



9 March 2012

MILITARY DEPARTMENT
STATE of NEBRASKA
LINCOLN, NEBRASKA

**TITAN READINESS CENTER
MEAD TRAINING SITE
HVAC REPLACEMENT**

at

785 County Road J
Mead, Nebraska 68041

PROJECT No. 310086

ADDENDUM NO. 4

The original specifications and drawings sent to you by the NEBRASKA MILITARY DEPARTMENT CFMO-CMB and Davis Design for the project noted above are amended as noted in this Addendum No. 4.

Receipt of this Addendum shall be acknowledged by inserting its number and date into your proposal.

The following changes to the Contract Documents are issued by CFMO/CMB and shall have the same force and affect as though a part of the original issue.

ITEMS NO.

- 1-1 As a matter of clarification, all Exterior Finish System on Cement Board soffits are to have "FRY REGLET #WPM-75-V-300 CONTINUOUS SOFFIT VENT OR APPROVED EQUAL" at all perimeter conditions.
- 1-2 In reference to specification Section 019113 - General Commissioning Requirements. Delete pages 8 through 12.
- 1-3 In reference to specification Section 034500 - Precast Architectural Concrete. Refer to paragraph 2.7.A. Change the thickness of insulation from 4" to 3".
- 1-4 In reference to specification Section 034500 - Precast Architectural Concrete. Refer to paragraph 2.7.B. Add "low conductive, non-corrosive epoxy coated carbon fiber connectors" as a type of Wythe connector approved for use.
- 1-5 In reference to specification Section 061600 - Sheathing. Change paragraph 2.3.A. as follows: "A. Oriented Strand Board Surfaced, Polyisocyanurate Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation with oriented strand board laminated to one face complying with ASTM C 1289, Type V.
- 1-6 In reference to specification Section 061600 - Sheathing. Delete paragraph 2.3.A.3.
- 1-7 In reference to specification Section 074213.19 - Insulated Metal Wall Panels. Delete this Section.
- 1-8 In reference to Section 074219 - Metal Plate Wall Panels, attached. Insert this specification in the project manual.



- 1-9 In reference to specification Section 075323 – Ethylene-Propylene-Diene-Monomer (EPDM) Roofing. Add paragraph 1.2.B as follows: "B. Provide assembly complying with Factory Mutual Corporation (FM) Roof Assembly Classification, FM DS 1-28 and 1-29, and meeting minimum requirements of FM 1-60 wind uplift rating.
- 1-10 In reference to specification Section 075323 – Ethylene-Propylene-Diene-Monomer (EPDM) Roofing. Change paragraph 2.4.C as follows: "C. Cover Board: High Density Polyisocyanurate foam board, non-composite. Acceptable product: 1/2 inch IsoGard HD by Firestone."
- 1-11 In reference to specification Section 076100 - Sheet Metal Roofing. As a matter of clarification, factory formed standing seam metal roofing is acceptable subject to compliance with specifications.
- 1-12 In reference to specification Section 079200 - Joint Sealants. Refer to paragraph 2.2.A.1. Add Sika to the approved manufactures, subject to compliance with specifications and approval of shop drawings.
- 1-13 In reference to specification Section 079200 - Joint Sealants. Refer to paragraph 2.3.A.1. Add Sika to the approved manufactures, subject to compliance with specifications and approval of shop drawings.
- 1-14 In reference to specification Section 081113 - Hollow Metal Doors and Frames. Delete paragraph 2.7.B.1.
- 1-15 In reference to specification Section 083113 - Access Doors and Frames. Refer to paragraph 2.2.C.4.a. and 2.2.D.6.a. Change finish from "Factory primed ready for field painting" to "Pre-finished powder coat. Color: White."
- 1-16 In reference to specification Section 084113 - Aluminum Framed Entrances and Storefronts. Add paragraph 1.3.F. as follows: "F. Test Reports: Provide certified test reports from a qualified independent testing laboratory showing that aluminum entrance and storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated."
- 1-17 In reference to specification Section 084413 - Glazed Aluminum Curtain Walls. Add paragraph 1.3.E as follows: "E. Test Reports: Provide certified test reports from a qualified independent testing laboratory showing that glazed aluminum curtain wall systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated."
- 1-18 In reference to specification Section 084113 - Aluminum Framed Entrances and Storefronts. As a matter of clarification, in order to comply with UFC 4-010-01 contractor may change exterior framing only to a 6 inch deep system.
- 1-19 In reference to specification Section 085113 - Aluminum Windows. Add paragraph 1.2.E. as follows: "E. Test Reports: Provide certified test reports from a qualified independent testing laboratory showing that aluminum windows have been tested in accordance with specified test procedures and comply with performance requirements indicated in Article 1.6 and 2.2."
- 1-20 In reference to specification Section 085113 - Aluminum Windows. As a matter of clarification, in order to comply with UFC 4-010-01 contractor may change aluminum windows to a 6 inch deep system.
- 1-21 In reference to specification Section 095123 - Acoustical Panel Ceilings. Refer to paragraph 2.3.A.1. and paragraph 2.3.B. Change the Product for LAP-1 from Ultima 1912HRC to Ultima 1911HRC.
- 1-22 In reference to specification Section 095123 - Acoustical Panel Ceilings. Refer to paragraph 2.3.G. Change the paragraph to read "G. Edge/Joint Detail: Beveled Tegular to accommodate a 15/16" grid."



- 1-23 In reference to specification Section 095123 - Acoustical Panel Ceilings. Add the following product for LAP-2: " Armstrong 1935; Classification: Type IV, Form 2, Pattern E, Fire Class A; Color: White; LR: Not less than .86; NRC: Not less than .70, Type E-400 mounting according to ASTM E 795; Edge/Joint Detail: Square Lay-in to accommodate a 15/16" grid; Thickness: 3/4 inch; Modular Size: 24 by 24 inches.
- 1-24 In reference to specification Section 095426 – Wood Panel Ceilings, attached. Insert this specification in the project manual.
- 1-25 In reference to specification Section 101419 - Dimensional Letter Signage. Add paragraph 2.2.A.7. as follows: "7. Characters shall be "*The Strong - The Brave*" in 24'-0" space for interior signage. Refer to drawings for radius surface.
- 1-26 In reference to specification Section 230800 - Commissioning of HVAC Systems, as a matter of clarification in regards to Article 1.01, Paragraph C, Subparagraph 3, no envelope leakage or infrared scanning is required on this project. The building envelope commissioning will consist of field reviews by the Commissioning Agency.
- 1-27 In reference to specification Section 230800 - Commissioning of HVAC Systems, functional performance testing sheets are available to download from A & D Technical Supply's web-site (www.adtechplans.com) or hardcopies are available for pick-up (at no cost to bidders) from A & D Technical Supply, 1822 'N' Street, Lincoln, Nebraska:
- 1-28 In reference to specification Section 232113.33 - Ground-Loop Heat-Pump Piping. In reference to Article 1.2, Paragraph A, the heat pump system will not operate below 36 degrees F.
- 1-29 In reference to specification Section 232113.33 - Ground-Loop Heat-Pump Piping. Add the following as Article 1.6, Paragraph A, Subparagraph 1: The following contractors are approved: a. Geothermal Green Team, b. K2 Construction, c. Loop Tech International, d. Mid America Drilling Corp. e. Saathoff, Inc.
- 1-30 In reference to specification Section 232113.33 - Ground-Loop Heat-Pump Piping. Delete Article 1.6, Paragraph D.
- 1-31 In reference to specification Section 232113.33 - Ground-Loop Heat-Pump Piping. Add the following as Article 1.9: Job Conditions, Paragraph A: Geothermal Conference: Meet with Owner and Architect for a pre-installation conference to discuss expectations prior to proceeding with installation.
- 1-32 In reference to specification Section 232113.33 - Ground-Loop Heat-Pump Piping. Revise Article 3.4, Paragraph A to read, "Chemical treatment is specified in Section 232113 "Hydronic Piping", para, Coordinate with water treatment specialist."
- 1-33 In reference to specification Section 232113.33 - Ground-Loop Heat-Pump Piping. Delete Article 3.4, Paragraph B and Paragraph C.
- 1-34 In reference to specification Section 233500 - Overhead Vehicle Tailpipe Exhaust Removal Systems. Add the following as Article 2.1, Paragraph D: Manufacturers: Subject to compliance with requirements, provide products by one of the following. Subparagraph 1: NSGV, Subparagraph 2: DSP Monoxivent.
- 1-35 In reference to specification Section 233813 - Commercial-Kitchen Hoods. Add the following manufacturer as Article 2.3, Paragraph A, Subparagraph 5: Kees.
- 1-36 In reference to specification Section 237333 - Indoor Indirect-Fuel-fired Heating and Ventilating Units. Add the following manufacturer as Article 2.1, Paragraph A, Subparagraph 9: Kees.



- 1-37 In reference to specification Section 260800 - Electrical Systems Commissioning, entire section is available for download from A & D Technical Supply's web-site (www.adtechplans.com) or hardcopies are available for pick-up (at no cost to bidders) from A & D Technical Supply, 1822 'N' Street, Lincoln, Nebraska.
- 1-38 In reference to specification Section 260816 - Electrical Systems Functional Performance Tests, entire section is available for download from A & D Technical Supply's web-site (www.adtechplans.com) or hardcopies are available for pick-up (at no cost to bidders) from A & D Technical Supply, 1822 'N' Street, Lincoln, Nebraska.
- 1-39 In reference to specification Section 263213 – Engine Generators. Replace the last sentence of Article 2.2, Paragraph C.1 with the following: Under Alternate Bid Item #15, the generator shall be a 125kW (150kVA) unit equipped with one 225 amp and one 40 amp breaker.
- 1-40 In reference to specification Section 263600 – Transfer Switch. Replace Article 2.2, Paragraph G with the following: G. Neutral Switching. Provide 3 pole switches with solid neutral connection.
- 1-41 In specification Section 312000 – Earth Moving, under Article 3.19, delete Paragraph A and replace with the following:
- Testing Agency: Contractor shall engage, at their own expense, a qualified geotechnical engineering testing agency to perform tests and inspections.
- 1-42 In reference to specification Section 321812- Stabilized Decomposed Granite. Refer to paragraph 2.3.A.1 and edit to read 'Forty 50 pound bags of the aggregate paving blended with proper amount of stabilizer.
- 1-43 In reference to Sheet C-104, the added jointing design is to be used for ABI 4 – 9" PCC pavement for the truck apron. See attached supplemental drawings.
- 1-44 In reference to Sheet C-501, the added detail is a typical joint layout to be used for ABI 6 to determine the jointing pattern for the access road. See attached supplemental drawings.
- 1-45 In reference to Sheet L-501, delete the aluminum edging from Detail 9, Turf/Gravel Paving-Vehicular Grade.
- 1-46 In reference to Sheet S-501, Details. Refer to 28/S-501. At contractor's option, in lieu of continuous joist bearing angles, single bearing angles at each joist locations may be provided. Coordination between joist and precast suppliers shall be by the contractor.
- 1-47 In reference to Sheet S-501, Details and Sheet A-306, Wall Sections. Refer to 6/A-306 and 28/S-501. As a matter of clarification, the exterior precast bearing condition is similar to 28/S-501.
- 1-48 In reference to Sheet S-501, Detail 6, change thickness of precast concrete wall from 12" to 18."
- 1-49 In referenced to Sheet A-101, change the thickness of the freestanding portion of the North precast panel wall of the building to 18" Thick. See attached drawings A-313.1 and A-313.2.
- 1-50 In reference to Sheet A-101, First Level Floor Plan. As a matter of clarification all system furniture will be selected by Owner at a later date. Include loose furniture indicated in Offices, Admin Units and Conference rooms west of Corridor 104, and also in Library 126, Break/Vending 139, IU#1 Work Center 147, IU#2 Work Center 149, and Maintenance Office 165.
- 1-51 In reference to Sheet A-101, First Level Floor Plan. As a matter of clarification the nylon backdrop curtain in Drill Hall 125 is the Gymnasium Divider Curtain referenced in Section 116653.



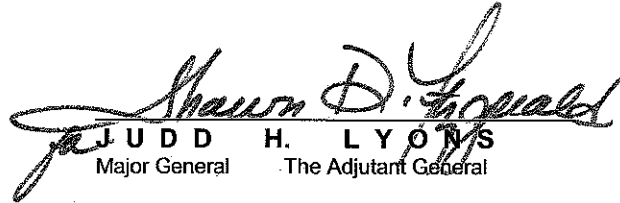
- 1-52 In reference to Sheet A-305, Wall Sections. Refer to attached detail 10/A-305 and to 14/A-304 and other details and sections where the insulated metal wall panel is indicated. Delete the insulated wall panels and provide metal plate wall panels as indicated in Section 074219 in lieu thereof, typical. Backup behind metal plate wall panels shall consist of metal studs with fiberglass faced gypsum sheathing and moisture barrier with flashing as indicated in 10/A-305, typical. Where masonry is shown similar to 14/A-304, provide metal stud furring (depth as required) at 16" o.c. with 5/8" fiberglass faced gypsum sheathing and moisture barrier with flashing, typical, as a substrate to the metal plate wall panels as indicated in Section 074219.
- 1-53 In reference to Sheet A-309, Wall Sections. Refer to Section 4. As a matter of clarification In lieu of roofing membrane adhered to concrete below the roof paver system provide the waterproofing membrane shown in other sections of the same area.
- 1-54 In reference to Sheet A-313, as a matter of clarification, add the following details:
- 12 – “Butt Joint at Free Standing Wall Panels”, See attached drawing A-313.1. As a matter of clarification, the reference for this typical detail would be located between column lines 1B and 2, north of column line A and applies to all free standing walls west of column line 3 .
 - 13 – “Butt Joint at Wall Panel Thickness Change” , See attached drawing A-313.1. As a matter of clarification, the reference for this typical detail would be located just outside Room Tele/Info 136 where thickness changes.
 - 14 – “Corner Joint at NW Corner of Library 126” , See attached drawing A-313.2
 - 15 – “Vertical Recess Butt Joint at Wall Panel” , See attached drawing A-313.3. As a matter of clarification, the reference for this typical detail would be located just outside Classroom 131 and applies to joints between column line 3 and column line 5b.
 - 16 – “Corner Joint at Thin Brick Faced Wall Panel” , See attached drawing A-313.4. As a matter of clarification, the reference for this typical detail would be located just outside Office 120 and at all outside corners where thin brick is indicated.
 - 17 – “Typical Wall Panel Corner Joint.” See attached drawing A-313.5.
 - 18 – “Typical Wall Panel Butt Joint.” See attached drawing A-313.5
- 1-55 In reference to Sheet A-401, Enlarged Floor Plans. The Roof Paver and Pedestal System shall be by Tile Tech Industries (Los Angeles, CA. - 213-380-5560) or approved equal. Provide 12"x12"x1" Granite Tech pavers in standard color as selected by the Architect and supported with pedestals at each corner.
- 1-56 In reference to Sheet I-601 Room Finish Schedule. Add to the ceiling finish for Room Number 104 the ceiling designation WPC-1.
- 1-57 In reference to Sheet I-601 Room Finish Schedule. Change the ceiling finish to "LAP-2" for Room Numbers 159, 159A, and 159C.
- 1-58 In reference to Sheet I-601 Room Finish Schedule, Room Number 162B Mail Receiving, change note 16 to note 19.
- 1-59 In reference to Sheet I-601 Material Legend. Add Note 19 as follows: "19. Countertop to be solid surface SS-1."
- 1-60 In reference to Sheet I-601 Material Legend. Change LAP-1 row as follows: Style: Ultima 1911HRC, Notes: Prelude 15/16" ceiling suspension system.



1-61 In reference to Sheet I-601 Material Legend. Add the following row to the Material Legend: "Code: LAP-2; Type: Lay-in Acoustical Panel; Manufacturer: Armstrong; Style: Clean Room Ultima 1935; Color: White; Size: 24"x24"x3/4"; Finish: Square Lay-in with water repellent membrane; Notes: Prelude 15/16" ceiling suspension system."

1-62 In reference to Sheet I-601 Material Legend. Add the following row to the Material Legend: "Code: WPC-1; Type: Wood Panel Ceiling; Manufacturer: Armstrong; Style: 6660W1; Color: CMA; Size: 96" x 5-1/4" x 3/4"; Finish: Clear; Notes: Refer to specifications."

THIS ADDENDUM SHALL BE ATTACHED TO AND MADE A PART OF THE DRAWINGS AND SPECIFICATIONS AND SHALL BE ACKNOWLEDGED WITH THE BIDDER'S PROPOSAL.


J U D D H . L Y O N S
Major General The Adjutant General

End of Addendum No. 4



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SECTION 074219 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal plate wall panels.

1.3 DEFINITION

- A. Metal Plate Wall Panel Assembly: Metal plate wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weather tight wall system based on AAMA - CW-RS -1-04 The Rain Screen Principle and Pressure Equalized Wall Design.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal plate wall panel assemblies shall comply with performance requirements without failure due to defective manufacturing, fabrication, installation, or other defects in construction. Design, fabricate, and erect a pressure equalized "rainscreen" aluminum wall panel system to meet the requirements of **AAMA 508-7** Voluntary Test Method and Specifications for Pressure Equalized Rain Screen Wall Cladding Systems, specifically as follows.
- B. All AAMA 508-07 tests must be completed with the following criteria;
- C. All manufacturers must achieve the required **15.00psf** criteria without the use of sealants, butyl tapes or gaskets (hidden or otherwise) in the panel joints or at the perimeter of the panels to the test buck perimeter flashing. In addition, a minimum of 70 lineal feet of unsealed panel joint must be incorporated in the test assembly.
- D. Pressure Equalization: ASTM E1233 Cyclic Static Air Pressure Differential Testing; Positive pressure loading to 1200 pa. (25psf) for 100 three second cycles.
- E. Air Leakage: Not more that 0.06 (cfm)/sf of wall area when tested at 6.24 psf in accordance with ASTM E283.

