1E type.](#)

### 2.2.3 Fiber Optic Terminations

Provide fiber optic cable terminations as specified in [27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM](#). [Ensure terminations within the Fiber Distribution Center \(FDC\) are logical left to right and top to bottom \(OSP SM/Backbone SM then MM/Row to Row SM then MM\).](#)

### 2.2.4 Pathways

Underground applications for single buildings: provide a minimum of (3) four inch ducts (copper, fiber, maintenance duct... in that order), one of which (fiber) contains (2)- three cell fabric inner duct. The (3) four inch ducts shall enter the Main Communications Room (entrance facility) to the far left of the communications backboard (longest farthest wall from the door) and shall be 3-6 inches above floor and 3-6 inches away from wall, aligned parallel to the communications backboard wall. The underground ducts must have 3" concrete encasing, with 24 inches minimum backfill below grade from the Communications Entrance Facility to the maintenance hole that will be providing service to the building (Demarcation point).

For campus distribution between maintenance holes, ducts may need to be 5" to support larger cables, also there will be no less than 4, and up to xx ducts as needed for distribution to the area serviced. All new ducts will include bell ends and terminators flush with MH walls sealed water tight. Both ends of new duct shall be plugged with compression plugs or duct seal around cables (no expanding foam). All new pathway shall be visibly marked and provided on area map with GPS coordinates. All ducts shall be installed as straight through runs between holes and shall not cross each other allowing a straight pull through. All duct banks where fiber cables are installed shall include fabric innerduct to maximize the pathway.

For direct buried applications (only in remote areas where there is no manhole duct systems and none is in project contract), provide a minimum of three (3) four inch ducts from the Communications Entrance Facility to outside the bldg foot print past any obstructions, footers, or sidewalks by at least 5 feet into clear soil/entryway, 24 inches below grade. The ducts will be plugged at both ends and clearly marked on outside end. For distribution to demarcation, between handholes, and riser points cables need to be 36" below grade with metal locating tape at 24" below grade. Cables need to be in HDDPE direct bored, HDDPE direct buried, concrete encased in conduit, or concrete encased split duct under all roadways and pavement. All new cables need to be provided on area map with GPS coordinates for riser points or hand holes. Handholes and maintenance holes shall be traffic rated (MIN tier 22). Handhole size min 4'x4'x4'.

Maintenance hole size 6'x7'x8' and all penetrations should be splayed.

If utility pathway conflicts necessitate placement of a manhole below the typical/normal depth (6-12 inches), the roof of the manhole shall be placed at normal depth and riser extensions shall be used to increase the depth of the manhole. If a deep collar is unavoidable and the depth of the collar will exceed 24 inches, the Designer shall obtain written permission from TSD (Base Telephone) and ensure that the collar is equipped with permanent galvanized steps (rungs). Also do not drill hole in bottom of maintenance/handhole for grounding rod, use grounding ribbon built into the concrete structure itself that is in full contact with the ground.

## 2.3 CLOSURES

### 2.3.1 Copper Conductor Closures

#### 2.3.1.1 Aerial Cable Closures

Provide cable closure assembly consisting of a frame with clamps, a lift-off polyethylene cover, cable nozzles, and drop wire rings. Closure shall be suitable for use on Figure 8 cables. Closures shall be free breathing and suitable for housing either straight-through type or branch type splices of non-pressurized communications cables and shall be sized as indicated. The closure shall be constructed with ultraviolet resistant PVC.

**NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.**

#### 2.3.1.2 Underground Cable Closures

- a. Aboveground: Provide aboveground closures constructed of not less than 14 gauge steel and acceptable for pole or stake mounting in accordance with RUS 1755.910. Closures shall be sized and contain a marker as indicated. Covers shall be secured to prevent unauthorized entry. PVC type closures are to be used in beach areas. All pedestals shall contain a minimum 4 foot x 3/8 inch pigtailed ground rod.
- b. Direct burial: Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity in the buried environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with RUS Bull 345-72.

**NOTE: The installation of a direct buried closure aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized; all closures shall be in a riser point, handhole, or manhole.**

- c. In vault or manhole: Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which air can be pumped for flash testing. Closure shall be of suitable thermoplastic or stainless steel material supplying structural



strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. **Heat shrinkable type closures shall not be used.** Provide filled splice cases in accordance with **RUS Bull 345-72.**

### 2.3.2 Fiber Optic Closures

#### 2.3.2.1 Aerial

Provide aerial closure that is free breathing and suitable for housing splice organizer of non-pressurized cables. Closure shall be constructed from heavy PVC with ultraviolet resistance.

**NOTE: The installation of new aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.**

#### 2.3.2.2 Direct Burial

Provide buried closure suitable to house splice organizer in protective housing into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity, when metallic, in buried environment. Encapsulating compound shall be reenterable and shall not alter chemical stability of the closure.

**NOTE: The installation of a direct buried closure aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized; all closures shall be in a riser point, handhold, or manhole.**

#### 2.3.2.3 In Vault or Manhole

Provide underground closure suitable to house splice organizer in a protective housing into which **air can be pumped for flash testing.** Closure shall be of thermoplastic material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. **Provide 60' slack coils on fiber in every 3rd manhole/handhole or in any which a turn is made.**

### 2.4 PAD MOUNTED **CROSS-CONNECT TERMINAL CABINETS**

Provide in accordance with **RUS 1755.910** and the following:

- a. Constructed of 14 gauge steel.
- b. Equipped with a double set of hinged doors with closed-cell foam weatherstripping. Doors shall be locked and contain a marker as indicated.
- c. Equipped with spool spindle bracket, mounting frames, binding post log, jumpering instruction label, and load coil mounting provisions.
- d. Complete with cross connect modules to terminate number of pairs as indicated.
- e. Sized as indicated.

### 2.5 **CABLE SPLICES, AND CONNECTORS**

### 2.5.1 Copper Cable Splices

In vaults or manholes or entrance protectors provide multi-pair, in-line fold back to maximize length of accessible conductors for maintenance or single pair, in-line splices of a moisture resistant, three-wire insulation displacement connector held rigidly in place to assure maximum continuity in accordance with RUS Bull 1753F-401. Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time (typical 710). Provide correct connector size to accommodate the cable gauge of the supplied cable. Provide enough cable slack suitable for splicing operations to maximize length of accessible conductors for maintenance operations. In above ground splices use three wire insulation displacement single pair connectors no matter what size the cable. In longer runs of copper provide proper load coils to balance the load as needed to ensure line quality in accordance with RUS Bull 1753F-201.

### 2.5.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 19 to 26 AWG solid wire with a maximum insulation diameter of 0.065 inch and shall only be installed with manufacturer recommended crimp/cut tool. Fill connector with sealant grease to make a moisture resistant connection, in accordance with RUS Bull 1753F-401.

### 2.5.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for fusion methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with TIA-455-78-B using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with TIA-455-107. Physically protect each fiber optic splice by a splice kit specially designed for the splice. Provide enough cable slack suitable for splicing operations, but in no case less than 30 feet at each end.

### 2.5.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly logical fashion. Splice organizer shall allow for a minimum of 3 feet of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

### 2.5.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bull 345-65.

## 2.6 CONDUIT

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

## 2.7 PLASTIC INSULATING TAPE

Tape shall be premium quality, heavy-duty, weather-resistant designed for use on electrical and telecommunications applications and UL 510 compliant.

## 2.8 WIRE AND CABLE

### 2.8.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points, slack required, and pair count required prior to ordering cable. Gauge of conductor shall be determined by the distance from the central office. In all cases the installed cable shall be of the same gauge as the cable it is being spliced into at the Demarcation point. The cable range available is; numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). **26 AWG is not used on Camp Lejeune** Copper conductors shall conform to the following: All outside plant copper conductor cable available in PE-39 type shall be used; PE-89 is only approved for large pair counts when PE-39 is not manufactured due to large count.

#### 2.8.1.1 Underground

Provide filled cable (type PE-39/89) meeting the requirements of ICEA S-99-689, RUS 1755.390, and RUS 1755.890. Provide enough cable slack suitable for splicing operations, but in no case less than 10 feet.

#### 2.8.1.2 Aerial

Provide filled cable meeting the requirements of ICEA S-99-689, ICEA S-98-688, and RUS 1755.390 except that it shall be suitable for aerial installation and shall be Figure 8 distribution wire with 6,000 pound Class A galvanized steel or 6,000 pound aluminum-clad steel strand.

#### 2.8.1.3 Screen

Provide screen-compartmental core cable filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.390.

### 2.8.2 Fiber Optic Cable

Provide single-mode, 8/125-um, 0.10 aperture 1310 nm fiber optic cable in accordance with TIA-492CAAA, and single-mode, 8/125-um, 0.10 aperture 1550 nm fiber optic cable in accordance with TIA-492E000 and multimode 62.5/125-um, 0.275 aperture fiber optic cable in accordance with TIA-492AAAA, TIA-472D000, and ICEA S-87-640 including any special requirements made necessary by a specialized design. Provide a minimum of

24 optical fibers or more as indicated by drawings but never less without a waiver from local authority having jurisdiction. Fiber optic cable shall be specifically designed for outside use with preferred double jacket (if buried), single armor, loose buffer construction, and must be shielded. Provide fiber optic color code in accordance with TIA/EIA-598. Provide minimum 60' slack coil in every 3rd MH or any one where a turn is made.

**NOTE: The installation of Multi-mode OSP Fiber Optic cables aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized; except as Backbone Underground Cabling between Communications Rooms within the same building, which is allowed, but not recommended.**

#### 2.8.2.1 Strength Members

Provide central/non-central, non-metallic/metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

#### 2.8.2.2 Shielding or Other Metallic Covering

Provide continuous, conductive or locatable, single tape covering and shield in accordance with ICEA S-87-640 on all cables.

#### 2.8.2.3 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

#### 2.8.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Solid bare copper wire meeting the requirements of ASTM B1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B8, for sizes No. 6 AWG and larger. Conductors should be installed so as not to exceed minimum bend radius and shall be attached to most suitable bond available at location. Do not install field modified ground rods in maintenance holes that already have factory grounding. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

#### 2.9 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with pressurized housings, sized as indicated and shall meet the requirements of RUS Bull 345-50.

#### 2.10 POLES AND HARDWARE

Provide poles and hardware as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

#### 2.11 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be stainless steel or polyethylene and labeled in accordance with TIA-606. Coordinate actual cable tag information with TSD. Handwritten labeling is unacceptable.

#### 2.11.1 Stainless Steel

Provide stainless steel, cable tags 1 5/8 inches in diameter 1/16 inch thick minimum, and circular in shape. Tags shall be die stamped with numbers, letters, and symbols not less than 0.25 inch high and approximately 0.015 inch deep in normal block style.

#### 2.11.2 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags orientation.

#### 2.12 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection in accordance with TIA-590. Provide color, type and depth of tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 23 00.00 20 EXCAVATION AND FILL.

#### 2.13 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper properly attached to factory ground in maintenance/handhole, TMGB, building steel, electrical bus, or approved grounding rods in riser points.

#### 2.14 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 2.15 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

## 2.16 TESTS, INSPECTIONS, AND VERIFICATIONS

### 2.16.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single mode fiber and TIA-526-14 Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions, IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system from designated demarcation point to building entrance facility, to include lightning protection terminations at one or both ends of the cable as required per paragraph: SYSTEM DESCRIPTION.

#### 3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify Base Telephone via the Contracting Officer of damage.

#### 3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

#### 3.1.3 Direct Burial System

Installation shall be in accordance with RUS Bull 1751F-640. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment after proper locates and pothole methods are used. Provide a minimum cable cover of 36 inches below finished grade for both fiber and copper cable. Trenches shall be not less than 6 inches wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, space laterally at least 3 inches apart. When rock is encountered, remove it to

a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Do not unreel and pull cables into the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 23 00.00 20 EXCAVATION AND FILL. Fiber optic cable will not be direct buried, it will be installed in a smooth wall HDPE type duct.

#### 3.1.3.1 Cable Placement

- a. Prior to design and installation of any copper or optical fiber cable systems, cable routes and pathways must be approved by the Base Telephone via Contracting Officer. Manhole layouts (butterflies) shall be provided for review and approval. Cable route shall include which conduits are to be used for which cables using a logical bottom up and straight run approach.
- b. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than 3 inches of well tamped earth. Do not install circuits for communications under or above traffic signal loops.
- c. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.
- d. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.
- e. Leave a horizontal slack of approximately 10 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary connections. (For fiber, provide a minimum of 30 feet at each end.)

#### 3.1.3.2 Identification Slabs (Markers)

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 20 inches square by 6 inches thick.

#### 3.1.3.3 Backfill for Rocky Soil

When placing cable in a trench in rocky soil, the cable shall be cushioned by a fill of sand or selected soil at least 2 inches thick on the floor of the trench before placing the cable or wire. The backfill for at least 4 inches above the wire or cable shall be free from stones, rocks, or other hard or sharp materials which might damage the cable or wire. If the buried cable is placed less than 24 inches in depth, a protective cover of concrete shall be used.

#### 3.1.4 Cable Protection

Provide direct burial cable protection in accordance with NFPA 70 and as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.



Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting outside either side of the concrete minimum of 6 inches per 12 inches burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40 percent of cross-sectional area, or in concrete encased 4 inches PVC pipe. Conduit may be installed by jacking or trenching. Trenches shall be backfilled with earth and mechanically tamped at 6 inches lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.