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- F. Water Penetration ; Static: No water infiltration under static pressure when tested in accordance with ASTM E331 at a differential of 10% of inward acting design load, **15.00 psf** min. after 15 minutes.
- G. Water Penetration; Dynamic: AAMA 501.1 Dynamic Water Test at a minimum of 300 Pa (6.24 psf.)
- A. Structural: Provide systems that have been tested in accordance with ASTM E330 and have been certified to be without permanent deformation or failures of structural members.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal plate wall panel and accessory.
- B. Test Results: For each test indicated in 1.4 “Performance Requirements”, submit complete test results and detail drawings of the test from an approved, independent test facility.
- C. Shop Drawings: Show fabrication and installation layouts of metal plate wall panels including joint locations; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.
 - 1. Accessories: Include details of the following items, at a full scale.
 - a. Manufacturers Standard Extrusions.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Plate Wall Panels: 2’x3’ Sample Chips.
- E. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Metal plate wall panels and attachments.
 - 2. Girts
 - 3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - 4. Penetrations of wall by pipes and utilities.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified independent testing agency, for each product.
- G. Maintenance Data: For metal plate wall panels to include in maintenance manuals.
- H. Warranties: Sample of Manufacturers standard warranty

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1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations:
 - 1. Source Limitations: Obtain each type of metal plate wall panel from single source and single manufacturer.
 - 2. Installer: Pre-Qualified Company specializing in performing the work of this Section shall install the system in strict compliance with the written "Installation Guide."
- C. Obtain each type of metal plate wall panel from single source from single manufacturer.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall panels and typical details as shown on Drawings or as directed by Architect, at a minimum include 4 panels indicating a four-way joint of the panels by full thickness, including supports, attachments, and accessories. .
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Pre-installation Conference:
 - 1. Meet with Owner, Architect, and metal plate wall panel Installer, metal plate wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects panels including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal plate wall panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal plate wall panels.
 - 6. Review temporary protection requirements for metal plate wall panel assembly during and after installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal plate wall panels, and other manufactured items so as not to be damaged or deformed. Package panels for protection during transportation and handling. Store and handle in strict compliance with manufacturers instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

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- B. Store and erect metal plate wall panels in a manner to prevent bending, warping, twisting, and surface damage. Do not store panels horizontally. Always store vertically with top of panel down.
- C. Store covered with suitable weather tight and ventilated covering. Store panels to ensure dryness, with positive slope for drainage of water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Remove strippable protective covering on metal plate wall panel prior to installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal plate wall panels to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal plate wall panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate metal plate wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work.

1.10 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal plate wall panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: One year from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish of metal plate wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Aluminum Plate: Alloy and temper as recommended by manufacturer for application and in strict adherence to Manufacturers "Design Guide". Dri-Design® Wall Panel System of 3003-H14 Aluminum. Thickness shall be .080" per the requirements.

2.2 MISCELLANEOUS METAL FRAMING

- A. Subgirts: Z-shaped sections with Gauge per project requirements, Minimum 16 ga. nominal thickness.

2.3 MISCELLANEOUS MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Panel Fasteners: Suitable fasteners designed to withstand design loads. Stainless steel fastener with a minimum 7/16" diameter head and neoprene washer.

2.4 METAL PLATE WALL PANELS

- A. Metal Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal formed into a Dri-design dry-joint pressure equalized rainscreen system with interlocking gutter and drainage system integral to the panel with single horizontal attachment to complete a dry-joint rainscreen assembly. The use of joint sealants, butyl tapes, gaskets (hidden or otherwise) or drainage channels, brackets, support pins to manage the drainage of the system are not allowed.
 - 1. Product Basis for Design: Panels shall be manufactured by Dri-Design, Holland, Michigan. (616) 355-2970. Subject to compliance with manufacturers requirements, provide the following:
 - a. Dri-Design Painted Aluminum Wall Panels
 - b. Pohl Panel
 - c. Firestone Una-Clad 2500 Series Only
 - 2. Material: Tension-leveled, smooth 3003-H14 Aluminum.
 - 3. Thickness of shall be .080"
 - 4. Panel Depth: 1.25"
 - 5. Exterior Finish: Kynar resin finish as manufactured by Valspar, PPG, Akzo Noble or equivalent.
 - 6. Color: As indicated by manufacturer's designations selected by Architect.

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2.5 ACCESSORIES

- A. Metal Plate Wall Panel Accessories: Provide components required for a complete metal plate wall panel assembly including trim, copings, fascia, mullions, sills, corner units, flashings, and similar items. Match material and finish of panels unless otherwise indicated.
- B. Manufacturers Standard Extrusions: Provide integral drainage system and manufactures standard extrusions at termination of dissimilar materials.
- C. Flashing and Trim: Same material, finish, and color as adjacent metal plate wall panels, minimum 0.040 inch thick unless otherwise indicated.
- D. Weather Resistive Barriers: Provide a weather barrier with performance characteristics for Air Penetration , Water Vapor Transmission and Water Penetration Resistance. Weather Barriers can be climate specific. Consult Div. 7 Weather Resistive Barriers for specific requirements of the project.

2.6 FABRICATION

- A. General: Panels shall be factory fabricated and finished by manufacturer to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.8 ALUMINUM FINISHES

- A. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal plate wall panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal plate wall panel manufacturer.

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2. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal plate wall panels to verify actual locations of penetrations relative to seam locations of panels before installation.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous metal plate wall panel support members and anchorage according to ASTM C 754 and panel manufacturer's written instructions.

3.3 METAL PLATE WALL PANEL INSTALLATION

- A. General: Install metal plate wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels according to manufacturer's pressure equalized rainscreen installation method in strict accordance to the manufacturer's installation guidelines. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Commence metal plate wall panel installation
 2. Shim or otherwise plumb substrates receiving metal plate wall panels.
 3. Flash and seal metal plate wall panels with weather closures at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
 4. Install flashing and trim as metal plate wall panel work proceeds.
 5. Provide weather tight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
 1. Aluminum Plate Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal plate wall panel manufacturer.
- D. Attachment System, General: Install attachment system required to support metal plate wall panels and to provide a complete weather tight wall system, including subgirts, manufacturer's extrusions, flashings and trim.
 1. Include attachment to supports and extrusion trims at dissimilar-materials
 2. Do not apply sealants to joints unless otherwise indicated on Drawings or Manufacturers Shop Drawings.
 3. Include manufactures starter extrusion at base course and at cut panel locations.

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- E. Rainscreen-Principle Installation: Provide manufacturer's standard pressure-equalized, rainscreen-principle system factory-formed, metal plate wall panels fabricated from single sheets of metal formed with interlocking gutter and drainage system integral to the panel with single horizontal attachment to complete dry-joint rainscreen assembly. The use of secondary drainage channels, brackets, support pins, joint sealants or gaskets to manage the drainage of the system are not allowed. Attach metal plate wall panels in a progressive interlocking method by engaging bottom of panel in top of previous panel working left to right.
 - 1. Install metal plate wall panels with single top attachment in pre-punched holes to allow individual panels to free-float. Do not fasten perimeter of panel or compromise internal gutter.
 - 2. Do not apply sealants to joints unless otherwise indicated on Drawings at dissimilar materials.

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal plate wall panel assembly including trim, copings, corner and standard extrusion covers, flashings and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- C. Weather Resistive Barrier: Install Air& Moisture barrier behind metal plate panels over substrate according to the requirements specified in Division 07 Section "Weather Resistive Barrier".

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal plate wall panel units within installed tolerance of 1/4 inch in 20 feet, non-cumulative, on level, plumb, and location lines as indicated.

3.6 CLEANING

- A. On completion of metal plate wall panel installation, clean finished surfaces as recommended by panel manufacturer.
- B. After metal plate wall panel installation, clear weep holes and drainage channels of obstructions, dirt.
- C. Replace metal plate wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074219

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SECTION 095426 - WOOD PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood veneer ceiling planks.
 - 2. Concealed grid suspension system.
 - 3. Wire hangers, fasteners, main runners, wall angle moldings and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured and regionally extracted and manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 - 3. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
 - 4. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

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- C. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.
- D. Samples: Minimum 3-1/2 inch or 5-1/2 inch samples of specified panel; 8 inch long samples of suspension system, including main runner.
- E. Shop Drawings: Layout and details of ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
 - 2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.
- C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels should not be removed until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

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1.6 PROJECT CONDITIONS

- A. Wood veneer ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation.
- B. The wood veneer panels should not be installed in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide ceiling panels and suspension systems as manufactured by Armstrong World Industries, Inc. Product: WoodWorks Linear, 6660W1 or approved equal.

2.2 WOOD VENEER CEILING UNITS

- A. Regional Materials: Wood cabinets for transparent finish shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.
- B. Certified Wood: Wood cabinets for transparent finish shall be produced from wood certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- C. Ceiling Panels - Type WPC-1:
 - 1. Surface Texture: Smooth
 - 2. Composition: Wood
 - 3. Finish: Manufacturer's standard natural veneer - Constants
 - 4. Species: Constants Maple
 - 5. Size: 96in X 5-1/4in X 3/4in
 - 6. Reveal: 3/4 inch black fleece reveal
 - 7. Edge Banding: Provide matching veneer/finish at cut end of panels where exposed in final construction (low end of sloped ceiling system).
 - 8. Noise Reduction Coefficient (NRC): ASTM C 423
 - a. Nominal 6" Module - 0.40; 0.50 with optional acoustical backing

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9. Flame Spread: ASTM E 1264; Class A.
10. Dimensional Stability: Standard

D. Accessories:

1. Item #5479 24 inch x 24 inch x 5/8 inch, BioAcoustic Infill Panel

2.3 SUSPENSION SYSTEMS

- A. Components: All linear carriers shall be commercial quality hot dipped galvanized steel as per ASTM A 653. Linear carriers are double-web steel construction with concealed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Linear carriers shall have rotary stitching.

1. Structural Classification: ASTM C 635, Heavy Duty.
2. Color: Black, unless noted otherwise.
3. Clips: Integral, factory-applied, spring steel clips on linear carriers in sufficient number to receive 8 foot linear wood (nominal 6 inch) planks.
4. Acceptable Product: HD Linear Carrier as manufactured by Armstrong World Industries, Inc.

- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three times design load, but not less than 12 gauge.

D. Accessories:

1. Linear Splices, Item #5843, for splicing planks together end-to-end

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as painting has been completed and thoroughly dried out.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans.

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3.3 INSTALLATION

- A. Install suspension system and panels in compliance with ASTM C636; approved construction drawings; with the authorities having jurisdiction; and in accordance with the manufacturer's installation instructions.
- B. Suspend linear carriers from overhead construction with hanger wires spaced 4 feet on center along the length of the linear carrier. Install hanger wires plumb and straight. Hanger wires shall not be installed in convenience holes. Install linear carriers 24 inches on center (or less).
- C. Install wall moldings at intersection of suspended ceiling and vertical surfaces.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of ceilings panels. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095426

Water-Source Heat Pump Functional Performance Test

| | |
|-------------------|------------------------------------|
| Project: | NEARNG Mead Titan Readiness Center |
| WSHP Tags: | See Below |

Test Participants

| | Date |
|----------------|------|
| Name & Company | |
| GC | |
| MC | |
| EC | |
| TAB | |
| CC | |
| A/E | |
| CxA | |

GC = General Contractor; MC = Mechanical Contractor; EC = Electrical Contractor; BC = Balancing Contractor; CC = Controls Contractor; OR = Owner Representative; A/E = Architect/Engineer; CA = Commissioning Agent

Lead Witness Filling Out Form: _____

Testing Dates:

1. _____
2. _____
3. _____
4. _____

Unit Sampling –

The specifications call for the following percentage of the heat pumps to be tested:

| Type | Qt. | % to Test | # to Test |
|------------|-----|-----------|-----------|
| HP 0.5 ton | 3 | 33 | 1 |
| HP .75 ton | 3 | 33 | 1 |
| HP 1.0 ton | 3 | 33 | 1 |
| HP 1.5 ton | 3 | 33 | 1 |
| HP 2.0 ton | 7 | 15 | 1 |
| HP 3.0 ton | 2 | 50 | 1 |

If unit/system is judged to fail performance test, it will be corrected and an additional heat pump type will need to be tested. This will continue until a unit/system passes test or all the units/systems have been tested.

Testing Prerequisites

The following items have been completed and the equipment is ready for Functional Testing
 Check if OK. Enter Issue # if Deficient

| Item | OK? | ISSUE # |
|---|-----|---------|
| Product Documentation Submitted | | |
| Start-Up Complete | | |
| Test and Balance Complete | | |
| Equipment Checklist Complete | | |
| Sequence of Operation Programmed | | |
| Related Systems Started and Checklists Complete | | |

Functional Performance Test Water-Source Heat Pump TAG _____

Fill out one form per unit tested

Functional Performance Verifications

Demonstrate operation of equipment per contract documents including the following:

Control Checks and Sequences

| Item | OK? | ISSUE # |
|--|-----|---------|
| Verify that unit is accurately represented and tagged on building automation system front-end workstation | | |
| Verify that every point listed in the specification is visible, readable, and accurate on the control system front-end workstation | | |
| Activate air-handling fan using control system command, manual start, and/or other equipment interlock | | |
| Verify isolation valve opens upon unit start and closes upon unit stop | | |
| Verify max/min temp setpoint limited by BAS function when sensor is set beyond the min/max. | | |
| Verify setpoint and space temp are accurately represented on controls system | | |
| Validate unit function when there is a call for heating | | |
| Validate unit function when there is a call for cooling | | |
| Validate unit function when it enters unoccupied mode. (Verify unoccupied setpoint for heating and cooling.) | | |
| Validate unit function when override command is given during unoccupied mode | | |
| Validate that control system receives proper indication when the unit fails due to unit safety switch or lockout | | |
| Simulate power failure to unit. Restore power and verify failure recovery | | |

Control Sensor, Flow Meter Validation and Calibration

| Sensor/Flow Meter/Hose Kit/Actuator Tag & Location | Location OK | 1 st Gage or BAS Value | Instrument Measured Value | Final Gage or BAS Value | Pass Y / N |
|--|-------------|-----------------------------------|---------------------------|-------------------------|------------|
| Space Temp | | | | | |
| Supply Air Temp | | | | | |
| Auto-Flow Meter | | | | | |
| Occupancy Sensor | | | | | |
| Other | | | | | |
| | | | | | |
| | | | | | |

Static Checks

| Item | OK? | ISSUE # |
|--|-----|---------|
| Verify heat pump/valves/piping are installed per drawings | | |
| Verify that there is adequate clearance for service | | |
| Verify flow meter has correct range of pressure to function properly | | |
| Verify pressure drop across valve meets specified requirements | | |
| Valve off from water loop, open and inspect strainer | | |
| Check filter for proper filter type, correct install and cleanliness | | |
| Verify unit vibration isolation is installed per spec | | |
| Verify that duct inlet/discharge conditions are OK and per SMACNA to insure minimum pressure drop and noise generation | | |

Issues List

| |
|-----|
| 1. |
| 2. |
| 3. |
| 4. |
| 5. |
| 6. |
| 7. |
| 8. |
| 9. |
| 10. |

Functional Performance Test Circulation Pumping System

| | |
|-------------------|------------------------------------|
| Project: | NEARNG Mead Titan Readiness Center |
| Pump Tags: | HWHP-1, HWHP-2 |

Test Participants

| | Name & Company | Date |
|-----|----------------|------|
| GC | | |
| MC | | |
| EC | | |
| TAB | | |
| CC | | |
| A/E | | |
| CxA | | |

GC = General Contractor; MC = Mechanical Contractor; EC = Electrical Contractor; BC = Balancing Contractor; CC = Controls Contractor; OR = Owner Representative; A/E = Architect/Engineer; CA = Commissioning Agent

Lead Witness Filling Out Form: _____

Testing Dates:

1. _____
2. _____
3. _____
4. _____

Unit Sampling

The specifications call for the following units to be tested:

| Type | Qt. | % to Test | # to Test |
|--------|-----|-----------|-----------|
| HWHP-1 | 1 | 100 | 1 |
| HWHP-2 | 1 | 100 | 1 |
| | | | |
| | | | |
| | | | |
| | | | |

Testing Prerequisites

The following items have been completed and the equipment is ready for Functional Testing

Check if OK. Enter Issue # if Deficient

| Item | OK? | ISSUE # |
|---|-----|---------|
| Product Documentation Submitted | | |
| Start-Up Complete | | |
| Test and Balance Complete | | |
| Equipment Checklist Complete | | |
| Sequence of Operation Programmed | | |
| Related Systems Started and Checklists Complete | | |

Functional Performance Test Circulation Pump

TAG _____

Fill out one form per unit tested

Functional Performance Verifications

Demonstrate operation of equipment per contract documents including the following:

Control/System Checks and Sequences

| Item | OK? | ISSUE # |
|---|----------------|---------|
| Verify that pump is accurately represented and tagged on building automation system front-end workstation | | |
| Verify that every point listed in the specification concerning the pumping system is visible, readable, and accurate on the control system front-end workstation | | |
| Verify controls automatically start system pump when system is occupied and automatically shut down pump when system is unoccupied | | |
| With pump automatically controlled, increase/decrease load on heat pump loop and observe if pump responds accordingly by increase/decreasing speed. Do this for both cooling and heating. | | |
| Note the speed of drive at max/min heating load (Hz) | Max = Min = | |
| Note GPM at max/min heating load (GPM) | Max = Min = | |
| Note pump differential pressure at max/min heating load | DP = | |
| Note the speed of drive at max/min cooling load (Hz) | Max = Min = | |
| Note GPM at max/min cooling load (GPM) | Max = Min = | |
| Note pump differential pressure at max/min cooling load | DP = | |
| Increase/decrease differential pressure setpoint via controls and verify that the speed of the drive increases/decreases in response | | |
| What is the final DP setpoint after system balance. What is the pressure at the furthest unit from the pump. | DP = PSI = | |
| Manually shut off one pump and validate that the controls indicate pump failure and the secondary pump automatically comes up | | |

Control Sensor, Flow Meter Validation and Calibration

| Sensor/Flow Meter/Actuator Tag & Location | Location OK | 1 st Gage or BAS Value | Instrument Measured Value | Final Gage or BAS Value | Pass Y / N |
|---|-------------|-----------------------------------|---------------------------|-------------------------|------------|
| Diff Press Sensor | | | | | |
| Loop Supply Temp Sens | | | | | |
| Loop Return Temp Sensor | | | | | |
| Loop Flow Sensor | | | | | |
| Other | | | | | |
| | | | | | |
| | | | | | |

Static Checks

| Item | OK? | ISSUE # |
|---|-----|---------|
| Verify pump/valves/piping are installed per drawings | | |
| Verify that there are no leaks | | |
| Verify that there is adequate clearance for service | | |
| Valve off from water loop, open and inspect strainer | | |
| Verify unit vibration isolation is installed per spec | | |

Issues List

| |
|-----|
| 1. |
| 2. |
| 3. |
| 4. |
| 5. |
| 6. |
| 7. |
| 8. |
| 9. |
| 10. |

Functional Performance Test Energy Recovery Unit

| | |
|-----------------|------------------------------------|
| Project: | NEARNG Mead Titan Readiness Center |
| Tags: | AHU-1, ERV-1 |

Test Participants

| | Date |
|----------------|------|
| Name & Company | |
| GC | |
| MC | |
| EC | |
| TAB | |
| CC | |
| A/E | |
| CxA | |

GC = General Contractor; MC = Mechanical Contractor; EC = Electrical Contractor; BC = Balancing Contractor; CC = Controls Contractor; OR = Owner Representative; A/E = Architect/Engineer; CA = Commissioning Agent