#### 3.1.4.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

#### 3.1.5 Underground Duct

Provide underground duct and connections (terminators and bell ends) to existing manholes or handholes, as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION with any additional requirements as specified herein. Minimum size of ducts shall be 4 inch and minimum number will be three (3) into any building.

#### 3.1.6 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

#### 3.1.7 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

#### 3.1.8 Cable Pulling

Test duct lines with a mandrel (SHALL BE WITNESSED BY GOVERNMENT) and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of Base Telephone via the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid

an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

#### 3.1.8.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

#### 3.1.8.2 Pulling Eyes

Equip cables 1.25 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 3/4 inch links between pulling-in eyes or grips and pulling strand.

#### 3.1.8.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Do not install slack coils in copper unless approved or requested by AHJ. Fiber slack coils should be min 60' in every 3rd MH or any MH where a turn is made. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. Install cable or cables in corresponding ducts entering and exiting the manholes in straight lines, do not cross ducts or manhole. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags. All fiber optic cables will be installed in fabric innerduct measuring min 1 inch (or larger) with min of three cells (but should maximize pathways).

#### 3.1.9 Aerial Cable Installation

Pole installation shall be as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Where physical obstructions make it necessary to pull distribution wire along the line from a stationary reel, use cable stringing blocks to support wire during placing and tensioning operations. Do not place ladders, cable coils, and other equipment on or against the distribution wire. Wire shall be sagged in accordance with the data shown. Protect cable installed outside of building less than 8 feet above finished grade against physical damage.

**NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.**

#### 3.1.9.1 Figure 8 Distribution Wire

Perform spiraling of the wire within 24 hours of the tensioning operation. Perform spiraling operations at alternate poles with the approximate length of the spiral being 15 feet. Do not remove insulation from support members except at bonding and grounding points and at points where ends of support members are terminated in splicing and dead-end devices. Ground support wire at poles to the pole ground.

#### 3.1.9.2 Suspension Strand

Place suspension strand as indicated. Tension in accordance with the data indicated. When tensioning strand, loosen cable suspension clamps enough to allow free movement of the strand. Place suspension strand on the road side of the pole line. In tangent construction, point the lip of the suspension strand clamp toward the pole. At angles in the line, point the suspension strand clamp lip away from the load. In level construction place the suspension strand clamp in such a manner that it will hold the strand below the through-bolt. At points where there is an up-pull on the strand, place clamp so that it will support strand above the through-bolt. Make suspension strand electrically continuous throughout its entire length, bond to other bare cables suspension strands and connect to pole ground at each pole.

#### 3.1.9.3 Aerial Cable

Keep cable ends sealed at all times using cable end caps. Take cable from reel only as it is placed. During placing operations, do not bend cables in a radius less than 10 times the outside diameter of cable. Place temporary supports sufficiently close together and properly tension the cable where necessary to prevent excessive bending. In those instances where spiraling of cabling is involved, accomplish mounting of enclosures for purposes of loading, splicing, and distribution after the spiraling operation has been completed.

**NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.**

#### 3.1.10 Cable Splicing

##### 3.1.10.1 Copper Conductor Splices

Perform splicing in accordance with manufacturer, best known practices, and requirements of RUS Bull 1753F-401 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

##### 3.1.10.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices.

**NOTE: The installation of Mechanical Fiber Optic Splices aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.**

### 3.1.11 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection (710 input/66 output) installed at each end which meet the requirements of RUS Bull 1751F-815.

### 3.1.12 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

#### 3.1.12.1 Telecommunications Master Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. The TMGB will at a minimum be 4 inches by 10 inches by 1/4 inch as shown in TIA-607.

#### 3.1.12.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs at the main distribution frame. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

#### 3.1.12.3 Campus Distributor Grounding

- a. Protection assemblies: Mount CD protector assemblies directly on the telecommunications backboard. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to TMGB.
- b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

### 3.1.13 Cut-Over

All necessary transfers and cut-overs, shall be accomplished by the telecommunications contractor except government owned cables with active service which must be done by TSD.

## 3.2 LABELING

### 3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using either thermal ink transfer process or laser printer. Actual information on labels shall be obtained from TSD via contracting office.

### 3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with TIA-606. Tag legend shall be as indicated. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

### 3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with TIA-606.

### 3.3 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

### 3.4 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

#### 3.4.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

##### 3.4.1.1 Cable Capacitance

Perform capacitance tests on all pairs within a cable to determine if cable capacitance is within the limits specified.

##### 3.4.1.2 Loop Resistance

Perform DC-loop resistance on all of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

##### 3.4.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

### 3.4.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports to TSD via Contracting officer in soft and hard copy in .pdf or .xls form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis. Blank forms can be provided from Base Telephone upon request.

#### 3.4.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with TIA-758:

- a. Wire map (pin to pin continuity)
- b. Continuity to remote end
- c. Crossed pairs
- d. Reversed pairs
- e. Split pairs
- f. Shorts between two or more conductors
- g. Grounded pairs.

#### 3.4.2.2 Fiber Optic Cable

Test fiber optic cable in accordance with TIA/EIA-455 and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, outside plant field un-terminated at demarcation point, and the far-end pre-connectorized single fiber cable assembly.

- a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 1000 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct

OTDR test and provide calculation or interpretation of results in accordance with TIA-526-7 for single-mode fiber and TIA-526-14 for multimode fiber. Splice losses shall not exceed 0.2 db.

- b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 850 & 1300 for 62.5 multi-mode fiber and 1310 & 1550 for single mode nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with TIA-455-46A for multimode and TIA-526-7 for single-mode fiber optic cables. The measurement method shall be in accordance with TIA-455-78-B. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses shall not exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multimode fiber.
- c. Bandwidth Test: The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with TIA/EIA-455-204.

#### 3.4.3 Soil Density Tests

- a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D1557, Method D.
- b. Determine soil-density relationships as specified for soil tests in Section 31 23 00.00 20 EXCAVATION AND FILL.

-- End of Section --

## SECTION 23 73 33

## HEATING, VENTILATING, AND COOLING SYSTEM

01/07

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 210 (2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

AMCA 500 (1994) Test Methods for Louvers, Dampers and Shutters

## AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI UD Directory of Certified Unitary Air Conditioning Equipment

ANSI/AHRI 210/240 (1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment

AHRI 340/360 (2000) Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment

AHRI 710 (1995) Liquid-Line Driers

## AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 (2001) Safety Standard for Mechanical Refrigeration System

## ASME INTERNATIONAL (ASME)

ASME B16.18 (2018) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.22 (2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME/ANSI B16.26 (1988) Cast Copper Alloy Fittings for Flared Copper Tubes



ASME B31.1	(2016; Errata 2016) Power Piping
ASME/ANSI B31.5	(2001) Refrigeration Piping and Heat Transfer Components
ASTM INTERNATIONAL (ASTM)	
ASTM A 525	(1991; Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A653/A653M	(2017) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B42	(2015a) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B88	(2016) Standard Specification for Seamless Copper Water Tube
ASTM B 280	(1999e1) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
U.S. DEPARTMENT OF ENERGY (DOE)	
Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)	
MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17 ) National Electrical Code
NFPA 90A	(2018) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

- SMACNA HVAC Duct Const Stds (1995; Addenda Nov 1997; 6th Printing 2001) HVAC Duct Construction Standards - Metal and Flexible
- SMACNA Leakage Test Mnl (1985; 6th Printing 1997) HVAC Air Duct Leakage Test Manual

## UNDERWRITERS LABORATORIES (UL)

- UL Elec Equip Dir (2001) Electrical Appliance and Utilization Equipment Directory
- UL 181 (1996; Rev Dec 1998) Factory-Made Air Ducts and Air Connectors
- UL 1025 (1980; R 1990, Bul. 1991) Electric Air Heaters

## 1.2 SYSTEM DESCRIPTION

Provide heating, ventilating, and cooling (HVAC) systems complete and ready for operation. HVAC systems include equipment, ducts, and piping which is located within, on, under, and adjacent to buildings.

## 1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

## SD-03 Product Data

- Dedicated Outside Air Systems
- Mini-Split Heat Pump Systems
- Electric Unit Heaters
- Pre-Fabricated Insulated Ductwork
  
- Packaged heat pumpsExhaust fans
  
- Pipe hangers and supports
- Dampers
- Diffusers, registers, and grilles
- Outside air intake louvers
- Flexible round ducts

## Valves

Pipe and fittings Energy Star Label For Heat Pump Product

### SD-06 Test Reports

Dedicated Outside Air Systems

### SD-08 Manufacturer's Instructions

Installation manual

### SD-10 Operation and Maintenance Data

Dedicated Outside Air Systems, Data Package 3

Mini-Split Heat Pump Systems, Data Package 3

Electric Unit heaters, Data Package 2 Exhaust fans, Data Package 2

Submit in accordance with Section 01 78 23, "Operation and Maintenance Data."

### SD-11 Closeout Submittals

Dedicated Outside Air Systems

Air filter inventory

#### 1.3.1 Installation Manual

Provide for each item of equipment.

#### 1.3.2 Air Filter Inventory

Submit an inventory of sizes and quantity of air filters required to be replaced. Inventory shall indicate location of each piece of equipment. Include sketches of drawings.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

Dehydrate, purge, and charge refrigerant circuit with refrigerant and oil at factory. Factory oil and refrigerant charge shall be full amount required for operation, if within limits permitted by the Department of Transportation; otherwise, a holding charge shall be furnished. Field charging, where only a holding charge is shipped, shall be accomplished without breaking permanent refrigerant connections. Equipment using R-11, R-12, R-13, R-113, R-114, R-115, R-500, or R-502 as a refrigerant will not be permitted. Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Program. Refrigerants that operate anywhere in the cycle below 20 psia will not be permitted. Efficiency of equipment shall meet the minimum's of Table 15701-1.

### 2.1.1 Dedicated Outside Air Systems

#### 2.1.1.1 Cabinet

- a. Cabinet shall be unpainted, non-weatherized and constructed of scratch resistant heavy duty galvanized G90 steel.
- b. Cabinet access panels shall fit into recessed pockets within the cabinet structure and held in place with screws or tool-operated quick-turn fasteners. Recessed areas will be lined with flexible gasket to minimize air leakage. Some access panels shall have inserts to easily facilitate panel removal. Service panels for filter maintenance are hinged for ease of service.
- c. Panels shall allow side access to key internal components to facilitate installation, maintenance and servicing of the unit. The front end panel will be hinged to allow for ease of access.
- d. Duct flanges shall be factory-installed prior to shipment for side supply and exhaust/return air configurations. This side panel is field reversible and duct flanges and panel gasket must be moved for opposite side supply and exhaust/return air configuration
- e. The back of the cabinet shall have an inlet and outlet for outside air intake and exhaust air discharge. The cabinet shall be suitable for installation adjacent to an exterior wall or interior space within the building.
- f. Double Wall with Solid Liner - Cabinet and removable panels shall be double-wall construction with interior panels consisting of solid galvanized metal.

#### 2.1.1.2 Enthalpy Wheel

- a. The system shall utilize a total enthalpy wheel to capture waste heat energy from the building exhaust air stream for conditioning of the entering outdoor air stream. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt. The wheel shall not allow more than 5% crossover between the supply and exhaust air stream. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity. The wheel shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop-to-efficiency ratios. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. The wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of

tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

#### 2.1.1.3 Plate Heat Exchanger

- a. The plate heat exchanger will have a maximum temperature of 190°F. The plate heat exchanger shall have a maximum leakage of 0.1% at nominal air flow with non-silicone sealant at 400 Pa WC differential pressure. The plate material shall be aluminum. The frame material corner profiles shall be aluminum or aluzinc.

#### 2.1.1.4 Refrigerant Circuit

- a. Refrigerant circuit shall be provided with high and low-side Schrader access valves, sight glass with integral moisture indicator, filter-drier, maximum operating pressure (MOP) expansion valve with external equalizer line, expansion valve with internal equalizer line, manual reset high and auto-reset low pressure safety switches.
- b. Refrigerant circuit will be factory leak tested, evacuated, and charged with R-410A refrigerant and run tested prior to shipment.
- c. Units shall contain a 1-row auxiliary/reheat coil and a receiver tank for refrigerant management. The auxiliary/reheat coil shall be constructed of copper tubing mechanically expanded into aluminum fins. The fin spacing shall be 13 fins per inch. The auxiliary/reheat coil shall be vertically mounted a minimum of 8" after the evaporator coil for ease of cleaning and to prevent re-hydration of the condensate from the evaporator coil.
- d. Compressor section is to be provided with resealable refrigerant fittings in order to allow for compressor change at the ceiling level requiring no recovery of refrigerant, brazing, and evacuation or charging of the unit using a factory compressor retrofit kit.
- e. Heat Pump Cycle unit will be equipped with a solenoid valve operating a 4 way valve. In addition the refrigeration circuit will shall contain a suction accumulator.

#### 2.1.1.5 Compressor

- a. Refrigerant circuit (.75 ton) shall utilize a single reciprocating compressor. Reciprocating compressors shall be mounted on vibration isolators to ensure quiet operation. Each reciprocating compressor shall be protected internally from overheating
- b. Compressor shall be mounted outside the air stream in an insulated compartment.
- c. Compressor circuit shall be protected with a high and low pressure safety switch.