Lead Witness Filling Out Form: _____

Testing Dates:

1. _____
2. _____
3. _____
4. _____

Unit Sampling

The specifications call for the following units to be tested:

| Tag | Qt. | % to Test | # to Test |
|-------|-----|-----------|-----------|
| AHU-1 | 1 | 100 | 1 |
| ERV-1 | 1 | 100 | 1 |
| | | | |
| | | | |
| | | | |
| | | | |

Testing Prerequisites

The following items have been completed and the equipment is ready for Functional Testing

Check if OK. Enter Issue # if Deficient

| Item | OK? | ISSUE # |
|---|-----|---------|
| Product Documentation Submitted and Approved | | |
| Start-Up Complete | | |
| Test and Balance Complete | | |
| Equipment Checklist Complete | | |
| Sequence of Operation Programmed | | |
| Related Systems Started and Checklists Complete | | |

Functional Performance Test Energy Recovery Unit TAG _____

Fill out one form per unit tested

Functional Performance Verifications

Demonstrate operation of equipment per contract documents including the following:

Control/System Checks and Sequences

| Item | OK? | ISSUE # |
|---|--|---------|
| Verify that unit is accurately represented and tagged on building automation system front-end workstation | | |
| Verify that every point listed in the specification is visible, readable, and accurate on the control system front-end workstation | | |
| Turn system on using control system command and verify fans turn on, refrigeration system is enabled, energy recovery wheel starts, and outside air/exhaust air dampers open (Occupied Mode) | | |
| Turn system off using control system command and verify fans turn off, refrigeration shuts down, energy recovery wheel stops, and outside air/exhaust air dampers close (Unoccupied Mode) | | |
| Verify wheel bypass damper strokes open when unit calls for economizer | | |
| Verify digital scroll compressor modulates correctly from 100% down to 10% | | |
| Verify hot gas modulating valve function properly. Indicate at what suction compressor it starts to modulate and at what suction pressure it is 100% open | Start PSI = 100% PSI = | |
| Verify correct functionality of wheel and refrigeration system when: <ul style="list-style-type: none"> • Cooling mode where OA enthalpy is higher than exhaust • Cooling mode where OA enthalpy is lower than exhaust • Heating mode where OA temperature is lower than exhaust • Heating mode where OA temperature is higher than exhaust | Sply Temp = Sply Temp = Sply Temp = Sply Temp = | |
| Verify the following unit safeties engage and are indicated on the control system front end workstation: <ul style="list-style-type: none"> • OA damper fails to open, fans do not start • EA damper fails to open fans do not start • Wheel shuts off if either fan fails to energize • Fans shut off if wheel fails to energize • Unit shuts down if refrigeration system trips on fault • Unit shuts down if fire alarm is engaged | | |

Validate that control system receives proper indication when the unit fails due to unit safety switch or refrigerant lockout

Simulate power failure to unit. Restore power and verify failure recovery

Control Sensor, Flow Meter Validation and Calibration

| Sensor/Flow Meter/Actuator Tag & Location | Location OK | 1 st Gage or BAS Value | Instrument Measured Value | Final Gage or BAS Value | Pass Y / N |
|---|-------------|-----------------------------------|---------------------------|-------------------------|------------|
| OA Temp Sensor | | | | | |
| SA Temp Sensor | | | | | |
| RA Temp Sensor | | | | | |
| EA Temp Sensor | | | | | |
| OA Damper Actuator | | | Open Closed | | |
| EA Damper Actuator | | | Open Closed | | |
| Wheel Bypass Damper | | | Open Closed | | |

Static Checks

| Item | OK? | ISSUE # |
|---|-----|---------|
| Verify flow through wheel is in counterflow arrangement | | |
| Verify filters are installed and are per spec | | |
| Verify that there is adequate clearance for service | | |
| Verify unit vibration isolation is installed per spec | | |

Issues List

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.

Water-Source Heat Pump Construction Checklist

| | |
|------------------|--|
| Project: | |
| Date: | |
| WSHP Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

TAG: _____

| WSHP Information as Specified | | | | | |
|-------------------------------|--|--------------|--|---------|--|
| Make | | Model Number | | | |
| Serial Number | | Capacity | | GPM | |
| Volts/Phase | | Refrigerant | | Airflow | |
| Comments: | | | | | |

| Requested documentation submitted | Rec'd | Comments |
|---|--------------------------|----------|
| Manufacturer's cut sheets | <input type="checkbox"/> | |
| Performance data (pump curves, coil data, etc.) | <input type="checkbox"/> | |
| Installation and startup manual and plan | <input type="checkbox"/> | |
| O&M manuals | <input type="checkbox"/> | |
| Sequences and control strategies | <input type="checkbox"/> | |
| Warranty Certificate | <input type="checkbox"/> | |
| Comments: | | |

Model Number Verification

1 = as specified, 2 = as submitted, 3 = as operating. Check if acceptable, provide comment if unacceptable.

| Equip Tag> | | | A | NA | comments |
|------------------|---|--|--------------------------|--------------------------|----------|
| Manuf. | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Model | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Serial # | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Volts/Ph/A | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| GPM | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Head(PSI) | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| FLA | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Clg MBH | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Htg MBH | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Electric Htg MBH | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |

The equipment installed matches the specifications for given trade ___ YES ___ NO

| Installation Checks | | | |
|---|--------------------------|--------------------------|----------------|
| Check if Acceptable; Provide comment if unacceptable | NA | | Comment |
| | A | NA | |
| General appearance good, no apparent damage | <input type="checkbox"/> | <input type="checkbox"/> | |
| Proper vibration isolators, flex installed and adjusted | <input type="checkbox"/> | <input type="checkbox"/> | |
| Thermostat installed, wired correctly and working | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe packages, hoses, and accessories complete | <input type="checkbox"/> | <input type="checkbox"/> | |
| Heat pump isolation valve installed, wired as required | <input type="checkbox"/> | <input type="checkbox"/> | |
| Adequate access to fan compartment | <input type="checkbox"/> | <input type="checkbox"/> | |
| PT ports installed at the unit | <input type="checkbox"/> | <input type="checkbox"/> | |
| Internal refrigerant lines are insulated or above drain pan | <input type="checkbox"/> | <input type="checkbox"/> | |
| Adequate access to compressor compartment | <input type="checkbox"/> | <input type="checkbox"/> | |
| Adequate access to filters | <input type="checkbox"/> | <input type="checkbox"/> | |
| Equipment labels affixed | <input type="checkbox"/> | <input type="checkbox"/> | |
| No refrigerant/oil leaking apparent | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | | |
| Piping | | | |
| Piping installation checked against the drawings and all devices and appurtenances are in place | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping type and flow direction labeled on piping | <input type="checkbox"/> | <input type="checkbox"/> | |
| Isolation valves, balancing valves and piping specialties installed per detail shown on plans | <input type="checkbox"/> | <input type="checkbox"/> | |
| Hydronic system flushing complete and strainers cleaned | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | | |
| Electrical and Controls | | | |
| Power disconnect is located within site of the unit it controls and labeled | <input type="checkbox"/> | <input type="checkbox"/> | |
| All electric connections tight | <input type="checkbox"/> | <input type="checkbox"/> | |
| Grounding installed for components and unit | <input type="checkbox"/> | <input type="checkbox"/> | |
| Safeties installed and operational | <input type="checkbox"/> | <input type="checkbox"/> | |
| All control devices and wiring complete | <input type="checkbox"/> | <input type="checkbox"/> | |
| Control system interlocks connected and functional | <input type="checkbox"/> | <input type="checkbox"/> | |
| HOA Switch installed per manufacturer's instructions (if applicable) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Operation of HOA switch checked in all positions | <input type="checkbox"/> | <input type="checkbox"/> | |
| Proper safeties in control when HOA switch in Hand position | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | | |
| Sensors and Gages | | | |
| Temperature, pressure and flow gages and sensors installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping gages, BAS and associated panel temperature and pressure readouts match | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | | |
| TAB | | | |
| Installation of system and balancing devices allowed balancing to be completed following specified NEBB or AABC procedures and contract documents | <input type="checkbox"/> | <input type="checkbox"/> | |
| Operational Checks | | | |

| Installation Checks | | |
|---|--------------------------|--------------------------|
| Check if Acceptable; Provide comment if unacceptable | A | NA |
| Record full load running amps for WSHP in cooling mode | <input type="checkbox"/> | <input type="checkbox"/> |
| Record full load running amps for WSHP in heating mode | <input type="checkbox"/> | <input type="checkbox"/> |
| Specified airflow is being delivered to the space | <input type="checkbox"/> | <input type="checkbox"/> |
| Specified water-flow is being delivered to the heat exchanger | <input type="checkbox"/> | <input type="checkbox"/> |
| No unusual noise and vibration when running | <input type="checkbox"/> | <input type="checkbox"/> |
| Specified point-to-point checks have been completed and documentation record submitted for this system | <input type="checkbox"/> | <input type="checkbox"/> |
| Startup report completed with this checklist attached. (Includes full listing of all internal settings with notes as to which settings are BAS controlled or monitored and which are integral | <input type="checkbox"/> | <input type="checkbox"/> |

| Sensor or Actuator Tag & Location | Location OK | 1 st Gage or BAS Value | Instrument Measured Value | Final Gage or BAS Value | Pass Y / N |
|-----------------------------------|-------------|-----------------------------------|---------------------------|-------------------------|------------|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Comments:

Energy Recovery Ventilator

| | |
|------------------|--|
| Project: | |
| Date: | |
| ERV Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

TAG: _____

| ERV Information as Specified | | | | | |
|------------------------------|--|--------------|--|---------|--|
| Make | | Model Number | | | |
| Serial Number | | Capacity | | GPM | |
| Volts/Phase | | Refrigerant | | Airflow | |
| Comments: | | | | | |

| Requested documentation submitted | Rec'd | Comments |
|---|--------------------------|----------|
| Manufacturer's cut sheets | <input type="checkbox"/> | |
| Performance data (pump curves, coil data, etc.) | <input type="checkbox"/> | |
| Installation and startup manual and plan | <input type="checkbox"/> | |
| O&M manuals | <input type="checkbox"/> | |
| Sequences and control strategies | <input type="checkbox"/> | |
| Warranty Certificate | <input type="checkbox"/> | |
| Comments: | | |

| Model Number Verification | | | | | |
|---|---|--|--------------------------|--------------------------|----------|
| 1 = as specified, 2 = as submitted, 3 = as operating. Check if acceptable, provide comment if unacceptable. | | | | | |
| Equip Tag> | | | A | NA | comments |
| Manuf. | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Model | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Serial # | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Volts/Ph/A | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| FLA | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Clg Capacity (incl wheel) | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Htg Capacity (incl wheel) | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| GPM | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Head | 1 | | | | |
| | 2 | | | | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |

The equipment installed matches the specifications for given trade __ YES __ NO

| Installation Checks | | | |
|--|--------------------------|--------------------------|---------|
| Check if Acceptable; Provide comment if unacceptable | NA | | Comment |
| | A | NA | |
| Cabinet and General Installation | <input type="checkbox"/> | <input type="checkbox"/> | |
| Permanent labels affixed, including for fans | <input type="checkbox"/> | <input type="checkbox"/> | |
| Casing condition good: no dents, leaks, door gaskets installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Access doors close tightly - no leaks | <input type="checkbox"/> | <input type="checkbox"/> | |
| Boot between duct and unit tight and in good condition | <input type="checkbox"/> | <input type="checkbox"/> | |
| Vibration isolation equipment installed & released from shipping locks | <input type="checkbox"/> | <input type="checkbox"/> | |
| Maintenance access acceptable for unit and components | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sound attenuation installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Thermal insulation properly installed and according to specification | <input type="checkbox"/> | <input type="checkbox"/> | |
| Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Clean up of equipment completed per contract documents | <input type="checkbox"/> | <input type="checkbox"/> | |

| Installation Checks | | | |
|---|--------------------------|--------------------------|---------|
| Check if Acceptable; Provide comment if unacceptable | NA | | Comment |
| | A | NA | |
| Filters installed and replacement type and efficiency permanently affixed to housing--construction filters removed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Fans and Dampers | <input type="checkbox"/> | <input type="checkbox"/> | |
| Supply/exhaust fan and motor alignment correct | <input type="checkbox"/> | <input type="checkbox"/> | |
| Supply/exhaust fan belt tension & condition good | <input type="checkbox"/> | <input type="checkbox"/> | |
| Supply/exhaust fan protective shrouds for belts in place and secure | <input type="checkbox"/> | <input type="checkbox"/> | |
| Supply/exhaust fan area clean | <input type="checkbox"/> | <input type="checkbox"/> | |
| Supply/exhaust fan and motor properly lubricated | <input type="checkbox"/> | <input type="checkbox"/> | |
| Filters clean and tight fitting | <input type="checkbox"/> | <input type="checkbox"/> | |
| Filter pressure differential measuring device installed and functional (magnahelic, inclined manometer, etc.) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Smoke and fire dampers installed properly per contract docs (proper location, access doors, appropriate ratings verified) | <input type="checkbox"/> | <input type="checkbox"/> | |
| All dampers close tightly | <input type="checkbox"/> | <input type="checkbox"/> | |
| All damper linkages have minimum play | <input type="checkbox"/> | <input type="checkbox"/> | |
| Low limit freeze stat sensor located to deal with stratification & bypass | <input type="checkbox"/> | <input type="checkbox"/> | |
| Ducts | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sound attenuators installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Duct joint sealant properly installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| No apparent severe duct restrictions | <input type="checkbox"/> | <input type="checkbox"/> | |
| Turning vanes in square elbows as per drawings | <input type="checkbox"/> | <input type="checkbox"/> | |
| OSA intakes located away from pollutant sources & exhaust outlets | <input type="checkbox"/> | <input type="checkbox"/> | |
| Branch duct control dampers operable | <input type="checkbox"/> | <input type="checkbox"/> | |
| Balancing dampers installed as per drawings and TAB's site visit | <input type="checkbox"/> | <input type="checkbox"/> | |
| Electrical and Controls | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pilot lights are functioning | <input type="checkbox"/> | <input type="checkbox"/> | |
| Power disconnects in place and labeled | <input type="checkbox"/> | <input type="checkbox"/> | |
| All electric connections tight | <input type="checkbox"/> | <input type="checkbox"/> | |
| Proper grounding installed for components and unit | <input type="checkbox"/> | <input type="checkbox"/> | |
| Safeties in place and operable | <input type="checkbox"/> | <input type="checkbox"/> | |
| Starter overload breakers installed and correct size | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sensors calibrated (see below) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Control system interlocks hooked up and functional | <input type="checkbox"/> | <input type="checkbox"/> | |
| Smoke detectors in place | <input type="checkbox"/> | <input type="checkbox"/> | |
| All control devices, pneumatic tubing and wiring complete | <input type="checkbox"/> | <input type="checkbox"/> | |
| TAB | <input type="checkbox"/> | <input type="checkbox"/> | |

| Installation Checks | | | |
|---|--------------------------|--------------------------|---------|
| Check if Acceptable; Provide comment if unacceptable | A | NA | Comment |
| Installation of system and balancing devices allowed balancing to be completed following specified NEBB or AABC procedures and contract documents | <input type="checkbox"/> | <input type="checkbox"/> | |
| Final | <input type="checkbox"/> | <input type="checkbox"/> | |
| Smoke and fire dampers and unpowered TU's are open | <input type="checkbox"/> | <input type="checkbox"/> | |
| | A | NA | |
| Startup report completed with this checklist attached | <input type="checkbox"/> | <input type="checkbox"/> | |
| Safeties installed and safe operating ranges for this equipment provided to the commissioning agent | <input type="checkbox"/> | <input type="checkbox"/> | |
| If unit is started and will be running during construction: have quality filters on RA grills, etc. to minimize dirt in the ductwork and coils and in any finished areas. Verify moisture migration is not a problem, due to improper pressures between spaces. | <input type="checkbox"/> | <input type="checkbox"/> | |

| Operational Checks | | | |
|---|--------------------------|--------------------------|---------|
| | A | NA | Comment |
| Supply fan rotation correct | <input type="checkbox"/> | <input type="checkbox"/> | |
| Fans > 5 Hp Phase Checks: (%Imbalance = 100 x (avg. - lowest) / avg.) Record all 3 voltages in cell. Imbalance less than 2%? | <input type="checkbox"/> | <input type="checkbox"/> | |
| Record full load running amps for each fan. _____rated FL amps x _____srtc factor = _____ (Max amps). Running less than max? | <input type="checkbox"/> | <input type="checkbox"/> | |
| Record full load running amps when refrigeration system is running 100% Cooling and Heating. Running less than specified FLA? | <input type="checkbox"/> | <input type="checkbox"/> | |
| Supply fan has no unusual noise or vibration | <input type="checkbox"/> | <input type="checkbox"/> | |
| All dampers (OSA, RA, etc.) stroke fully without binding and spans calibrated and BAS reading site verified (follow procedure in Calibration and Leak-by Test Procedures) | <input type="checkbox"/> | <input type="checkbox"/> | |
| The HOA switch properly activates and deactivates the unit | <input type="checkbox"/> | <input type="checkbox"/> | |
| Specified sequences of operation and operating schedules have been implemented with all variations documented | <input type="checkbox"/> | <input type="checkbox"/> | |
| Specified point-to-point checks have been completed and documentation record submitted for this system | <input type="checkbox"/> | <input type="checkbox"/> | |

| Sensor or Actuator Tag & Location | Location OK | 1 st Gage or BAS Value | Instrument Measured Value | Final Gage or BAS Value | Pass Y / N |
|--------------------------------------|----------------|--------------------------------------|------------------------------|----------------------------|---------------|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| Sensor or Actuator Tag & Location | Location OK | 1 st Gage or BAS Value | Instrument Measured Value | <i>Final</i> Gage or BAS Value | Pass Y / N |
|--------------------------------------|----------------|--------------------------------------|------------------------------|-----------------------------------|---------------|
| | | | | | |

Comments:

Water Loop Circulation Pump

| | |
|------------------|--|
| Project: | |
| Date: | |
| Pump Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