## 2.1.1.6 Evaporator Coil Section

- a. It shall be made with heavy wall seamless copper tubes mechanically expanded into tempered aluminum fins with drawn self-spacing collars. Coil end sheets shall be hot-dipped galvanized. Coils shall be 6 rows deep and 13 FPI for uniform performance and optimum part load and humidity operation. All coils shall be factory leak checked under pressure
- b. A maximum operating pressure (MOP), adjustable thermostatic expansion valves, externally equalized, shall feed the evaporator coil.
- c. Evaporator coil section shall be equipped with a double sloped 304 stainless steel drain pan with 3/4" NPT female connection condensate drain connection located on the side of the cabinet. Drain pan shall extend to the entire length and width of the evaporator coil.

## 2.1.1.7 Condenser Coil Section

- a. It shall be made with heavy wall seamless copper tubes mechanically expanded into tempered aluminum fins with drawn self-spacing collars. Coil end sheets shall be hot-dipped galvanized. Coils shall be 4 rows deep and 18 FPI for uniform performance and optimum part load and humidity operation. All coils shall be factory leak checked under pressure.
- b. A maximum operating pressure (MOP), adjustable thermostatic expansion valve, internally equalized shall feed the evaporator coil.
- c. Condenser coil section shall be equipped with a double sloped 304 stainless steel drain pan with 3/4" NPT female connection condensate drain connection located on the side of the cabinet. Drain pan shall extend to the entire length and width of the condenser coil.

## 2.1.1.8 Blower / Motor Assemblies

- a. Unit supply and exhaust fans shall consist of centrifugal backward curve fans with electronically commutated motors (ECM). The motor RPM shall be directly set by the package unit control system. The balancing contractor shall have direct access to set the motor RPM through the unit control system
- b. Section shall include a factory-installed, fan motor fault proving switch. Upon loss of fan motor operation, this control shall enunciate.

## 2.1.1.9 Electrical System

- a. Unit shall have a single isolated electrical control panel located out of the air stream. Access to the control panel shall be from the right or left side of the unit. A single point power connection shall be provided through the right or left side of the cabinet. Power shall be connected to factory installed terminal blocks. Ground lug shall be affixed in the control panel.

- b. A low-voltage transformer, with protection, shall be provided to supply 24 VAC to the control circuit.
- c. Terminal strips and blocks shall be factory installed internal to the control box and be clearly labeled for control wiring connections. External control wires shall enter the cabinet through the right or left side of the cabinet
- d. Terminal blocks shall be factory provided for a Remote On / Off switch capability. Controls shall be suitably wired and enabled to accept a signal from a field supplied Remote On / Off switch.
- e. Terminal blocks shall be factory provided for a Fire / Smoke Detector sensor interface. Controls shall be suitably wired and enabled to accept a signal from a Fire / Smoke Detector.
- f. Terminal blocks shall be factory provided for an External Condensate Pump / Float Switch interface. Controls shall be suitably wired and enabled to accept a signal from an External Condensate Pump / Float Switch.
- g. Unit shall contain a self-contained programmable thermostat.

#### 2.1.1.10 Air Filtration

- a. Filter rack shall be factory mounted in the unit cabinet and shall be accessible from either side.
- b. Filters shall be nominal 2" depth pleated, MERV 8, throwaway type panel filters consisting of cotton and synthetic or synthetic only media with galvanized expanded metal backing and moisture resistant enclosing frame. The filter shall be classified for flammability by Underwriters Laboratories, Inc. as Class 2.
- c. Filter face area shall contain not less than 10 pleats per lineal foot. Media support shall be heavy gauge expanded, electro-galvanized metal with grid members being no less than 0.025" wide, providing an open area of not less than 96%. The grid shall be 100% bonded to the media on the air exiting side to eliminate media vibration and pull-away. The grid shall be formed to provide a uniform V-shaped pleat with the open area on the air exiting matched to the open area on the air entering side for maximum utilization of the media and low airflow resistance. The enclosing frame shall be constructed of a rigid, high wet strength board.

#### 2.1.1.11 Options

- a. Baked Phenolic Coil Coating - Finned tube coil shall be protected with a pure Phenolic thermosetting resinous coating. Metal preparation to provide a surface profile degreasing and etching or phosphatizing by immersion. The coating shall be applied in multiple coats by immersion. After each coat immersion, the coating shall be partially cured in an oven. Following the final immersion and application of (1) spray coat, the coating shall be totally cured in an oven. The total Dry Film Thickness of the coating shall be approximately 2 mils, thereby providing good protection without adversely

affecting heat transfer. Dry Film Thickness varies depending upon fin spacing and the number of tubes and rows in depth. The coating shall withstand dry heat up to 205 °C (400 °F) and show no sign of attack after 3000 hours of salt spray test to A.S.T.M. Specification B117.

### 2.1.2 Mini-Split Heat Pump Systems

Provide units factory assembled, designed, tested, and rated in accordance with ANSI/AHRI 210/240. System shall consist of a slim silhouette, compact, wall mounted indoor fan coil section with wired remote controller and a slim silhouette horizontal discharge outdoor unit which shall be of an inverter driven heat pump design. Provide proof of Energy Star Label for Heat Pump Product.

- a. Outdoor Unit Cabinet: The casing shall be fabricated of galvanized steel, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating in manufacturer's standard color. Assembly hardware shall be cadmium plated. Provide unit with two (2) steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes. Assembly shall withstand lateral wind gust up to 155 MPH.
- b. Outdoor Unit Fan: The unit shall be furnished with a direct drive, high performance propeller type fan. The condenser fan motor shall be a variable speed, direct current (DC) motor and shall have permanently lubricated bearings. Fan speed shall be switch automatically according to the number of operating indoor units and the compressor operating frequency. The fan motor shall be mounted with vibration isolation. The fan shall be provided with a raised guard to prevent contact with moving parts. The outdoor unit shall have horizontal discharge airflow.
- c. Outdoor Unit Coil: The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The coil shall be protected with an integral guard. Refrigerant flow from the outdoor unit to the indoor units shall be independently controlled by means of individual electronic linear expansion valves for each indoor unit. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to thirty three (33) feet of refrigerant piping. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84. All refrigerant connections between outdoor and indoor units shall be flare type.
- d. Outdoor Unit Compressor: The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual



rotary type. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package. The outdoor unit shall be equipped with a suction side refrigerant accumulator. The compressor shall be equipped with an internal thermal overload. The outdoor unit must have the ability to operate over the full capacity range with a maximum height difference of 40 feet and have refrigerant tubing length of 65 feet. The compressor shall be mounted to avoid the transmission of vibration.