TAG: _____

| Circulation Pump Information as Specified | | | | | |
|---|--|--|-----|--------------|--|
| Make | | | | Model Number | |
| Serial Number | | | GPM | | |
| Volts/Phase | | | PSI | | |
| Comments: | | | | | |

| Requested documentation submitted | Rec'd | Comments |
|---|--------------------------|----------|
| Manufacturer's cut sheets | <input type="checkbox"/> | |
| Performance data (pump curves, coil data, etc.) | <input type="checkbox"/> | |
| Installation and startup manual and plan | <input type="checkbox"/> | |
| O&M manuals | <input type="checkbox"/> | |
| Sequences and control strategies | <input type="checkbox"/> | |
| Warranty Certificate | <input type="checkbox"/> | |
| Comments: | | |

| Model Number Verification | | | | | |
|---|---|--|--------------------------|--------------------------|----------|
| 1 = as specified, 2 = as submitted, 3 = as operating. Check if acceptable, provide comment if unacceptable. | | | | | |
| Equip Tag> | | | A | NA | comments |
| Manuf. | 1 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 2 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Model | 1 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 2 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Serial # | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Volts/Ph/A | 1 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 2 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| GPM | 1 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 2 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| Head | 1 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 2 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| FLA | 1 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 2 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| VFD Mfg. | 1 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 2 | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | 3 | | <input type="checkbox"/> | <input type="checkbox"/> | |

| Installation Checks | | | |
|---|--------------------------|--------------------------|---------|
| Check if Acceptable; Provide comment if unacceptable | A | NA | Comment |
| | A | NA | |
| Installation is per manufacturers instructions | <input type="checkbox"/> | <input type="checkbox"/> | |
| Manufacturers recommended spare parts are provided | <input type="checkbox"/> | <input type="checkbox"/> | |
| Permanent label affixed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pump lubricated | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pump drive properly aligned | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pump turns freely | <input type="checkbox"/> | <input type="checkbox"/> | |
| Drive guard or shield is properly installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pumps in place and properly anchored | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipes are supported independently of the pump | <input type="checkbox"/> | <input type="checkbox"/> | |
| Vibration isolation devices installed and functional | <input type="checkbox"/> | <input type="checkbox"/> | |
| Seismic anchoring installed and functional where applicable | <input type="checkbox"/> | <input type="checkbox"/> | |
| Isolation valves and piping specialties installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| No leaks apparent | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pump detail checked against the drawings and all devices, gages and appurtenances are in place | <input type="checkbox"/> | <input type="checkbox"/> | |
| | A | NA | |
| Insulation installed per requirements; pumps for cold water insulated to avoid condensation yet allow for service | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | | |

| Installation Checks | | |
|--|--------------------------|--------------------------|
| Check if Acceptable; Provide comment if unacceptable | NA | Comment |
| Electrical and Controls | | |
| | A | NA |
| Power disconnect is located within site of the unit it controls and labeled | <input type="checkbox"/> | <input type="checkbox"/> |
| All electric connections tight | <input type="checkbox"/> | <input type="checkbox"/> |
| Grounding installed for components and unit | <input type="checkbox"/> | <input type="checkbox"/> |
| Safeties installed and operational | <input type="checkbox"/> | <input type="checkbox"/> |
| Starter overload breakers installed and correct size | <input type="checkbox"/> | <input type="checkbox"/> |
| All control devices and wiring complete | <input type="checkbox"/> | <input type="checkbox"/> |
| Control system interlocks connected and functional | <input type="checkbox"/> | <input type="checkbox"/> |
| Operation of HOA switch checked in all positions | <input type="checkbox"/> | <input type="checkbox"/> |
| Proper safeties in control when HOA switch in hand position | <input type="checkbox"/> | <input type="checkbox"/> |
| Installation per manufacturer's instructions | <input type="checkbox"/> | <input type="checkbox"/> |
| Rotates in the correct direction (for VFD, check Inverter and Bypass modes) | <input type="checkbox"/> | <input type="checkbox"/> |
| | | |
| VFD | | |
| | A | NA |
| Installation per manufacturer's requirements and start up instructions completed | <input type="checkbox"/> | <input type="checkbox"/> |
| Drive location not subject to excessive moisture or dirt | <input type="checkbox"/> | <input type="checkbox"/> |
| Drive location not subject to excessive temperatures | <input type="checkbox"/> | <input type="checkbox"/> |
| Appropriate Volts vs. Hz curve is being used | <input type="checkbox"/> | <input type="checkbox"/> |
| Drive size matches motor size | <input type="checkbox"/> | <input type="checkbox"/> |
| Drive mounted on house keeping pad (if applicable) | <input type="checkbox"/> | <input type="checkbox"/> |
| Cooling air flow path clean and unobstructed | <input type="checkbox"/> | <input type="checkbox"/> |
| Permanent label affixed and UL stamp approved | <input type="checkbox"/> | <input type="checkbox"/> |
| VFD interlocked to control system | <input type="checkbox"/> | <input type="checkbox"/> |
| Unit is programmed with full written programming record on site | <input type="checkbox"/> | <input type="checkbox"/> |
| Minimum and maximum speed set | <input type="checkbox"/> | <input type="checkbox"/> |
| Accel time set to _____ and Decel time set to _____ | <input type="checkbox"/> | <input type="checkbox"/> |
| Operation checked in HAND, OFF, and AUTO. As applicable operation also checked in BYPASS | <input type="checkbox"/> | <input type="checkbox"/> |
| Where applicable, ensure safeties are active in all modes | <input type="checkbox"/> | <input type="checkbox"/> |
| Coordinated with BAS for all interface ranges and signal isolation | <input type="checkbox"/> | <input type="checkbox"/> |
| Restart on Power Failure parameter set to auto | <input type="checkbox"/> | <input type="checkbox"/> |
| VFD powered (wired to controlled equipment) | <input type="checkbox"/> | <input type="checkbox"/> |
| Grounding installed for components and unit | <input type="checkbox"/> | <input type="checkbox"/> |
| Drive min and max speed set to _____ Hz min and 60 Hz max | <input type="checkbox"/> | <input type="checkbox"/> |
| Security settings set per Owner direction and Password documented for Owner | <input type="checkbox"/> | <input type="checkbox"/> |
| Drive response to loss of signal set to _____ | <input type="checkbox"/> | <input type="checkbox"/> |
| Output pulse resolution set to _____ MHz. (This is coordinated with the application to minimize audible noise and coordinated with driven bearing allowances.) | <input type="checkbox"/> | <input type="checkbox"/> |

| Installation Checks | | | |
|---|--------------------------|--------------------------|----------------|
| Check if Acceptable; Provide comment if unacceptable | NA | | Comment |
| | A | NA | |
| Checked the input voltage with drive disconnected | <input type="checkbox"/> | <input type="checkbox"/> | |
| Input of motor FLA represents 100% to 105% of motor FLA rating | <input type="checkbox"/> | <input type="checkbox"/> | |
| Upper frequency limit set at 100%, unless explained otherwise | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sensors and Gages | | | |
| Temperature, pressure and flow gages and sensors installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping gages, BAS and associated panel temperature and pressure readouts match | <input type="checkbox"/> | <input type="checkbox"/> | |
| TAB | | | |
| Installation of system and balancing devices allowed balancing to be completed following specified NEBB or AABC procedures and contract documents | <input type="checkbox"/> | <input type="checkbox"/> | |

| Operational Checks | | | |
|--|--------------------------|--------------------------|----------------|
| Check if Acceptable; Provide comment if unacceptable | NA | | Comment |
| | A | NA | |
| Specified sequences of operation and operating schedules have been provided with all variations documented | <input type="checkbox"/> | <input type="checkbox"/> | |
| Specified point-to-point checks have been completed and documentation record submitted for this system | <input type="checkbox"/> | <input type="checkbox"/> | |
| Startup report completed with this checklist attached (includes full listing of all internal settings with notes as to which settings are BAS controlled or monitored and which are integral | <input type="checkbox"/> | <input type="checkbox"/> | |
| Startup report includes written certification from pump manufacturer that all specified features, controls and safeties have been installed and are functioning properly and that the installation and application comply with the manufacturer's recommendations. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Start-up complete | <input type="checkbox"/> | <input type="checkbox"/> | |

| Sensor or Actuator Tag & Location | Location OK | 1st Gage or BAS Value | Instrument Measured Value | Final Gage or BAS Value | Pass Y / N |
|--|--------------------|---|----------------------------------|--------------------------------|-------------------|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Plumbing Systems Checklist

| | |
|-------------------------|--|
| Project: | |
| Date: | |
| Systems to Check | <ol style="list-style-type: none"> 1. Gas Metering 2. Domestic Water Piping 3. Water Metering 4. Sanitary Sewerage, Waste & Vent Piping 5. Storm Drainage Piping 6. Domestic Water Heaters 7. Hydronic Piping 8. Plumbing Fixtures |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

| | |
|---------------------|---------------------|
| ITEM #1: | Gas Metering |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

| Requested documentation submitted for all gas fired equipment | Rec'd | Comments |
|---|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| Manufacturer's startup instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Factory test report submitted | <input type="checkbox"/> | |
| Manufacturer's seismic shut-off device | <input type="checkbox"/> | |
| Utility installation requirements submitted | <input type="checkbox"/> | |
| Comments: | | |

GAS METER MODEL VERIFICATION

Fill in requested information.

| | Installed | Submitted | Specified |
|------------------|-----------|-----------|-----------|
| Manufacturer | | | |
| Model | | | |
| Serial No. | | | |
| Meter accuracy | | | |
| Working Pressure | | | |

INSTALLATION VERIFICATION

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks | | | |
|---|--------------------------|--------------------------|---------|
| | A | NA | Comment |
| Utility requirements met | <input type="checkbox"/> | <input type="checkbox"/> | |
| Label permanently affixed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Meters in place and properly supported | <input type="checkbox"/> | <input type="checkbox"/> | |
| Seismic anchoring installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Seismic shut-off installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| All connections tight | <input type="checkbox"/> | <input type="checkbox"/> | |
| Test all gas-fired equipment running at 100% at same time and verify all units fire properly | <input type="checkbox"/> | <input type="checkbox"/> | |

| | |
|---------------------|------------------------------|
| ITEM #2: | Domestic Water Piping |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

| Requested documentation submitted | Rec'd | Comments |
|--|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop/ As-built drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Comments: | | |

INSTALLATION VERIFICATIONS

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks | | | |
|--|--------------------------|--------------------------|---------|
| | A | NA | Comment |
| Domestic water piping installation completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping pressure testing completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pressure test report submitted | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping sterilization and flushing completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sterilization test report submitted | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe labeled per specifications | <input type="checkbox"/> | <input type="checkbox"/> | |
| Backflow preventer installed, tested and certified | <input type="checkbox"/> | <input type="checkbox"/> | |
| Backflow preventer certification submitted | <input type="checkbox"/> | <input type="checkbox"/> | |
| Isolation valves installed per plans | <input type="checkbox"/> | <input type="checkbox"/> | |
| Valves tags installed per specifications | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cold water piping installation completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Valves, drains and injection ports provided to facilitate piping sterilization | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping insulation completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe type and flow direction labeled on piping | <input type="checkbox"/> | <input type="checkbox"/> | |
| Balancing valves installed (hot water recirculation) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Trap primers installed and accessible for servicing | <input type="checkbox"/> | <input type="checkbox"/> | |
| Water hammer arrestor installed and accessible for servicing | <input type="checkbox"/> | <input type="checkbox"/> | |
| Hose bibs installed per plans | <input type="checkbox"/> | <input type="checkbox"/> | |
| Recirculation pumps installed and operational | <input type="checkbox"/> | <input type="checkbox"/> | |

Full flow test will double for test of waste piping system

| | |
|---------------------|-----------------------|
| ITEM #3: | Water Metering |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

Check if OK. Enter note number if deficient.

| Requested documentation submitted | Rec'd | Comments |
|--|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| Manufacturer's startup instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Factory test report submitted | <input type="checkbox"/> | |
| Utility installation requirements submitted | <input type="checkbox"/> | |
| Comments: | | |
| | | |

MODEL VERIFICATION

Fill in requested information.

| | Installed | Submitted | Specified |
|------------------|-----------|-----------|-----------|
| Manufacturer | | | |
| Model | | | |
| Serial No. | | | |
| Meter accuracy | | | |
| Working Pressure | | | |

1. INSTALLATION VERIFICATION

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks | | | |
|--|--------------------------|--------------------------|---------|
| | A | NA | Comment |
| Utility requirements met | <input type="checkbox"/> | <input type="checkbox"/> | |
| Label permanently affixed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Meters in place and properly supported | <input type="checkbox"/> | <input type="checkbox"/> | |
| All connections tight | <input type="checkbox"/> | <input type="checkbox"/> | |

| | |
|---------------------|--------------------------|
| ITEM #4: | Sanitary Sewerage |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

| Requested documentation submitted | Rec'd | Comments |
|--|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Comments: | | |

INSTALLATION VERIFICATIONS

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks | | | |
|--|--------------------------|--------------------------|---------|
| | A | NA | Comment |
| Sanitary sewer piping installation completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping pressure testing completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pressure test report submitted | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe labeled per specifications | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cleanouts installed per plans and accessible | <input type="checkbox"/> | <input type="checkbox"/> | |
| Backwater valves installed per plans | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sanitary vent piping installation completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe type labeled on piping | <input type="checkbox"/> | <input type="checkbox"/> | |
| Backwater valves installed per plans | <input type="checkbox"/> | <input type="checkbox"/> | |
| Termination of vent piping above the roof located away from fresh air intakes into the building or HVAC equipment. | <input type="checkbox"/> | <input type="checkbox"/> | |

Full flow water test will double as sanitary test

| | |
|---------------------|------------------------------|
| ITEM #5: | Storm Drainage Piping |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

| Requested documentation submitted | Rec'd | Comments |
|--|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop/ As-built drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Comments: | | |

INSTALLATION VERIFICATIONS

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks | | | |
|---|--------------------------|--------------------------|---------|
| | A | NA | Comment |
| Storm drain piping installation completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping pressure testing completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pressure test report submitted | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping insulation completed (if specified) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe type labeled on piping | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cleanouts installed per plans and accessible | <input type="checkbox"/> | <input type="checkbox"/> | |
| Roof drains and overflow drains installed per plans | <input type="checkbox"/> | <input type="checkbox"/> | |

| | |
|---------------------|-----------------------------------|
| ITEM #6: | Domestic Hot Water Heaters |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

| Requested documentation submitted | Rec'd | Comments |
|---|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop/ As-built drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| Manufacturer's startup instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Sequence of Operations submitted | <input type="checkbox"/> | |
| Manufacturer's representative start-up and check out complete and report submitted. | <input type="checkbox"/> | |
| Comments: | | |

MODEL VERIFICATION

Fill in requested information.

| | Installed | Submitted | Specified |
|-------------------------|-----------|-----------|-----------|
| Manufacturer | | | |
| Model | | | |
| Serial No. | | | |
| Capacity (GAL) | | | |
| Recovery Rate (90°F ΔT) | | | |
| Gas Input (MBH) | | | |

INSTALLATION VERIFICATIONS

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks | | | |
|---|--------------------------|--------------------------|---------|
| General Installation | A | NA | Comment |
| Unit installed and casing in good condition. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Unit interior/exterior cleaned. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Flue termination height and clearance per plumbing code. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Seismic restraints installed per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Instrumentation installed per specifications (thermometers, pressure gages, flow meters, etc.). | <input type="checkbox"/> | <input type="checkbox"/> | |
| Combustion air supply complete. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sufficient clearance around equipment for servicing. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Unit installed and casing in good condition. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Unit interior/exterior cleaned. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Flue termination height and clearance per plumbing code. | <input type="checkbox"/> | <input type="checkbox"/> | |

| | | | |
|---|--------------------------|--------------------------|----------------|
| Seismic restraints installed per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Instrumentation installed per specifications (thermometers, pressure gages, flow meters, etc.). | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping and Pumps | A | NA | Comment |
| Gas piping installed and tested with required supply pressure at inlet. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Isolation valves, control valve, and balancing valve, installed. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Test ports installed near all control sensors per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pressure and temperature gauges installed and functional | <input type="checkbox"/> | <input type="checkbox"/> | |
| No leaks apparent around fittings. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe type and flow direction labeled on piping. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping system pressure tested. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping system cleaned and flushed. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Expansion tanks verified to not be air bound and system is completely full with water. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Circulator pumps installed and operational. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Electrical and Controls | N | NA | Comment |
| Electrical connections to equipment completed and power available to unit. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Power disconnects installed and properly labeled. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Water Heater safeties installed and safe-operating ranges provided to the commissioning agent. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Control system interlocks functional. | <input type="checkbox"/> | <input type="checkbox"/> | |

| | |
|---------------------|------------------------|
| ITEM #7: | Hydronic Piping |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

| Requested documentation submitted | Rec'd | Comments |
|--|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| Manufacturer's startup instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Factory test report submitted. | <input type="checkbox"/> | |
| Comments: | | |
| | | |

INSTALLATION VERIFICATIONS

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks | | | |
|---|--------------------------|--------------------------|---------|
| Piping | A | NA | Comment |
| Pipe fittings complete | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipes properly supported and spacing of hangers per specs | <input type="checkbox"/> | <input type="checkbox"/> | |
| Seismic anchoring installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipe alignment guides, anchors and expansion compensation devices installed in accordance with contract documents. Verify clearances for expansion devices. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipes properly insulated | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pipes properly labeled | <input type="checkbox"/> | <input type="checkbox"/> | |
| Strainers in place and clean | <input type="checkbox"/> | <input type="checkbox"/> | |
| Isolation valves and balancing valves installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Test ports (P/T) installed near all control sensors and as per spec | <input type="checkbox"/> | <input type="checkbox"/> | |
| Flushing and cleaning plan submitted and approved | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping system properly flushed and cleaned and temporary piping removed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Flushing report submitted | <input type="checkbox"/> | <input type="checkbox"/> | |
| 10% of strainers and Owner-selected low-point drains opened and witnessed by Owner to be clean. (List points checked below). | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping pressure testing completed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Pressure test report submitted | <input type="checkbox"/> | <input type="checkbox"/> | |

| | | | |
|--|--------------------------|--------------------------|----------------|
| Chemical treatment system or plan installed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Water treatment report submitted according to contract documents | <input type="checkbox"/> | <input type="checkbox"/> | |
| No leaking apparent around fittings | <input type="checkbox"/> | <input type="checkbox"/> | |
| ASME pressure vessel data sheet or certification tag posted and inspection complete for each expansion tank | <input type="checkbox"/> | <input type="checkbox"/> | |
| Expansion tanks verified to not be air bound and system completely full of water. System completely purged of all air. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Air vents and bleeds at high points of systems functional | <input type="checkbox"/> | <input type="checkbox"/> | |
| Valves | A | NA | Comment |
| Valve labels permanently affixed | <input type="checkbox"/> | <input type="checkbox"/> | |
| Valves installed in proper direction | <input type="checkbox"/> | <input type="checkbox"/> | |
| No leaking apparent around valves | <input type="checkbox"/> | <input type="checkbox"/> | |
| Flow control devices installed and calibrated | <input type="checkbox"/> | <input type="checkbox"/> | |
| Valves stroke fully and easily and spanning is calibrated (see calibration section below). | <input type="checkbox"/> | <input type="checkbox"/> | |
| Valves that require a positive shutoff are verified to not be leaking when closed at normal operating pressure | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sensors & Gages | A | NA | Comment |
| Temperature, pressure, flow gages and sensors installed. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Piping gages, BAS, chiller panel temperature and pressure readouts match | <input type="checkbox"/> | <input type="checkbox"/> | |
| TAB | A | NA | Comment |
| Installation of system and balancing devices allowed balancing to be completed following specified NEBB or AABC procedures and contract documents. | <input type="checkbox"/> | <input type="checkbox"/> | |

| | |
|---------------------|--------------------------|
| ITEM #8: | Plumbing Fixtures |
| ID: | |
| AREA SERVED: | |