- e. Outdoor Unit Electrical: The unit electrical power shall be voltage as indicated in schedule. The outdoor unit shall be controlled by the microprocessors located in the indoor unit and in the outdoor unit communicating system status, operation, and instructions digitally over A-Control - a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 ga. AWG connection plus ground. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control.
- f. Indoor Unit Cabinet: The casing shall have a smooth front, white finish. Provide a separate, metal installation-plate that secures the indoor unit firmly to the wall. The installation-plate shall be securely attached to the wall using appropriate anchor method. Installing contractor shall determine the best method and be responsible for proper mounting of the installation plate to the wall.
- g. Indoor Unit Fan: The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor. The fan shall be statically and dynamically balanced and be powered by a motor with permanently lubricated bearing. Manual adjustable guide vanes shall be provided with the ability to change the airflow from side to side (left to right). Provide an integral, motorized, multi-position, horizontal air sweep flow louver. Unit shall be capable of five (5) positions plus Auto and Swing, controlled from the remote controller. The indoor fan shall operate at one of four (4) speeds. All speeds shall be selected from the remote controller.
- h. Indoor Unit Filter: Return air shall be filtered by means of washable filter.
- i. Indoor Unit Coil: The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing. All tube joints shall be brazed with phosphor copper or silver alloy. The coils shall be pressure tested at the factory. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil. An drain pan level switch shall be provided and installed on the condensate pan to prevent condensate from overflowing.
- j. Indoor Unit Electrical: The unit electrical power shall be voltage as indicated in schedule. The system shall be equipped with a system directing that the indoor unit be powered directly from the outdoor unit.
- k. System Control: Provide indoor unit with a wired remote controller mounted where indicated on plans. The wired remote controller shall be approximately 5" x 5" in size and white in

color with a LCD display.

### 2.1.3 Electric Unit Heaters

UL 1025; wattage, voltage, phase, number of steps, Btu/hr and CFM as indicated. Provide control-circuit terminals and single source of power supply. Heaters 5 Kw and larger shall be 3-phase, with load balanced on each of the three phases. Limit leaving air temperature to 140 degrees F with entering air of 60 degrees F.

#### 2.1.3.1 Enclosure

Minimum 20 gage steel.

#### 2.1.3.2 Heating Element

Nickel chromium heating wire element, free from expansion noise and 60 Hz hum. Embed element in magnesium-oxide insulating refractory. Seal element in high-mass steel or corrosion-resisting metallic sheath with fins. Enclose element ends in terminal box. Provide not more than six fins per inch. Limit fin surface temperature 550 degrees F at any point during normal operation.

#### 2.1.3.3 Controls

Include limit controls for overheat protection of heaters. For remote thermostatic operation, provide contactor rated for 100,000 duty cycles. Provide a control transformer to supply 120-volt thermostat control circuit for each heater as required.

#### 2.1.3.4 Wiring

Completely factory-rewired to terminal strips, ready to receive branch circuit and control connections for 140 degrees F copper wiring.

#### 2.1.3.5 Thermostat

Provide tamper resistant integral thermostat, adjustable without requiring removal of heater components. Thermostat operating range shall be approximately 50 degrees F to a maximum of 75 degrees F with operating differential of 3 degrees F or less.

### 2.1.4 Packaged Heat Pumps

Provide single package unit factory assembled, designed, tested, and rated in accordance with ANSI/AHRI 210/240 or AHRI 340/360. Unit shall be ARI certified or rated in AHRI UD. Provide guards to protect condenser fins. Unit shall be listed in UL Elec Equip Dir. Unit shall include fans, evaporator coil, filters, low leakage dampers, compressor, condenser, and controls. Provide additional heating section when indicated. Insulate interior of casing with manufacturer's standard insulation.

- a. Filter section: Provide UL listed throwaway 1-inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Provide gasketed hinged access panel with quick opening half-twist latches at end of filter rack. Filter rack shall accept 2 inch thick filters.
- b. Safety controls: Provide low refrigerant pressure protection and

pressure relief device. Provide compressor motor with thermal and overload protection, 5 minute anti-recycle timer, and start capacitor kit. Provide compressor with electrical crankcase heater and internal high pressure protection. The above safety controls are not required when scroll compressors are provided.

- c. Supplemental heater section: Provide UL listed electric resistance heaters including internal fusing integral with unit; fan shall run until heater cools. Locate downstream of coils. Provide controls to operate heaters only when indoor thermostat is in heating mode and outdoor thermostat indicates outside temperature is below 35 degrees F or unit balance point, whichever is higher; and when unit is in defrost mode at any outside temperature.
- d. Space temperature controls: Provide controls under Section 23 09 23.13, BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC."
- e. Weatherproof casing: Provide removable gasketed panels designed to exclude driving rain for access to fans, coils, filters, compressors, motors, and controls. Provide weatherproof outside air intake louvers or weatherproof hoods with moisture eliminators.
- f. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

#### 2.1.5 Exhaust Fans

AMCA 210 with AMCA seal. Provide centrifugal type exhaust fans with aluminum housing, fan wheel, and bird screen. Motors shall be completely shielded from the airstream. Provide exhaust opening and gravity closing type automatic backdraft dampers.

### 2.2 ELECTRICAL

#### 2.2.1 Electrical Motors, Controllers, Contactors, and Disconnects

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to Section 26 20 00, "Interior Wiring Systems." Provide electrical connections under Section, 26 20 00, "Interior Wiring Systems." Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

#### 2.2.2 Electrical Work

Provide under Section 26 20 00, "Interior Wiring Systems." Provide control wiring under Section 23 09 23.13, "BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC."

## 2.3 METAL DUCT SYSTEMS

Provide shop-fabricated, zinc-coated steel ducts conforming to [ASTM A 525](#) or [ASTM A653/A653M](#) coating designation G60. Fabricate, construct, brace, reinforce, install, support, and seal ducts and accessories, and test ducts in accordance with [SMACNA HVAC Duct Const Stds](#) and [SMACNA Leakage Test Mnl](#). Cover duct transverse joints with single component synthetic rubber type compound suitable for use with passivated coating on zinc-coated steel. Lap joints in direction of flow. Provide ducts straight and smooth on inside with neatly finished airtight joints. Provide air supply and return openings in ducts with air diffusers, registers, or grilles.

### 2.3.1 Flexible Duct Connectors

Provide airtight flexible duct connectors at duct connections to each air-conditioning unit, air-handling unit, exhaust fan, and ventilating fan. Support connectors at each end with metal angle frame bands, securely bolt in place. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene.

### 2.3.2 Turning Vanes

Provide fabricated tees and square elbows with turning vanes in accordance with [SMACNA HVAC Duct Const Stds](#) for vanned elbows. Turning vanes shall be single wall with trailing edges.

### 2.3.3 Dampers

Provide factory manufactured opposed blade adjustable manual dampers where indicated for duct heights of 12 inches and larger. Provide factory manufactured single leaf dampers for duct heights less than 12 inches. Provide damper shafts with 2 inch standoffs to clear 2 inches of duct insulation with bearings at both ends of the shafts. Provide adjustment quadrant with indicator and locking devices. Provide galvanized steel dampers one gage heavier than duct in which dampers are installed. [Provide automatic dampers under Section 23 09 23.13, "BACnet Direct Digital Control Systems for HVAC."](#)

### 2.3.4 Diffusers, Registers, and Grilles

Provide factory-fabricated metal units with edges rolled or rounded where exposed to view, and factory primed with white enamel finish. Provide each diffuser and register with factory-fabricated, group-operated, adjustable, opposed-blade, air-volume-control dampers, key or screwdriver operated from the face of unit without the use of a tool. Provide each unit with rubber or plastic installation gaskets. Diffusers in same room shall have same face design.