DOCUMENTATION VERIFICATION

| Requested documentation submitted | Rec'd | Comments |
|--|--------------------------|----------|
| Product information submitted | <input type="checkbox"/> | |
| Shop drawings submitted | <input type="checkbox"/> | |
| Manufacturer's installation instructions submitted | <input type="checkbox"/> | |
| O & M Manuals submitted | <input type="checkbox"/> | |
| Comments: | | |

INSTALLATION VERIFICATIONS AND PERFORMANCE TEST

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

| Installation Checks (each category should only be checked after all fixtures in that category have checked out) | | | |
|--|--------------------------|--------------------------|----------------|
| Lavatory | A | NA | Comment |
| Installed per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Properly supported per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Trim provided per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cold water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Hot water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Time for hot water to reach lavatory. () | <input type="checkbox"/> | <input type="checkbox"/> | |
| Drain piped and working properly. | <input type="checkbox"/> | <input type="checkbox"/> | |
| No apparent leaks. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Water Closet | A | NA | Comment |
| Installed per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Properly supported per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Trim provided per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cold water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Drain piped and working properly. | <input type="checkbox"/> | <input type="checkbox"/> | |
| No apparent leaks. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sink | A | NA | Comment |
| Installed per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Properly supported per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Trim provided per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cold water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |

| | | | |
|--|--------------------------|--------------------------|----------------|
| Hot water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Time for hot water to reach sink. () | <input type="checkbox"/> | <input type="checkbox"/> | |
| Drain piped and working properly. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Indirect drain provided (if applicable) | <input type="checkbox"/> | <input type="checkbox"/> | |
| No apparent leaks. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Shower | A | NA | Comment |
| Installed per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Properly supported per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Trim provided per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cold water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Hot water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Time for hot water to reach shower. () | <input type="checkbox"/> | <input type="checkbox"/> | |
| Drain piped and working properly. | <input type="checkbox"/> | <input type="checkbox"/> | |
| No apparent leaks. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Drinking Fountains | A | NA | Comment |
| Installed per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Properly supported per plans and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Trim provided per specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cold water piped and has adequate flow. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Drain piped and working properly. | <input type="checkbox"/> | <input type="checkbox"/> | |
| No apparent leaks. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Plumbing Chase | A | NA | Comment |
| Piping installed per drawings and specs. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Fixture connections complete. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Cleanouts Installed. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Hose bib installed. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Air control valves installed. | <input type="checkbox"/> | <input type="checkbox"/> | |
| Trap primer installed. | <input type="checkbox"/> | <input type="checkbox"/> | |
| No apparent leaks. | <input type="checkbox"/> | <input type="checkbox"/> | |

SECTION 26 08 00

ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
- C. Owner's Project Requirements (OPR), Basis of Design (BoD), and the Commissioning Plan contain documentation requirements that apply to this Section.

1.02 SUMMARY

- A. The purpose of this Section is to define Contractor responsibilities in the commissioning process, which are being directed by the Contractor. Other electrical system testing is required under other Division 26 Specification Sections.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 26 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Contractor and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. Electrical systems to be commissioned include the following:
 - 1. Secondary Service Electrical Systems.
 - 2. Motor Control Centers.
 - 3. Distribution and Branch Circuit Panelboards.
 - 4. Lighting Fixtures and Controls.
 - 5. Lightning Protection Equipment and Lightning Protection Systems.
 - 6. Equipment Monitoring.
 - 7. Fire Alarm Equipment/Fire Alarm Equipment Monitoring System.
 - 8. Telecommunications
 - 9. AC Motors.
 - 10. Grounding Equipment and Building Grounding System.
 - 11. Emergency Generators and Distribution System.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards.

1.04 DEFINITIONS

- A. Commissioning: A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Contract Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and that Contractor has provided Owner adequate system documentation and training. Commissioning includes deferred and/or seasonal tests as approved by Owner.
- B. Commissioning Plan: Document prepared by Contractor and approved by Owner that provides the structure, schedule, and coordination plan for the Commissioning process from the construction phase through the warranty period. The Commissioning Plan must satisfy the Owner's test requirements.
- C. Commissioning Team: Working group made up of representative(s) from the Architect/Engineer (A/E), Contractor, Owner's Test, Adjust, and Balance (TAB) Firm, Building Automation System (BAS) provider, specialty manufacturers and suppliers, and Owner. Contractor will provide ad-hoc representation of Subcontractors on the Commissioning Team as required for implementation of the Commissioning Plan.
- D. Deferred Tests: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other Site conditions that prohibit the test from being performed prior to Substantial Completion.
- E. Deficiency: Condition of a component, piece of equipment or system that is not in compliance with Contract Documents.
- F. Factory Testing: Testing of equipment at the factory, by factory personnel with an Owner's representative present if deemed necessary by Owner.
- G. Functional Performance Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly. Contractor prepares these procedures to document Functional Performance Tests.
- H. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by Contractor. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Functional Performance Tests are executed after start-ups and Prefunctional Checklists are complete.
- I. Integrated System Test: Test of dynamic function and operation of multiple systems. Integrated System Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Integrated System Tests are executed after Functional Performance Tests are complete and prior to Substantial Completion. Integrated System Tests provide verification that the integrated systems will properly function according to the Contract Documents.

- J. Integrated System Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly. Contractor prepares these procedures to document Integrated System Tests.
- K. Prefunctional Checklist: A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.). The word Prefunctional refers to before Functional tests. Prefunctional Checklists must include the manufacturer's Start-up checklist(s). Contractor shall sign Prefunctional Checklists as complete and submit with the Request for Start-up/Functional Performance Test Form.
- L. Start-up: The activities where equipment is initially energized, tested, and operated. Start-up is completed prior to Functional Performance Tests.
- M. Test Requirements: Requirements specifying what systems, modes and functions, etc. must be tested. Test requirements are not detailed test procedures. Test requirements and acceptance criteria are specified in the Contract Documents.

1.05 SUBMITTALS

- A. Contractor shall prepare Prefunctional Checklists and Functional Performance Test (FPT) procedures and execute and document results. All Prefunctional Checklists and tests must be documented using specific, procedural forms in Microsoft Word or Excel software developed for that purpose. Prior to testing, Contractor shall submit those forms to the Owner for review and approval.
- B. Contractor shall provide Owner with documentation required for Commissioning work. At minimum, documentation shall include: Detailed Start-up procedures, Full sequences of operation, Operating and Maintenance data, Performance data, Functional Performance Test Procedures, Control Drawings, and details of Owner-Contracted tests.
- C. Contractor shall submit to Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- D. Contractor shall review and approve other relative documentation for impact on FPT's of the systems:
 1. Shop Drawings and product submittal data related to systems or equipment to be commissioned. The Subcontractor responsible for the FPT shall review and incorporate comments from the Owner and A/E via the Contractor.
 2. Incorporate manufacturer's Start-up procedures with Prefunctional checklists.
 3. Draft Electrical Testing Agency (ETA) Reports: Review and provide comments to Owner.
 4. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPT's.
 5. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.
 6. Final ETA Reports: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.

7. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements: To validate adequacy and completeness of the FPT, the Contractor shall ensure that the O&M manual content, marked-up record Drawings and Specifications, component submittal drawings, and other pertinent documents are available at the Project Site for review.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 TEST EQUIPMENT

- A. Provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- B. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.
- C. Infrared Thermographic Scanner:
 1. Infrared scanning equipment shall be an AGA (or approved equal) thermovision set capable of viewing an entire bus or equipment assembly at one time and have a sensitivity of 0.2 degrees C with a liquid nitrogen reference.
 2. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Construction Phase:
 1. In each purchase order or subcontract that is written for changes in scope, include the following requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
 2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.
 3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
 4. Provide additional requested documentation to the Contractor, prior to O&M manual submittals, for development of Prefunctional Checklist and Functional Performance Tests procedures.

- a. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
 - b. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor.
 - c. This information and data request may be made prior to normal submittals.
5. With input from the BAS Provider and A/E, Clarify the operation and control of commissioned equipment in areas where the Specifications, BAS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
 6. Prepare the specific Functional Performance Test procedures specified in Section 26 08 16. Ensure that Functional Performance Test procedures address feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.
 7. Develop the Commissioning Plan using manufacturer's Start-up procedures and the Prefunctional Checklists. Submit manufacturer's detailed Start-up procedures and the Commissioning Plan and procedures and other requested equipment documentation to Owner for review.
 8. During the Start-up and initial checkout process, execute and document related portions of the Prefunctional Checklists for all commissioned equipment.
 9. Perform and clearly document all completed Prefunctional Checklists and Start-up procedures. Provide a copy to the Owner prior to the Functional Performance Test.
 10. Address current A/E and Owner punch list items before Functional Performance Tests. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.
 11. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
 12. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
 13. Compile all Commissioning records and documentation to be included in a Commissioning and Closeout Manual.
 14. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 15. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests). The as-built drawings and specifications shall be delivered to the Owner both in electronic format and hard copies as required by the Owner.
 16. Provide training of the Owner's operating personnel as specified.
 17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

B. Warranty Phase:

1. Execute seasonal or deferred tests, witnessed by the Owner, according to the Specifications.
 - a. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with Owner. Perform tests and document and correct deficiencies. Owner may observe the tests and review and approve test documentation and deficiency corrections.
 - b. If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, execution of such test may be delayed to later in the Warranty Period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as deferred tests.
 2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any seasonal testing.
- C. Electrical Testing Agency (ETA):
1. When requested by Owner, the Contractor shall retain an independent Electrical Testing Agency (ETA). Their specific testing responsibilities are delineated in Section 26 01 00. This generally requires checking and testing of the electrical power distribution equipment per National Electrical Testing Association (NETA).
 2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.
 3. Obtain all required manufacturer's data to facilitate tests.
 4. Provide assistance to the Contractor in preparation of the specific Prefunctional Checklist and Functional Performance Test procedures specified in Section 26 01 27 and 26 01 28. Generally ETA shall provide their standard forms to document the NETA tests to be incorporated into the Prefunctional Checklist and Functional Performance Tests record.
 5. During related tests, execute and document the tests in the approved forms and/or test record.
 6. Perform and clearly document all completed Start-up and system operational checkout procedures, providing a copy to the Contractor.
 7. Clearly indicate any deficiencies identified during testing and add to an action list for resolution and tracking. The field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, Contract interpretation requests and lists of completed tests to the Contractor at least twice a week and provide technical assistance in the resolution of deficiencies.
 8. Provide skilled technicians to execute testing. Ensure that they are available and present during the agreed-upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
 9. Warranty Phase: Perform thermographic imaging of loaded panel at time designated by Electrical SubContractor or Contractor.

3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.

3.03 TESTING

A. Functional Performance Tests:

1. Functional Performance Tests are conducted after system Start-up and checkout is satisfactorily completed.
2. Refer to Section 26 08 16 for specific details on the required Functional Performance Tests.

B. Coordination Between Testing Parties:

1. **Factory Start-ups:** Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
2. **Independent Testing Agencies:** For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the Prefunctional Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.

3.04 TRAINING

A. Submit a written training plan to the Owner and Architect/Engineer for review and approval. Contractor's training plan shall cover the following elements:

1. Equipment included in training.
2. Intended audience.
3. Location of training.
4. Objectives.
5. Subjects covered.
6. Duration of training on each subject.
7. Instructor for each subject.
8. Methods (classroom lecture, video, Site walk-through, actual operational demonstrations, written handouts, etc.).
9. Instructors and qualifications.

B. Contractor shall have the following training responsibilities:

1. Provide a training plan ten (10) calendar days prior to the scheduled training, in accordance with Division 01.
2. Provide Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned mechanical equipment or system.
3. Training shall start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including Start-up, shutdown, fire/smoke alarm, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This representative may be the Start-up technician for the piece of equipment, the installing contractor, or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
6. The training sessions shall follow the outline in the Table of Contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
 - a. Usage of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include Start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanation of information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
8. Hands-on training shall include Start-up, operation in all modes possible, including manual, shutdown, and any emergency procedures and maintenance of all pieces of equipment
9. Training shall occur after Functional Performance Tests are complete and shall be scheduled with the Owner's Project Manager.

C. Provide training on each system/piece of equipment according to the following schedule:

| HOURS | SYSTEM |
|-------|--|
| _____ | NORMAL POWER |
| _____ | LIGHTING |
| _____ | FIRE ALARM SYSTEM |
| _____ | LIGHTING CONTROLS |
| _____ | EMERGENCY GENERATOR AND EMERGENCY POWER SYSTEM |
| _____ | UNINTERRUPTIBLE POWER SYSTEM (UPS) |
| _____ | SECURITY SYSTEM |
| _____ | TELECOMMUNICATIONS AND DATA |
| _____ | PAGING SYSTEM |

END OF SECTION 26 08 00

SECTION 26 08 16

ELECTRICAL SYSTEMS FUNCTIONAL PERFORMANCE TESTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
- C. Owner's Project Requirements (OPR), Basis of Design (BoD), and the Commissioning Plan contain documentation requirements that apply to this Section.

1.02 SUMMARY

- A. This Section expands on and defines responsibilities of the Contractor in regards to Functional Performance Tests (FPT's) of the Commissioning process.
- B. Contractor shall oversee the Commissioning activities with the Contractor's Subcontractors and the Architect/Engineer (AE).
- C. Prefunctional Checklists, tests and Start-ups are to be completed and documented for the record prior to commencing with FPT's. Refer to Section 26 08 00 and 26 08 16 for additional requirements.
- D. Completed FPT Forms for all pieces of equipment and systems shall be submitted to the Owner prior to Substantial Completion.
- E. Refer to Attachments at the end of this Section for forms that indicate level of documentation required for the Commissioning process.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

1.04 SUBMITTALS

- A. Maintain and use an action item tracking system, "Action Item List," that indicates as a minimum, required information, identified deficiencies, work required, etc.). Each item shall be tracked with the initiator, the parties responsible, due date, the date of closure, and a description of the resolution. Each item shall be categorized for sorting and

tracking and for documentation on applicable forms. Action Item List shall be distributed and documented using Microsoft Excel or a database format approved by Owner.

B. Disseminate this list as appropriate to keep all parties involved with the FPT informed.

C. Functional Performance Test procedure forms must include the following:

System and equipment or component name(s).

1. Equipment location and identification number as identified in the Equipment List/Matrix described in Division 01.
2. Unique test identification number and reference to unique Prefunctional Checklist and Start-up Documentation Identification Numbers for the equipment.
3. Date and time of test.
4. Project name.
5. Participating parties.
6. Specific sequence of operation or other specified parameters, including performance data being verified.
7. Instructions for setting up a Functional Performance Test.
8. Specific script-type, step-by-step procedures to perform a Functional Performance Test, in a clear, sequential and repeatable format that is customized for the system being tested.
9. A Yes/No checkbox (or data entry box as appropriate) for clearly indicating whether or not proper performance of each part of a Functional Performance Test was achieved with space for actual readings.
10. Section for comments.
11. Signatures and date block for participants and Owner approvals.

D. Refer to Division 01 and 26 08 00 for additional documentation requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 TEST EQUIPMENT

A. Refer to Section 26 08 00 – Electrical Systems Commissioning.

PART 3 - EXECUTION

3.01 PREPARATION

- A. The objective of FPT's is to demonstrate that each system operates according to the Contract Documents through all specified modes of operation.
- B. Contractor shall operate each system through all modes of operation (occupied, unoccupied, warm-up, cool-down, etc.) where there is a specified system response. Verification of each sequence in the sequences of operation is required.
- C. All equipment, components and devices applicable to the FPT must be started and this Start-up must be documented. Refer to Section 26 08 13 for additional Prefunctional Checklist and Start-up requirements.
- D. Unless specifically agreed to by the Commissioning Team, all support systems shall be complete prior to FPT.
- E. Commissioning Team members shall assist in development and review of the optimal sequence of testing.

3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.

3.03 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. The purpose of a Functional Performance Test is to verify and document compliance with the stated criteria of acceptance. Contractor shall develop specific script-type test procedures and associated test forms to verify and document proper operation of each piece of equipment and system.
- B. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for duration a period as indicated in the Specification Section(s) for such item and/or in accordance with the manufacturer's written recommendations, the Contract Documents, and the Commissioning Plan.
- C. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.
- D. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting the Functional Performance Test(s).
- E. Sampling: Some types of identical equipment (such as circuit breakers, receptacles etc.) will be tested using a sampling strategy.
- F. Failure Limit on Sample Tests: With the sampling percentages is listed a failure limit. This limit indicates the maximum percentage of the tested devices that may have any test

that fails before an entirely new sample must be tested. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.

1. Where sample tests involve multiple systems (ie: checking receptacles on different floors) the maximum failure limit will apply per system.
- G. Deferred Tests: Contractor shall schedule with the Owner and complete Deferred Tests as part of this Contract during the Warranty Period. Testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. Deferred or "Opposite season" tests will be required where scheduling prohibits thorough testing in all modes of operation.
- H. Provide and deliver the required submitted documentation convenient to testing area. Validate that all required documentation has been submitted to the Owner and is per the Contract Document requirements.
- I. Review the Start-up documentation at the start of FPT's. Ensure that any items indicated as outstanding in the Prefunctional Checklist is entered as an Action Item and enter one if it is not. The Prefunctional Checklists and Start-up tests/measurements shall be spot checked at the beginning of FPT's to ensure accuracy. Complete a test that indicates Contractor has reviewed the Prefunctional Checklists and finds the Prefunctional Checklists acceptable and notes any outstanding items.
- J. Check for and as applicable direct the Subcontractor to demonstrate that access is sufficient to perform required maintenance.
- K. Validate that all prerequisite work is complete and confirm this validation via a test record for documentation.
- L. Specifically check labeling and ensure conformance to the Contract Documents.
- M. Check proof indication, alarming on failure and restart/acknowledgement as applicable.
- N. Observe operating conditions encountered at the start of the FPT. Contractor shall examine for normal functionality and record parameters as a test.
- O. All dynamic systems powered by electricity shall be tested to simulate a power outage to ensure proper sequencing. Those on emergency power or uninterruptible power shall be tested on all sources. This test shall generally be coordinated with electrical power systems testing addressed in the Contract Documents.
1. Emergency power tests for mechanical systems will be conducted in concert with the testing of the emergency power systems. Testing Contractor shall be available for the power outage test to test their systems under a power outage. This is in addition to the requirement specified by system.
- P. Inspect the installation and compare it to the Contract Documents. Record the inspection as a test.
- Q. Capacities and adjusted and balanced conditions as applicable will generally be checked.
- R. Verify all sequence modes and sequences of operation. Contractor must initiate all modes and may not refer to or rely on a Prefunctional Test done by the building

automation system. Some examples of generic modes that apply to most systems include:

1. Off mode.
 2. Failed mode: Proof, safeties, power outage etc. See below for crash testing.
 3. Start sequence in various modes.
 4. Stop sequences in various modes.
- S. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation. The Contractor is responsible for placing systems in optimal condition for occupancy and not simply relying on initial design estimated settings.
- T. Dynamic Graphics: The graphic for all components, systems, and areas sampled and required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints are required to be adjustable, verify that they can be adjusted directly from the graphic screen.
- U. All interfaces between two systems or equipment of different manufacturers must be checked for accuracy and functionality.
- V. Contractor shall to the extent possible, load the heating and cooling systems during initial FPT's to check the capacity of the building central systems and initially optimize system settings. This will typically be done using the preheat system to false load the cooling system. This test will incorporate varying the load to check central systems response.
- W. "Crash Testing": Contractor shall analyze systems to identify possible conditions where functionality may be compromised. Contractor shall design non-destructive tests that will demonstrate either the automated response to the conditions or so that team can identify the best method for responding or fixing the condition. All tests and their findings shall be documented in a Microsoft Excel spreadsheet.
- X. The equipment/functional performance checklists which are part of this specification are specific to equipment types that are required to be commissioned and systems types that are required to be tested. These checklists must be completed and submitted to the CA for review and approval.

3.04 PARTICIPATION

- A. Required participating parties are indicated with the individual tests. Typically, multiple parties are required for any given test, yet participation for any given party is only required for the respective portion of the test for which the party is responsible. In many cases, the maximum required time in hours is indicated in parenthesis for any given test. The time is typically per unit system unless indicated otherwise. If no time is indicated, participation is required throughout the entire test.
- B. Frequently, on multiple samples where a given party does not directly conduct the test, the participation of that party will only be required for an initial quantity of systems/equipment. It is required that the parties be available on-site throughout the testing of any given system for which they are required participants. Therefore time for

which they are not directly involved can be spent performing other work (typically addressing identified punch list items or failed test).

- C. No party involved with the Project is prohibited from participation in or witnessing of any tests. Any Subcontractor may elect to witness all tests on their systems even if their involvement is not directly required.
- D. Coordinate effectively with the individual Subcontractors throughout the development and execution of FPT's and maximize Subcontractors' involvement.

3.05 NON-CONFORMANCE

- A. Record results of Functional Performance Tests. Contractor shall report all deficiencies and non-conformance issues to Owner on the Functional Performance Test report form and in a Commissioning deficiency report.
- B. At the sole discretion of Owner, Owner may permit the Contractor to make corrections of minor deficiencies observed during a Functional Performance Test. However, the Contractor must document the deficiency and resolution on the appropriate report form.
- C. Contractor and Owner will attempt to resolve deficiencies in the following manner:
 - 1. When there is no dispute about a deficiency and Contractor accepts responsibility for correction.
 - a. Contractor documents the deficiency and the corrective actions, and then proceeds to another test or sequence. Contractor submits a deficiency report to Owner. Contractor corrects the deficiency, completes the statement of correction form certifying that the equipment or system is ready for retesting, and sends the certification to Owner.
 - b. Contractor reschedules test with Owner.
 - 2. When there is a dispute about whether or not the test indicates a Deficiency, or the Contractor's responsibility for the correction of the apparent Deficiency.
 - a. Contractor documents the apparent Deficiency and proceeds to another test or sequence. Contractor submits a Deficiency report to Owner, including the apparent Deficiency.
 - b. Contractor facilitates resolution of Deficiency and provides recommendations to the Owner. Contractor and Owner may bring other parties into the discussions as needed. Final technical interpretive authority is with the Architect/Engineer. Final acceptance authority is with the Owner.
 - c. Contractor documents resolution process.
 - d. If Owner agrees with Contractor's interpretation and proposed resolution, Contractor forwards response to Owner. Contractor reschedules test with Owner. Contractor must repeat this process until satisfactory performance and Owner's approval is obtained.

3.06 ACCEPTANCE CRITERIA

- A. Acceptance criteria for tests are indicated in the Specification Sections applicable to the systems being tested. Generally, unless indicated otherwise, the criteria for acceptance will be that specified with the individual system, equipment, component, or device.

3.07 SPECIFIC SYSTEM FUNCTIONAL TEST PROCEDURES

| Equipment/System Description | TEAM MEMBERS | | | | |
|---------------------------------------|--------------|----|----|----|-----|
| | CA | MC | EC | CC | TAB |
| Emergency Power System | X | X | X | X | X |
| Distribution Power System | X | X | X | X | X |
| Lighting and Lighting Control Systems | X | X | X | X | X |
| Fire Alarm System | X | X | X | X | X |
| Telecommunications Systems | X | | X | X | X |

END OF SECTION 26 08 16

Functional Performance Test Emergency Power

| | |
|-----------------|------------------------------------|
| Project: | NEARNG Mead Titan Readiness Center |
| Tags: | EG-1 |

Test Participants

| Name & Company | Date |
|----------------|------|
| GC | |
| MC | |
| EC | |
| TAB | |
| CC | |
| A/E | |
| CxA | |

GC = General Contractor; MC = Mechanical Contractor; EC = Electrical Contractor; BC = Balancing Contractor; CC = Controls Contractor; OR = Owner Representative; A/E = Architect/Engineer; CA = Commissioning Agent

Lead Witness Filling Out Form: _____

Testing Dates:

1. _____
2. _____
3. _____
4. _____

Unit Sampling

| Tag | Qt. | % to Test | # to Test |
|------|-----|-----------|-----------|
| EG-1 | 1 | 100 | 1 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Testing Prerequisites

The following items have been completed and the equipment is ready for Functional Testing

Check if OK. Enter Issue # if Deficient

| Item | OK? | ISSUE # |
|---|-----|---------|
| Product Documentation Submitted and Approved | | |
| Start-Up Complete | | |
| Equipment List/Matrix | | |
| Equipment Checklist Complete | | |
| Sequence of Operation Programmed | | |
| Related Systems Started and Checklists Complete | | |

Functional Performance Test Emergency Power TAG _____

Fill out one form per unit tested

Functional Performance Verifications

Demonstrate operation of equipment per contract documents including the following:

Operational Checks

| Item | OK? | ISSUE # |
|---|-----|---------|
| Verify that unit is accurately represented and tagged on building automation system front-end workstation | | |
| Verify that every point listed in the specification is visible, readable, and accurate on the control system front-end workstation | | |
| ATS operates correctly | | |
| Resistance checks complete with results included with this form | | |
| Fuel system operates correctly | | |
| Ignition and battery system operate correctly | | |
| Cooling system operates correctly | | |
| Spot check Start-ups and factory tests. Record system settings and parameters. | | |
| Participants shall witness generator load testing | | |
| Contractor shall schedule building power outage testing in concert with mechanical systems check out under emergency power | | |
| Open normal breakers to simulate various levels of power outages including all utility feeds, single feed, transformers, and distribution panels | | |
| With each outage test configuration, observe generators start and take load. Record volts, amps, frequency, power factor phase angle for all phases for all generators. Monitor engine temperatures. Monitor battery charge | | |
| With each outage test configuration, fail generators successively by simulating different support system component failures: <ul style="list-style-type: none">• Fuel delivery• Engine safety trips• High temperature• High oil pressure | | |

Issues List

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

Emergency Power System Checklist

| | |
|------------------|--|
| Project: | |
| Date: | |
| Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

1. General:

- a. This Checklist does not take the place of the manufacturer's recommended checkout and Start-up procedures or report.
- b. Checklist items shall be completed as part of start-up and initial checkout, preparatory to functional testing.

2. Requested Documentation Submitted:

| | Specified Requirement | Yes | No | Date to be Submitted |
|----|---|-----|----|----------------------|
| a) | Manufacturer's Product Data including Performance Data and Shop Drawings, as approved by Architect/Engineer | | | |
| b) | Required Test Reports and/or Certifications | | | |
| c) | Installation and Start-up Manual and Plan | | | |
| d) | Wiring Diagrams, Control Schematics and Sequences | | | |
| e) | Operating and Maintenance Manual Content for Applicable System | | | |
| f) | Equipment List/Matrix | | | |

3. Equipment Verification:

| Item | Specified | Submitted | Installed |
|--|-----------|-----------|-----------|
| Manufacturer | | | |
| Model Number | | | |
| Serial Number | | | |
| Service | | | |
| Size/Rating (kW / continuous or standby) | | | |
| Fuel Type | | | |
| Voltage/Phase | | | |

4. Installation Checks:

| a) Unit and General Installation | | Yes | No | Comments |
|----------------------------------|--|-----|----|----------|
| 1. | Permanent labels affixed | | | |
| 2. | Physical condition acceptable | | | |
| 3. | Properly mounted with vibration isolators | | | |
| 4. | Factory alignment appears correct | | | |
| 5. | Field alignment complete | | | |
| 6. | Maintenance access acceptable | | | |
| 7. | Fuel piping and/or prime mover exhaust system are properly supported (independent of prime mover and/or generator) | | | |
| 8. | As-built drawings updated | | | |
| 9. | Equipment clean | | | |
| 10. | Equipment room properly ventilated, air-conditioned, heated, fire/smoke wall separated, fire/smoke dampered, fire sprinklered, fire alarmed and illuminated (normal, emergency and battery backed-up fixtures) | | | |
| 11. | All equipment properly identified and labeled | | | |

| b) Prime Mover | | Yes | No | Comments |
|----------------|---|-----|----|----------|
| 1. | Unit able to run on diesel fuel or a combination of natural gas and diesel fuel | | | |

| b) Prime Mover | | Yes | No | Comments |
|----------------|---|-----|----|----------|
| 2. | Air cleaner and oil filter(s) installed | | | |
| 3. | Vibration isolators active | | | |
| 4. | Proper oil type used, with level correct | | | |
| 5. | Exhaust duct installed with proper insulation and silencer/muffler | | | |
| 6. | Exhaust system discharges to outside | | | |
| 7. | Condensables able to be removed from exhaust system and discharged properly | | | |
| 8. | Combustion and/or ventilation air louvers installed correctly | | | |
| 9. | Cooling water radiator ducted to inlet louver | | | |

| c) Generator | | Yes | No | Comments |
|--------------|---|-----|----|----------|
| 1. | Bearings lubricated | | | |
| 2. | Rotor and stator in proper condition | | | |
| 3. | Voltage regulator installed | | | |
| 4. | Main breaker installed, rated at full load capacity | | | |
| 5. | Instrument panel is mounted on unit | | | |
| 6. | Remote annunciator panel installed | | | |
| 7. | Generator auxiliary panel (dedicated to generator room equipment/lighting) is installed | | | |

| d) Fuel System | | Yes | No | Comments |
|----------------|---|-----|----|----------|
| 1. | Piping Prefunctional Checklist complete and accepted | | | |
| 2. | Day tank installed, with electric pump, hand pump, and bypass piping/valves | | | |
| 3. | Above ground fuel tank installed, with pump(s) | | | |
| 4. | Monitoring system installed | | | |
| 5. | Owner Environmental reviews complete and accepted | | | |

| e) Battery Charger and Batteries | | Yes | No | Comments |
|----------------------------------|--|-----|----|----------|
| 1. | Batteries installed in a nonmetallic rack (wall mounted) adjacent to the prime mover | | | |
| 2. | Battery electrolyte level is correct | | | |
| 3. | Automatic trickle battery charger is installed (wall mounted) adjacent to battery bank | | | |
| 4. | Battery cable connections are tight, terminals are clean | | | |

| f) Automatic Transfer Switch | | Yes | No | Comments |
|------------------------------|---|-----|----|----------|
| 1. | ATS rated for operation at the same output as the emergency generator, capacity is greater than total system transferred load | | | |
| 2. | Transferred loads identified at panel, agrees with listed loads | | | |
| 3. | ATS installation is complete | | | |

| g) Electrical and Controls | | Yes | No | Comments |
|----------------------------|---|-----|----|----------|
| 1. | Panel devices labeled and wiring tagged per Contract Documents | | | |
| 2. | Unit mounted instrument panel includes: | | | |
| | AC voltmeter | | | |
| | Ammeter | | | |
| | V-a selector switch | | | |
| | Frequency meter | | | |
| | Running time meter | | | |
| | Voltage adjusting rheostat | | | |
| | Exciter overload protection | | | |
| | Warning lights and alarms | | | |
| 3. | Batteries provided with electronic sensing device for remote notification of battery conditions | | | |
| 4. | I/O devices labeled and wiring tagged per Contract Documents | | | |
| 5. | Digital inputs and outputs operational | | | |
| 6. | All electrical connections tight | | | |
| 7. | Proper grounding installed for the electrical system, equipment, components, and unit | | | |
| 8. | Safeties in place and operable | | | |
| 9. | Sensors, transmitters, gages, etc., installed | | | |
| 10. | Sensors calibrated (see below) | | | |
| 11. | Control system interlocks hooked up and functional | | | |
| 12. | All control devices and wiring complete | | | |
| 13. | Lightning protection installed | | | |

| h) Final | | Yes | No | Comments |
|----------|---|-----|----|----------|
| 1. | Start-up report completed and attached with this Prefunctional Checklist | | | |
| 2. | List of items/systems served by the emergency power system is attached | | | |
| 3. | Fuel tank(s) full | | | |
| 4. | Safeties and safe operating ranges for this equipment have been reviewed and accepted | | | |
| 5. | Sequence of operation adequately indicates all information | | | |
| 6. | System is ready for Functional Performance Test | | | |

5. Operational Checks:

- a. These checks supplement the manufacturer's list. This is not the Functional Performance Test.

| Operational Checks | | Yes | No | Comments |
|--------------------|---|-----|----|----------|
| 1. | Associated Prefunctional Checklists are complete and accepted | | | |
| 2. | ATS operates correctly | | | |
| 3. | Resistance check(s) complete with results attached | | | |
| 4. | Fuel system operates correctly | | | |
| 5. | Ignition and battery systems operate correctly | | | |
| 6. | Cooling system operates correctly | | | |

| Operational Checks | | Yes | No | Comments |
|--------------------|--|-----|----|----------|
| 7. | Specified point-to-point checks have been completed and documentation record submitted for this system | | | |
| 8. | Specified sequences of operation and operating schedules have been provided with all variations documented | | | |
| 9. | Generator control panel powered, interconnection to diagnostics performed | | | |

- 1) Spot check Start-ups and factory tests. Record system settings and parameters.
- 2) Participants shall witness generator load testing.
- 3) Contractor shall schedule building power outage testing in concert with mechanical systems check out under emergency power.
- 4) Open normal breakers to simulate various levels of power outages including all utility feeds, single feed, transformers, and distribution panels.
- 5) With each outage test configuration, observe generators start and take load. Record volts, amps, frequency, power factor phase angle for all phases for all generators. Monitor engine temperatures. Monitor battery charge.
- 6) With each outage test configuration, fail generators successively by simulating different support system component failures, including fuel delivery, engine safety trips, high temperature, high oil pressure, low oil pressure, and overspeed. Observe priority demand control dump load to the highest priority. Restore generators and observe the demand control to restore all priority blocks. Ensure generator support systems remain to highest priority.
- 7) Observe fuel delivery capacity at peak loads. Fail sample delivery systems deenergizing the feed pumps. Verify low level alarms on the day tanks. Document fuel usage during each load bank test and report this information to Owner, so they will know the consumption of fuel in an emergency event.
- 8) With systems operating on emergency power, spot check power parameters of all systems on emergency power. Emergency testing of individual systems are covered under those systems. In conjunction with the generator testing, test the UPS systems. Refer to that item below for more detail.
- 9) Measure noise levels.
- 10) While under Emergency Power, Contractor shall survey the facility for adequate functionality as a check of the design. Contractor shall identify loads that may be considered for adding to the system.
- 11) Restore normal breakers and observe systems retransfer to normal. Record timing of tie breakers opening. Observe generator cool down and shut down sequence and record parameters.

6. Sensor and/or Actuator Calibration:

- a. All field-installed temperature sensors, pressure sensors, meters, and gages, and all actuators and valves on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided are not required to be field calibrated.
- b. All test instruments have had a certified calibration within the last 12-months: Y / N

| Sensor/Actuator Verification Table | | | | | |
|---|----------------------------|---------------------------|---------------|-------------------------------|------------|
| Sensor or Actuator | Correct Location (Y/N) (1) | Thermometer or Gage Value | BAS Value (2) | Instrument Measured Value (3) | Pass (Y/N) |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Distribution Power System Checklist

| | |
|------------------|--|
| Project: | |
| Date: | |
| Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

1. General:

- a. This Checklist does not take the place of the manufacturer's recommended checkout and Start-up procedures or report.
- b. Checklist items shall be completed as part of start-up and initial checkout, preparatory to functional testing.