- a. Diffusers: Provide round, square, or rectangular diffusers as indicated. Ceiling diffusers shall be designed to deliver air in a horizontal direction. Provide baffles or other devices as required for proper air distribution pattern.
- b. Registers: Provide double deflection supply registers arranged to control air direction, throw, and drop. Exhaust and return air registers shall have single set of nondirectional face bars or vanes having the same appearance as supply registers. Provide face

bars or vanes spaced not more than 0.75 inch on center and not less than 0.62 inch depth.

- c. Grilles: Provide as specified for registers without air-volume-control dampers.

#### 2.3.5 Outside Air Intake Louvers

Louvers shall bear AMCA certified ratings program seal for air performance and water penetration in accordance with **AMCA 500**. Maximum pressure drop shall be 0.1 inch WG, unless indicated otherwise. Louvers shall have maximum water penetration of 0.20 ounce per square foot of free area at free velocity of 800 fpm. Provide aluminum alloy with anodized finish frames and blades assembled with stainless steel screws, including 0.5-inch mesh aluminum screen mounted in extruded aluminum frame.

#### 2.3.6 Access Doors

Provide for access to volume dampers, plenum chambers, and where indicated. Provide each door with double wall zinc-coated steel construction, gasketed airtight, with continuous hinges and cam latches. Insulate access doors with one-inch thick rigid insulation. Provide 12 inch by 12 inch door, except where larger sizes are indicated, or provide 12 inches by height of duct when duct is less than 12 inches high.

#### 2.3.7 Flexible Round Ducts

**UL 181** and **NFPA 90A** with factory-applied insulation, vapor barrier, and end connections. Fire hazard rating of duct assembly shall not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of 2 inches W.G. positive and 1.5 inches W.G. negative. Flexible round duct length shall not exceed 5 feet. Secure connections by applying adhesive for 2 inches over rigid duct, apply flexible duct 2 inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

- a. Inner duct core: Flexible core shall be interlocking spiral or helically corrugated and constructed of zinc-coated steel, aluminum, or stainless steel; or shall be constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.
- b. Insulation: Inner duct core shall be insulated with mineral fiber blanket type flexible insulation, minimum of one inch thick. Insulation shall be covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

#### 2.4 Pre-Fabricated Insulated Ductwork

Outdoor Installations: Provide double layered (total 50 mm thick min), double walled phenolic foam pre-insulated rectangular ductwork for all outdoor installations. Duct panels shall be manufactured of CFC/HCFC free phenolic foam (or other approved) bonded on both sides to a factory applied foil facing with a minimum thickness of 60 micron internal and 200 micron external. Phenolic panels are to be pre-fabricated and assembled into male/female interlocking sections. Thermal resistance R-10 minimum

to include equivalent R-Value at all joints with no metal pass through. Outdoor cladding shall meet UL 1709. Ductwork shall be fabricated per "SMACNA HVAC Phenolic Duct Construction Standards." Duct shall be fabricated not to pond water.

## 2.5 PIPING SYSTEMS

Provide the following **pipe and fittings**. Provide dielectric fittings, unions or flanges between steel piping and copper tubing for all piping sizes; except that copper alloy valves and strainers may be used without dielectric fittings, unions or flanges. Water piping sizes 4 inches and smaller shall be copper tubing. Water piping sizes larger than 4 inches shall be copper tubing or steel piping. If steel piping is provided, provide a solids-from-water separator.

### 2.5.1 Soldered Joint Copper Tubing

Provide **ASTM B88**, Type L for aboveground piping, Type K for buried piping, with **ASME B16.18** or **ASME B16.22** solder joint fittings, unions, and flanges; provide adapters as required. Provide **ASTM B42** copper pipe nipples with threaded end connections. Provide **ASTM B32**, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder.

### 2.5.2 Copper Tubing Piping Systems

Provide copper tubing for the following piping systems, except water piping sizes larger than 4 inches shall be copper tubing or steel piping.

- a. Cold drain piping from drain pans.

### 2.5.3 Copper Refrigerant Tubing

Provide **ASTM B 280**, cleaned, dehydrated, and sealed. Provide **ASME B16.22** solder joint refrigerant fittings and adapters. Provide silver brazing alloy solder and silver brazing alloy flux. During brazing operations bleed a small amount of dry oil-free nitrogen continuously through the refrigerant tubing. Provide **ASME/ANSI B16.26** flared fittings.

### 2.5.4 Valves

Valves shall have flanged end connections, except valves smaller than 2.5 inches may have threaded end connections with a union on one side of the valve. Solder end connections may be used for connections between copper alloy valves and copper tubing.

#### 2.5.4.1 Refrigerant Valves

**ASME/ANSI B31.5**, and shall be copper alloy. Provide valves in each system for servicing and for isolating system components in compliance with **ASHRAE 15**.

## 2.6 PIPING ACCESSORIES

### 2.6.1 Pipe Hangers and Supports

Provide **MSS SP-58** and **MSS SP-69**, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists

with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

#### 2.6.2 Traps

Provide traps of the types indicated with stainless steel internals. Pressure and temperature range shall be for the intended service. Traps for steam at 100 psig and greater shall be minimum of ASME Class 150.

#### 2.6.3 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide one-inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

##### 2.6.3.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

##### 2.6.3.2 Sleeves not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

#### 2.6.4 Sight Glass and Refrigerant Drier

AHRI 710. Provide in refrigerant liquid piping.

#### 2.6.5 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

#### 2.7 ACCESS DOORS FOR VALVES

Provide factory-prefabricated and primed flush face steel access doors including steel door frame for with continuous hinges and turn-screw-operated latch. Provide door frame installation in plaster and masonry walls. Furnish doors under this section; install doors under

appropriate section of this specification.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 HVAC System

Installation of HVAC system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, ASME/ANSI B31.5, NFPA 70, and in accordance with the manufacturer's recommendations.

##### 3.1.2 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

#### 3.2 PIPING

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections.

Make changes in piping sizes through tapered reducing fittings; bushings will not be permitted. Install valves with stems horizontal or above. Provide flanges or unions at valves, traps, strainers, and connections to equipment; unions are not required in copper tubing piping systems.

- a. Threaded connections: Provide Teflon pipe thread paste on male threads. Do not thread metal pipe into plastic piping.
- b. Pipe hangers and supports: Provide additional pipe hangers and supports at in-line water pumps and flanged valves.
- c. Piping to receive insulation: Provide temporary wood spacers between the pipe hangers and supports, and the pipe in order to properly slope the piping and establish final elevations. Provide temporary wood spacers of same thickness as insulation to be provided under Section 23 07 00, "Insulation of Mechanical Systems." Support plastic piping every 4 feet. Support metal piping as follows.

#### MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Copper Tubing	6	7	8	8	9	10	11	12	13	14
Steel Pipe	7	8	9	10	11	12	13	14	16	17

- d. Cleaning of piping: Keep interior and ends of new piping and existing piping affected by Contractor's operations, cleaned of water and foreign matter during installation by using plugs or other approved methods. When work is not in progress, securely



close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

- e. Demolition: Remove materials so as not to damage materials which are to remain. Replace existing work damaged by Contractor's operations with new work of same construction.
- f. Tee Joints: Extracted tee joints may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to assure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

### 3.3 ADJUSTMENTS

Adjust controls and equipment so as to give satisfactory operation. Adjust entire water temperature control system and place in operation so that water quantities circulated are as indicated. Air duct systems shall be adjusted and balanced so that air quantities at outlets are as indicated and so that distribution from supply outlets is free from drafts and has uniform velocity over the face of each outlet.

### 3.4 INSTRUCTING OPERATING PERSONNEL

Upon completion of work and at time designated by Contracting Officer, provide services of competent technician for period of not less than one 8-hour working day for instruction of Government operating personnel in proper operation and maintenance of equipment.

### 3.5 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish steam, fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, ducts, and filters.

#### 3.5.1 Piping Systems Except for Refrigerant Piping

Before insulating, hydrostatically test each new piping system at not less than 188 psig  
Maintain pressure for 2 hours with no leakage or reduction in gage pressure. Obtain approval before applying insulation.

#### 3.5.2 Refrigerant Piping

Perform following when field piping connections are provided.

- a. Pressure test: Test refrigerant piping using dry, oil-free nitrogen, and prove tight at 300 psig on the high side and 150

psig on the low side. Maintain pressure for 2 hours with no leakage or reduction in gage pressure

- b. Evacuation: Using high vacuum pump and certified micron gage, reduce absolute pressure on both sides of system simultaneously to 300 microns. After reaching this point charge system with proper refrigerant until pressure of zero psig is obtained. Repeat evacuation-charging procedure for two more cycles, totaling to three evacuation-charging cycles. On final evacuation, secure pump and maintain 300 microns for 2 hours before charging with required final refrigerant.

### 3.5.3 Air Ducts

Obtain approval before applying insulation.

### 3.5.4 Equipment

#### 3.5.4.1 Field Testing

Test each item of equipment in operation for continuous period of not less than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that the equipment operating parameters are within limits recommended by the manufacturer.

#### 3.5.4.2 Equipment Requiring Field Test Reports:

- a. Equipment Items for Reports: Equipment requiring field test reports are listed in paragraph "SD-12, Field Test Reports."
- b. Manufacturer's Recommended Test: Conduct the manufacturer's recommend field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field testing.
- c. Operational Test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.
- d. Notice of Tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.
- e. Report Forms: Type all data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director and the QC Manager. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

- f. Deficiency Resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

#### 3.5.5 Additional Field Testing

Provide testing, adjusting, and balancing (TAB) of ducts, piping, and equipment under Section 23 05 92, "TESTING/ADJUSTING/BALANCING: SMALL HEATING/VENTILATING/COOLING SYSTEMS."

#### 3.5.6 Testing and Balancing

Balance airflow in accordance with SMACNA and flows indicated. Submit written certificate to report the following:

- a. Air-handling unit and condensing unit nameplate data, and actual voltage and ampere consumption.
- b. Supply and return terminal airflow, and equipment used to measure airflow.
- c. Air-handling unit in and out cfm and temperatures, rpm of fan if belt driven.
- d. Ambient outside air temperature, date, and person testing, balancing, and reporting.

#### 3.5.7 Testing EMCS Equipment

- a. All EMCS equipment shall be given an operation test.
- b. Items not operating properly shall be repaired or replaced and retested.

TABLE 15701-1  
EQUIPMENT MINIMUM EFFICIENCY REQUIREMENTS  
Equipment must meet each rating listed

<u>Equipment Type</u>	<u>Efficiency</u>	<u>Rating Condition</u>
Air to Air Unitary Air Conditioner (Packaged and Split)		
<65 Mbtu/hr	12.0 SEER	
65-135 Mbtu/hr	11.0 EER 11.4 IPLV	
136-240 Mbtu/hr	10.8 EER 11.2 IPLV	
Air to Air Unitary Heat Pump (Packaged and Split)		
<65 Mbtu/hr	12.0 SEER 7.7 HSPF	
65-135 Mbtu/hr	10.1 EER 10.4 IPLV 3.2 COP	
136-240 Mbut/hr	9.3 EER 9.5 IPLV 3.1 COP	
Air Cooled Water Chiller	1.23 Full Load kW/ton .90 IPLV kW/ton	AHRI 550/590-98 AHRI 550/590-98
Air Cooled Condensing Units	12.0 SEER 11.0 EER 11.4 IPLV	
Room Air Conditioner (Window, not thru the wall)		
<20,000 btu/hr	10.7 EER	DOE test procedure
=>20,000 btu/hr	9.42 EER	DOE test procedure
Package Terminal Outdoor Air Conditioner	$10 = (.16 \times \text{Cap}/1000) * \text{EER}$ $12.2 - (.2 \times \text{Cap}/1000) * \text{EER}$	AHRI 310/380 @ 95 F AHRI 310/380 @ 82 F
Package Terminal Outdoor Heat Pump	$10 - (.16 \times \text{Cap}/1000) * \text{EER}$ $12.2 - (.2 \times \text{Cap}/1000) * \text{EER}$ $2.9 - (.026 \times \text{Cap}/1000) * \text{COP}$	AHRI 310/380 @ 95 F AHRI 310/380 @ 82 F AHRI 310/380 @ 47 F

\*Capacity is cooling capacity in but/hr. Use 7,000 if cap is less than 7,000, use 15,000 if cap is greater than 15,000.

TABLE 15701-1  
EQUIPMENT MINIMUM EFFICIENCY REQUIREMENTS  
Equipment must meet each rating listed

<u>Equipment Type</u>	<u>Efficiency</u>	<u>Rating Condition</u>
Computer Room Air Conditioner	8.9 EER	
Water Source Heat Pump		
Open Loop	16.2 EER	@ 59 F EWT
	3.6 COP	@ 50 F EWT
Closed Loop	14.1 EER	@ 77 F EWT
	3.3 COP	@ 32 F EWT
Oil Fired Heating Boilers		
Water	83% Et	
Steam	83% Et	
Natural Gas Fired Heating Boiler		
Water	80% Et	
Steam		
<2,500,000	79% Et	
=>2,500,000	80% Et	
Direct Vent Gas-Fired Central Furnaces		
<225,000 input	90%	
-- End of Section --		