2. Requested Documentation Submitted:

| | Specified Requirement | Yes | No | Date to be Submitted |
|----|---|------------|-----------|-----------------------------|
| a) | Manufacturer's Product Data including Performance Data and Shop Drawings, as approved by Architect/Engineer | | | |
| b) | Required Test Reports and/or Certifications | | | |
| c) | Installation and Start-up Manual and Plan | | | |
| d) | Wiring Diagrams, Control Schematics and Sequences | | | |
| e) | Operating and Maintenance Manual Content for Applicable System | | | |
| f) | Equipment List/Matrix | | | |

3. Equipment Verification:

| Item | Specified | Submitted | Installed |
|-------------------------|------------------|------------------|------------------|
| Manufacturer | | | |
| Model Number | | | |
| Serial Number | | | |
| Service | | | |
| Equipment Rating (amps) | | | |
| Voltage/Phase | | | |
| | | | |

4. Installation Checks:

| a) Unit and General Installation | | Yes | No | Comments |
|---|--|------------|-----------|-----------------|
| 1. | Permanent labels affixed | | | |
| 2. | Physical condition acceptable, no visible damage, cabinets in place | | | |
| 3. | Properly mounted on equipment pad and anchored | | | |
| 4. | Maintenance access acceptable | | | |
| 5. | Interior clean and dry | | | |
| 6. | Meter(s) installed per Contract Documents | | | |
| 7. | Disconnects installed and labeled | | | |
| 8. | Disconnects are pad lockable in open position | | | |
| 9. | Circuit breakers installed and labeled | | | |
| 10. | Fuses installed | | | |
| 11. | Conduits installed and connected | | | |
| 12. | Cable/conduit routing does not obstruct access | | | |
| 13. | Equipment room properly ventilated, air-conditioned, heated, fire/smoke wall separated, fire/smoke dampered, fire sprinklered, fire alarmed and illuminated (normal, emergency and battery backed-up fixtures) | | | |
| 14. | As-built drawings updated | | | |

| b) Distribution Panelboards and other Panelboards | | Yes | No | Comments |
|--|-------------------------------------|------------|-----------|-----------------|
| 1. | Tin plated copper buses | | | |
| 2. | Each circuit identified and labeled | | | |
| 3. | Space for additional circuits exist | | | |
| | | | | |

| c) Transformers | | Yes | No | Comments |
|------------------------|--|------------|-----------|-----------------|
| 1. | Dry type installed | | | |
| 2. | Unit properly labeled and identified | | | |
| 3. | Spot check insulation resistance and polarity for each type of transformer to ensure they are per the requirements | | | |
| | | | | |

| d) Electrical and Controls | | Yes | No | Comments |
|-----------------------------------|---|------------|-----------|-----------------|
| 1. | Panel devices labeled and wiring tagged per Contract Documents | | | |
| 2. | I/O devices labeled and wiring tagged per Contract Documents | | | |
| 3. | Digital inputs and outputs operational | | | |
| 4. | All electrical connections tight | | | |
| 5. | Proper grounding installed for the electrical system, equipment, components, and unit | | | |
| 6. | Safeties in place and operable | | | |
| 7. | Sensors, transmitters, gages, etc., installed | | | |
| 8. | Sensors calibrated (see below) | | | |
| 9. | Control system interlocks hooked up and functional | | | |
| 10. | All control devices and wiring complete | | | |
| 11. | Lightning protection installed | | | |
| 12. | Surge protection installed | | | |

| e) Final | | Yes | No | Comments |
|-----------------|---|------------|-----------|-----------------|
| 1. | Start-up report completed and attached with this Prefunctional Checklist | | | |
| 2. | Safeties and safe operating ranges for this equipment have been reviewed and accepted | | | |
| 3. | System is ready for Functional Performance Test | | | |
| | | | | |

5. Operational Checks:

- a. These checks supplement the manufacturer's list. This is not the Functional Performance Test.

| Operational Checks | | Yes | No | Comments |
|--------------------|--|-----|----|----------|
| 1. | Associated Prefunctional Checklists are complete and accepted | | | |
| 2. | Fuses are good | | | |
| 3. | Resistance check(s) complete with results attached | | | |
| 4. | Disconnect switch operates smoothly with full contact | | | |
| 5. | Specified point-to-point checks have been completed and documentation record submitted for this system | | | |
| | | | | |

- 1) Inspect the Panelboard for conformance to Contract Documents in concert with reviewing the ETA reports.
- 2) Contractor shall incorporate the ETA reports into the Microsoft Excel software.
- 3) Spot check phase balance after system is under load. Ensure proper, thorough and accurate identification of load. Trip breakers and validate load identified. Test GFI breakers.
- 4) Receptacle Polarity Test: Check all receptacles installed or reconnected under this Contract with a receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open.
- 5) Check circuit labeling by de-energizing circuits while circuit tester is in the receptacle. Labeling shall be checked on the load/receptacle and at the breaker.
- 6) Test each receptacle or branch circuit breaker having ground-fault circuit protection to assure that the ground-fault circuit interrupter will not operate when subjected to a ground-fault current of less than 4 milliamperes and will operate when subjected to a ground-fault current exceeding 6 milliamperes. Perform testing using an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. "TEST" button operation will not be acceptable as a substitute for this test. Replace receptacles that do not shutoff power with 5/1000 of an ampere within 1/40th of a second and retest. Submit test report signed by Test Engineer who performed this test.

6. Sensor and/or Actuator Calibration:

a. All field-installed temperature sensors, pressure sensors, meters, and gages, and all actuators and valves on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided are not required to be field calibrated.

b. All test instruments have had a certified calibration within the last 12-months: Y / N

c. Sensor/Actuator Verification Table

| Sensor or Actuator | Correct Location (Y/N) (1) | Thermometer or Gage Value | BAS Value (2) | Instrument Measured Value (3) | Pass (Y/N) |
|---------------------------|-----------------------------------|----------------------------------|----------------------|--------------------------------------|-------------------|
| | | | | | |
| | | | | | |
| | | | | | |

Lighting and Lighting Control Systems Checklist

| | |
|------------------|--|
| Project: | |
| Date: | |
| Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

1. General:

- a. This Checklist does not take the place of the manufacturer's recommended checkout and Start-up procedures or report.
- b. Checklist items shall be completed as part of start-up and initial checkout, preparatory to functional testing.

(CHECK ONE)

| INSTALLATION | Y | N | N/A | COMMENTS |
|---|----------|----------|------------|-----------------|
| <u>Site Visit Dates</u> | | | | |
| | | | | |
| | | | | |
| <u>Lighting Control</u> | | | | |
| Location | | | | |
| Tag # | | | | |
| Make | | | | |
| Model # | | | | |
| Equipment Ratings: Volts _____ Phase _____ | | | | |
| | | | | |
| | | | | |
| <u>Installation Checks</u> | | | | |
| | | | | |
| <u>Lighting</u> | | | | |
| Devices installed per manufacturer's instructions and specifications | | | | |
| Devices installed agrees with shop drawings and specifications | | | | |
| Verify mounting, location and clearances are per plans and specifications | | | | |
| Lighting control system installed per plans, specifications and manufacturer's recommendations | | | | |
| Switches, dimmers and occupancy sensors installed at correct height and have correct cover / escutcheon plate | | | | |
| All zone circuits and inputs are correctly wired, circuits labeled | | | | |
| Communications interconnection / interface is connected | | | | |
| | | | | |
| | | | | |
| <u>Operational Checks</u> | | | | |
| | | | | |
| Specified sequences of operation and operating schedules have been provided with all variations documented | | | | |
| Specified point-to-point checks have been completed and documentation record submitted for this system | | | | |
| Lighting control processor powered and battery backup operation checked. | | | | |
| Lighting control processor diagnostics performed | | | | |
| Lighting control communications interconnect checked | | | | |
| | | | | |

Fire Alarm System Checklist

| | |
|------------------|--|
| Project: | |
| Date: | |
| Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

1. General:

- a. This Checklist does not take the place of the manufacturer's recommended checkout and Start-up procedures or report.
- b. Checklist items shall be completed as part of start-up and initial checkout, preparatory to functional testing.

(CHECK ONE)

| INSTALLATION | Y | N | N/A | COMMENTS |
|--|----------|----------|------------|-----------------|
| <u>Site Visit Dates</u> | | | | |
| | | | | |
| <u>Unit Information</u> | | | | |
| Location | | | | |
| Tag # | | | | |
| Make | | | | |
| Model # | | | | |
| Equipment Ratings: Volts _____ Phase _____ | | | | |
| Capacity | | | | |
| Starter Mod | | | | |
| | | | | |
| | | | | |
| <u>Panel Enclosure/Cabinetry</u> | | | | |
| Equipment installed per manufacturer's instructions and specifications | | | | |
| Equipment installed agrees with shop drawings and specifications | | | | |
| Verify mounting, location and clearances are per plans and specifications | | | | |
| Inspect for physical, electrical and mechanical condition of equipment and cabinet - no damage evident | | | | |
| Inspect panels and doors for proper fit and alignment | | | | |
| Equipment labels permanently affixed | | | | |
| Panel is clean and clear of dust or dirt | | | | |
| Verify the application of manufacturer recommended torque values applied to bolted connections | | | | |
| Seismic anchoring installed and functional where applicable (non-short circuiting) | | | | |
| Inspect insulators, barriers and shields for damage or contamination | | | | |
| | | | | |
| | | | | |
| | | | | |
| <u>Batteries</u> | | | | |
| Installed per drawings and specifications | | | | |
| No corrosion or leakage | | | | |
| Verify tightness of all connections | | | | |
| Verify electrolyte level is correct (where applicable) | | | | |
| Terminations torqued per manufacturer's recommendations | | | | |
| | | | | |
| | | | | |

| INSTALLATION | (CHECK ONE) | | | COMMENTS |
|--|-------------|----------|------------|-----------------|
| | Y | N | N/A | |
| <u>Control Panel</u> | | | | |
| Mounted in accordance with plans, specifications and manufacturer's instructions | | | | |
| Adequate service access provided | | | | |
| | | | | |
| | | | | |
| <u>Power Supply Connected</u> | | | | |
| Communications interface/interconnect terminated per manufacturer's instructions | | | | |
| Panel grounded in accordance with manufacturer's instructions and code | | | | |
| | | | | |
| | | | | |
| <u>Operational Checks</u> | | | | |
| Specified sequences of operation and operating schedules have been provided with all variations documented | | | | |
| Specified point-to-point checks have been completed and documentation record submitted for this system | | | | |
| | | | | |
| | | | | |

- 1) Spot check location of sensors and switches to ensure conformance with requirements.
- 2) Verify sampling of all types of devices. Cause activation of the device, assure alarms are initiated and resulting response is per the requirements.
- 3) Verify interfaces with all other inter-related systems or equipment including FMS, sound systems, security systems, HVAC systems, vertical delivery systems, etc.
- 4) Validate output devices (speakers and strobes) meet the code criteria.
- 5) Test all functions and sequences associated with the elevator recall system.
- 6) Activate high temperature detectors in the elevator machine room. Verify all sequences including elevator shunt off, elevator recall including alternate floors when main floor is in alarm.
- 7) Activate smoke detector and verify all smoke control sequences and ensure fire/smoke dampers actuate as required.
- 8) Activate a sample of sprinkler flow switches. Validate that appropriate zone enunciates and alarms sound.
- 9) Verify audio aspects of the system function as required. Verify paging messages can be heard throughout the building.
- 10) Testing of the HVAC response is included with the associated equipment. Coordinate testing of the fire alarm system with the testing of the individual HVAC systems including shaft pressurization systems.
- 11) Ensure that the system functions while using all sources of power including normal, emergency, and battery. Check battery life by simulating an extended outage.

Telecommunications System Checklist

| | |
|------------------|--|
| Project: | |
| Date: | |
| Tag: | |
| Building: | |
| Location: | |

Submittal / Approvals

Submittal: The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval.

| | | | |
|-----------------------|------|------------------------|------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Electrical Contractor | Date | Sheet Metal Contractor | Date |
| | | | |
| TAB Contractor | Date | General Contractor | Date |

Construction checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

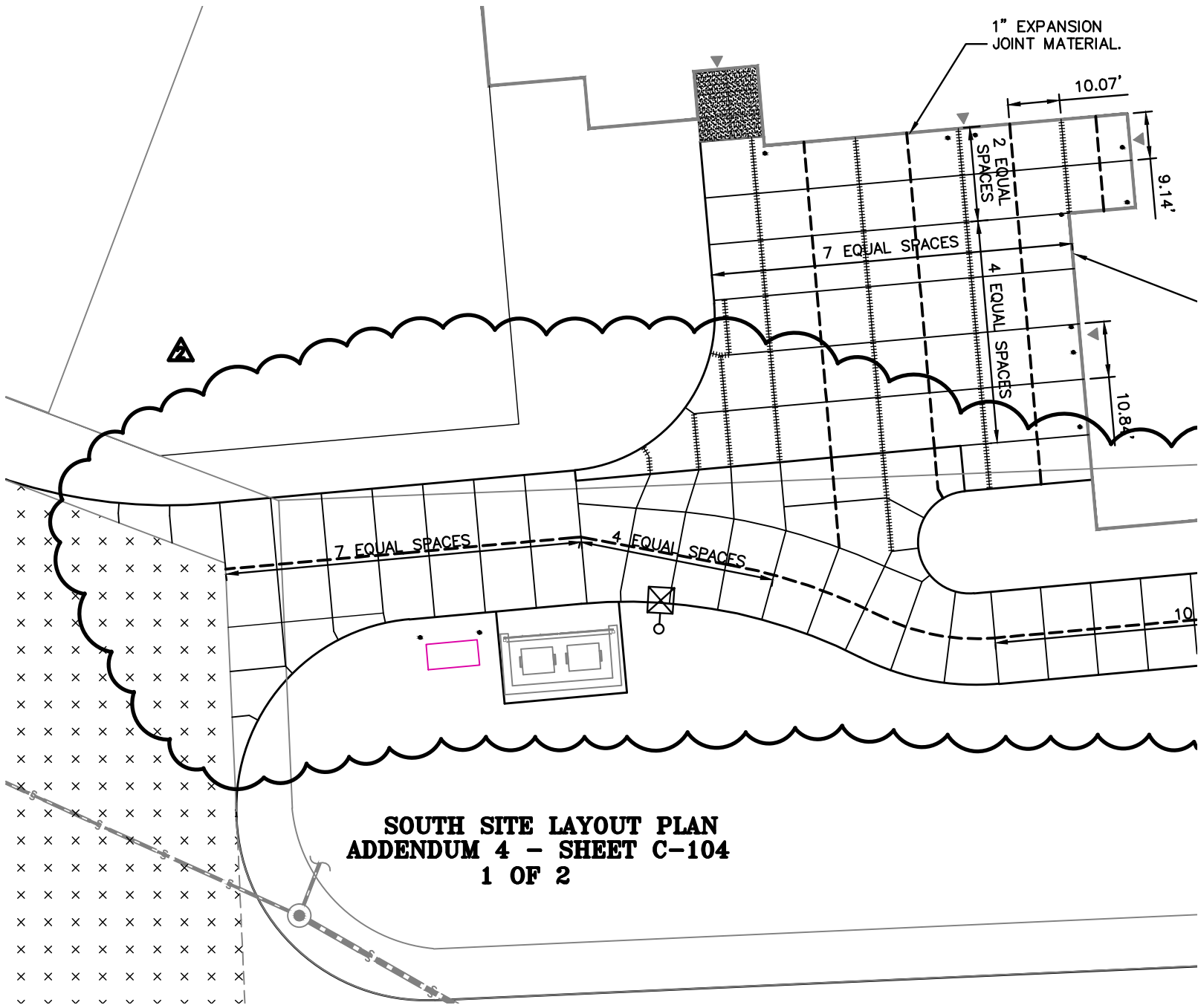
| | | | |
|-------------------------|------|------------------------|------|
| | | | |
| Commissioning Authority | Date | Owner's Representative | Date |

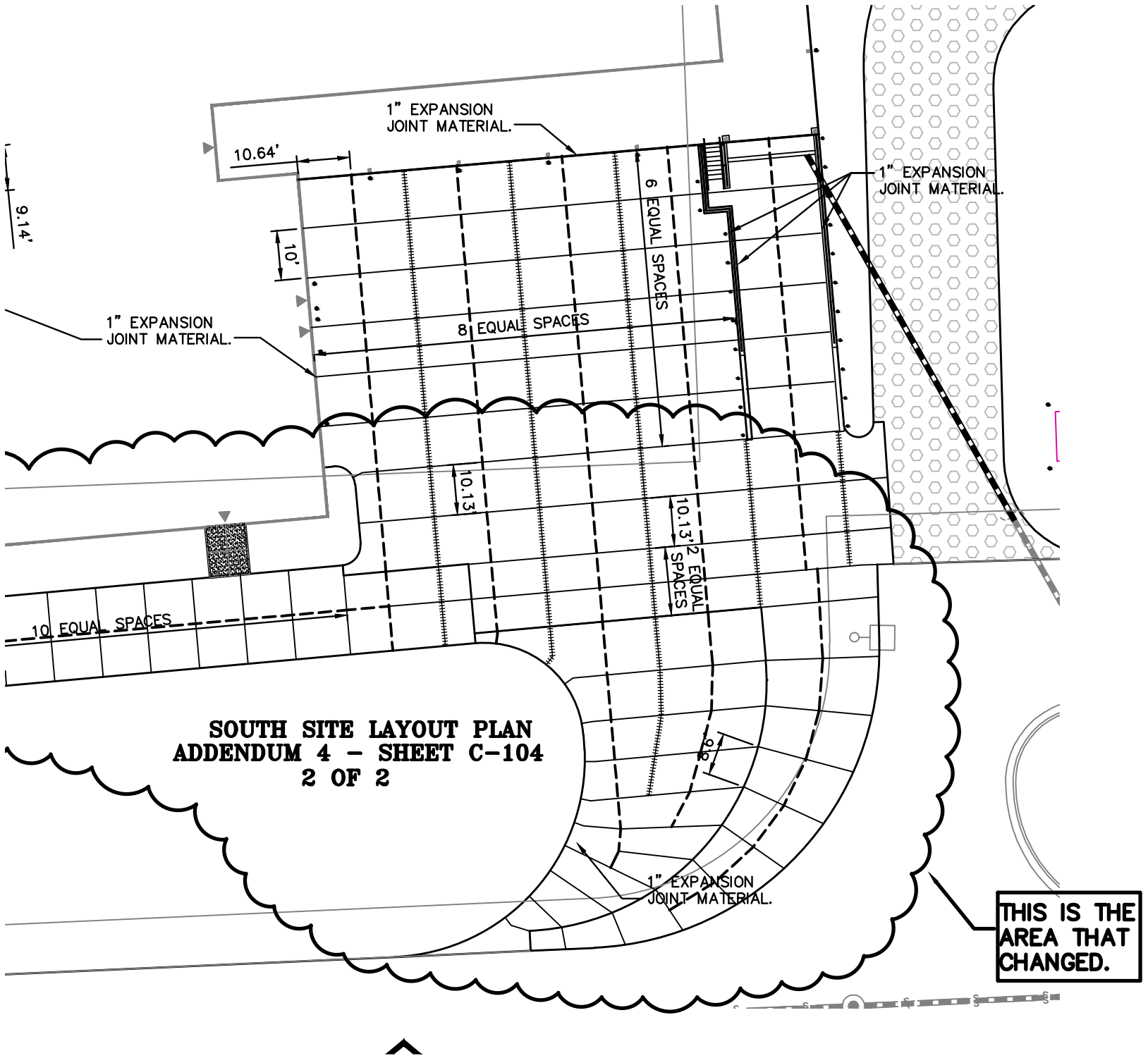
1. General:

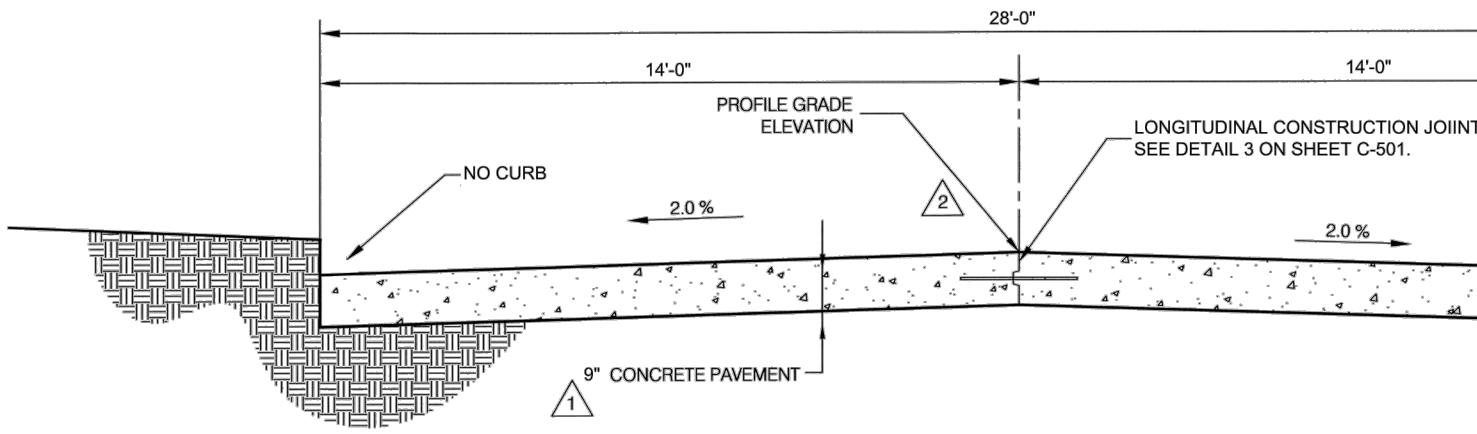
- a. This Checklist does not take the place of the manufacturer's recommended checkout and Start-up procedures or report.
- b. Checklist items shall be completed as part of start-up and initial checkout, preparatory to functional testing.

| | (CHECK ONE) | | | COMMENTS |
|--|-------------|---|-----|----------|
| | Y | N | N/A | |
| <u>INSTALLATION</u> | | | | |
| <u>Site Visit Dates</u> | | | | |
| | | | | |
| <u>Unit Information</u> | | | | |
| Location | | | | |
| Tag # | | | | |
| Make | | | | |
| Model # | | | | |
| | | | | |
| | | | | |
| <u>Panel Enclosure/Rack/Cabinetry</u> | | | | |
| Equipment installed per manufacturer's instructions and specifications | | | | |
| Equipment installed agrees with shop drawings and specifications | | | | |
| Verify mounting, location and clearances are per plans and specifications | | | | |
| Inspect for physical, electrical and mechanical condition of equipment and cabinet - no damage evident | | | | |
| Inspect panels and doors for proper fit and alignment | | | | |
| Equipment labels permanently affixed | | | | |
| Panel is clean and clear of dust or dirt | | | | |
| Verify the application of manufacturer recommended torque values applied to bolted connections | | | | |
| Rack/Enclosure grounded in accordance with manufacturer's instructions and code | | | | |
| Seismic anchoring installed and functional where applicable (non-short circuiting) | | | | |
| | | | | |
| | | | | |
| <u>Patch Panels</u> | | | | |
| Mounted in accordance with plans, specifications and manufacturer's instructions | | | | |
| Adequate service access provided | | | | |
| Communications interface/interconnect terminated per manufacturer's instructions and codes | | | | |
| | | | | |
| | | | | |
| <u>Connectors/Cabling</u> | | | | |
| Connectors and cabling installed per plans and specifications | | | | |
| Connectors and cabling terminated, tested, and checked per specifications and codes | | | | |

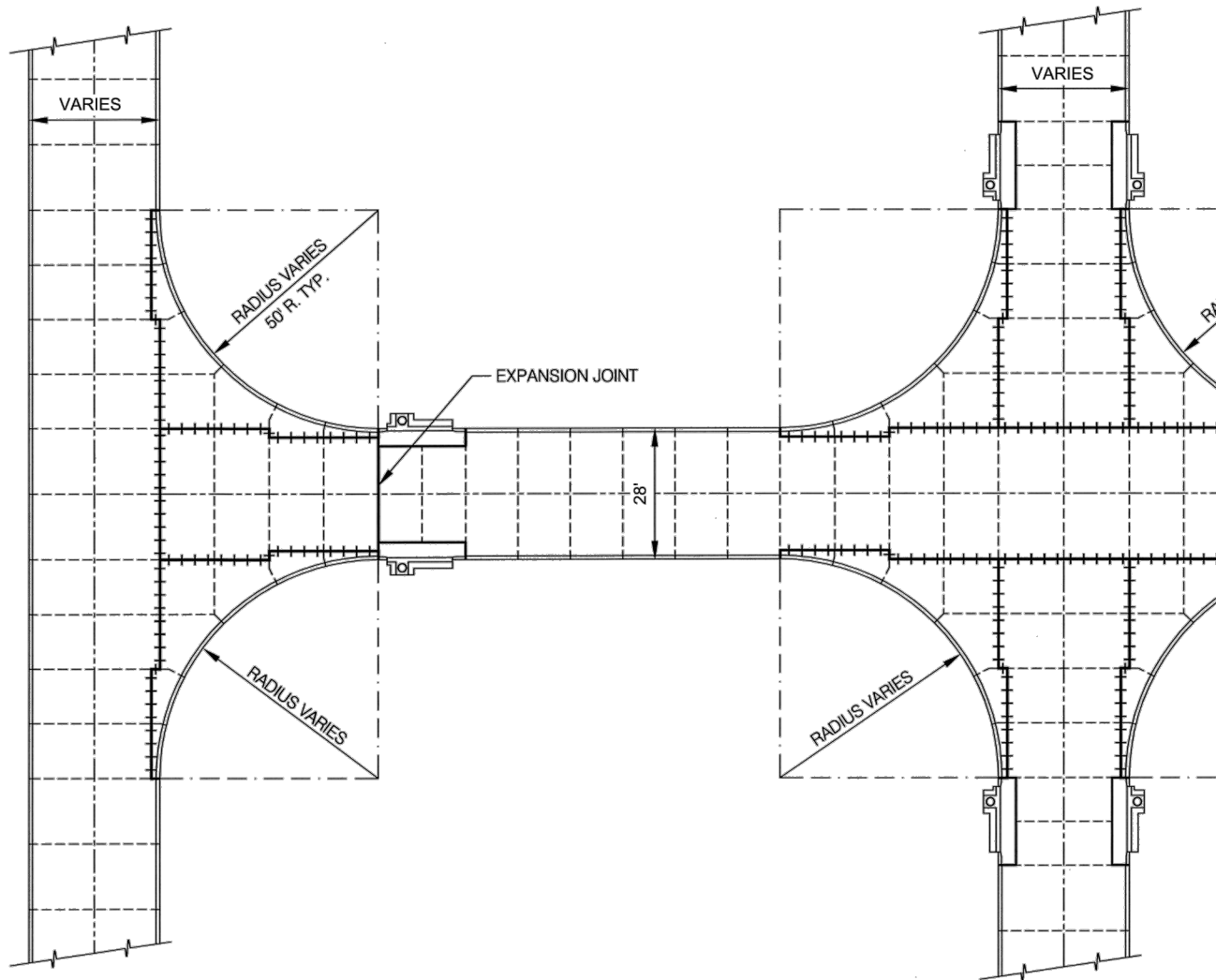
| INSTALLATION | (CHECK ONE) | | | COMMENTS |
|--|--------------------|----------|------------|-----------------|
| | Y | N | N/A | |
| <u>Operational Checks</u> | | | | |
| Specified point-to-point checks have been completed and documentation record submitted for this system | | | | |
| | | | | |
| | | | | |







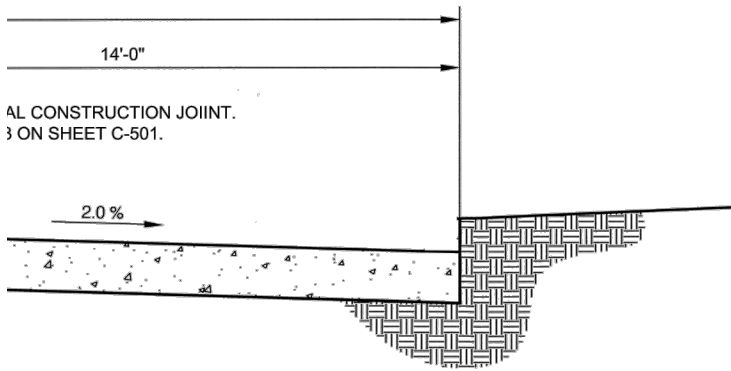
TYPICAL SECTION



TYPICAL JOINT PLAN

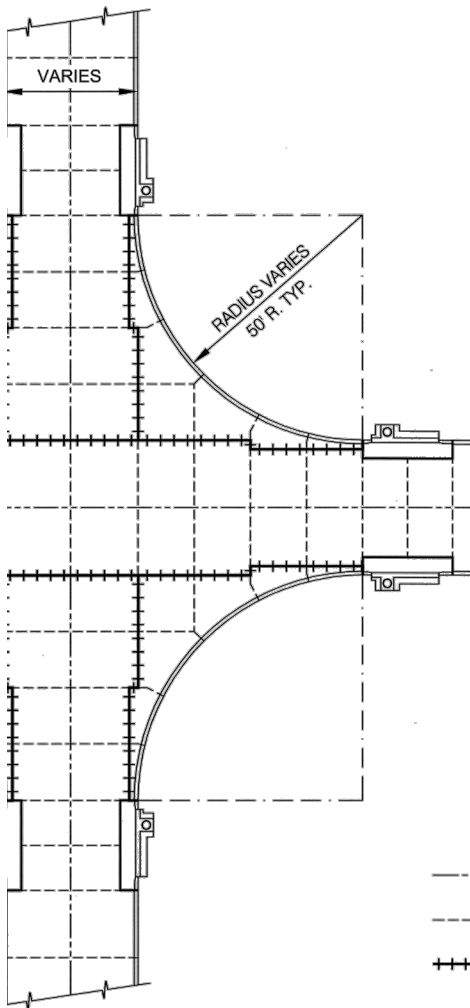
**MISCELLANEOUS DETAILS
ADDENDUM 4 - SHEET C-501
SHEET 1 OF 2**

FOR ABI 6 - ACCESS ROAD 9" PCC PAVEMENT



NOTES

1. WHEN BOTH LANES ARE PLACED AT THE SAME TIME THE LONGITUDINAL JOINT SHALL BE THE SAWED TYPE. THE KEYED TYPE LONGITUDINAL JOINT SHALL BE USED WHEN AN ADJACENT LANE IS NOT PLACED AT THE SAME TIME.
2. MAXIMUM SPACING FOR SAWED TRANSVERSE CONTRACTION JOINTS SHALL BE 12'.
3. TRANSVERSE JOINTS SHALL BE ALIGNED TO COINCIDE WITH THE CENTERLINE OF INTERSECTING SIDE STREETS WHEREVER POSSIBLE.
4. ALL SAWED TRANSVERSE JOINTS SHALL BE CONTINUOUS ACROSS THE PAVEMENT.



**MISCELLANEOUS DETAILS
ADDENDUM 4 - SHEET C-501
SHEET 2 OF 2**

| ----- LEGEND ----- | |
|--------------------|---|
| ----- | LONGITUDINAL JOINT |
| ----- | SAWED TRANSVERSE CONTRACTION JOINT |
| +++++ | KEYED JOINT - LUG-OUT TYPE NO. 4 TIE-BARS AT 3'-0" CENTERS |

CONT. 5X5X5/16" STEEL ANGLE TOP AND BOTTOM- WELD TO STRUCTURAL TUBE FRAMING

SEALANT

3/4" PLYWD SHEATHING ON 3 5/8" METAL STUD FRAMING @ 16" O.C.

5/8" FIBERGLASS FACED SHEATHING ON 2 1/2" METAL STUD FRAMING @ 16" O.C. WITH BUILDING WRAP.

1 1/4" METAL PLATE WALL PANEL

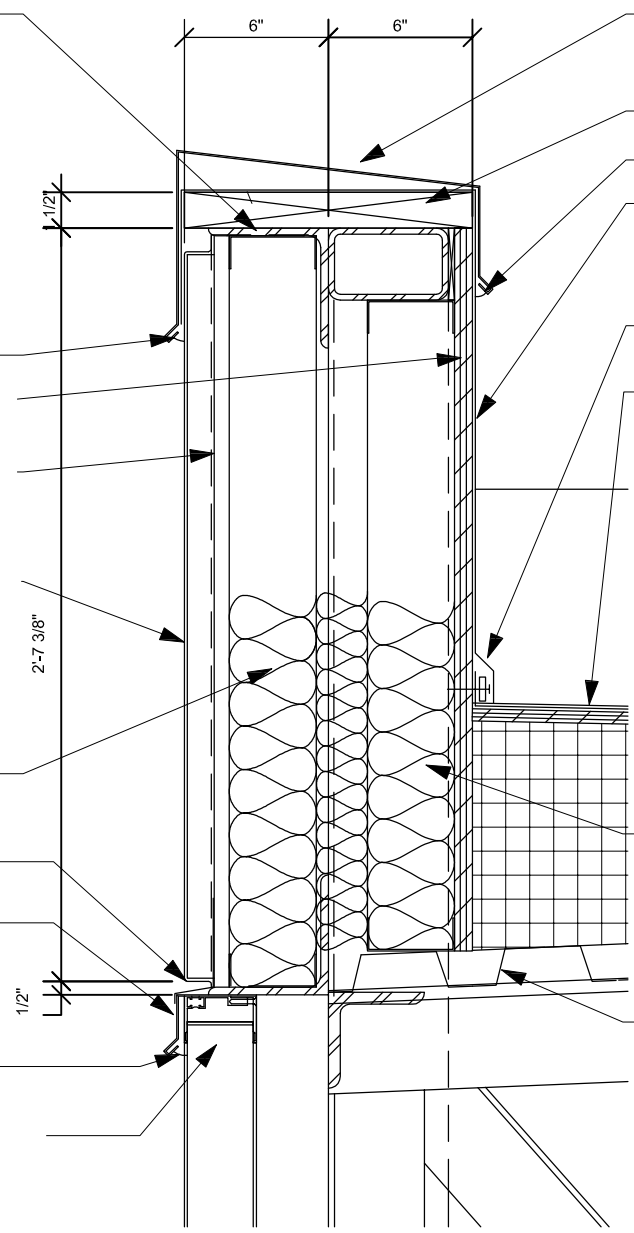
FILL W/ BATT INSULATION

PRE-FINISHED SHEET MET. FLASHING WITH CONT. CLEAT.

PRE-FINISHED ALUMINUM HEAD FLASHING

SEALANT

INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL



PREFINISHED ALUMINUM PARAPET CAP FLASHING WITH CONTINUOUS CONCEALED CLEAT-TYP.

WOOD BLOCKING

SEALANT

SINGLE MEMBRANE ROOFING, EXTEND UP AND OVER PARAPET WALL, RUN DOWN FRONT OF WALL 6" MIN.-TYP.

BASE TIE-IN PER MFG'R RECOMMENDATIONS

SINGLE PLY MEMBRANE ROOFING OVER COVERBOARD ON TAPERED INSULATION

SEE STRUCTURAL FOR STEEL TUBE FRAMING SIZES-TYP.

1 1/2" METAL DECK-SEE STRUCTURAL

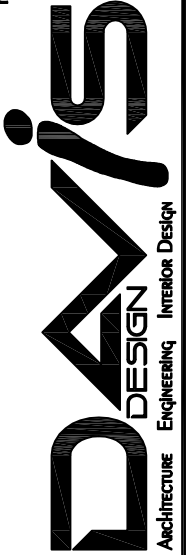
10

Parapet Detail

Scale: 1 1/2" = 1'-0"

VERMILLION
15 EAST MAIN STREET, STE. 201
VERMILLION SD 57069-3089
PHONE 605-624-1081

LINCOLN
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Client Information
Nebraska National Guard

Project Information
Titan Readiness Center

Mead Training Site
County Road J and 8th St.
Mead, Nebraska

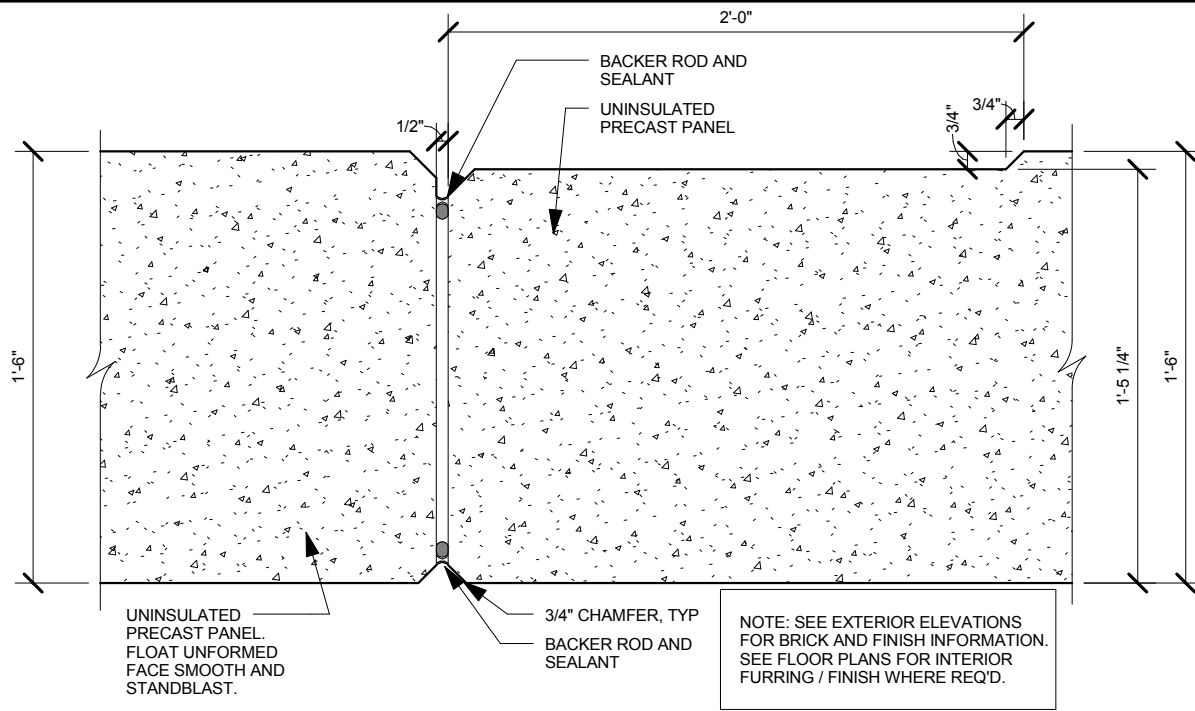
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| Job # | 10-0115 |
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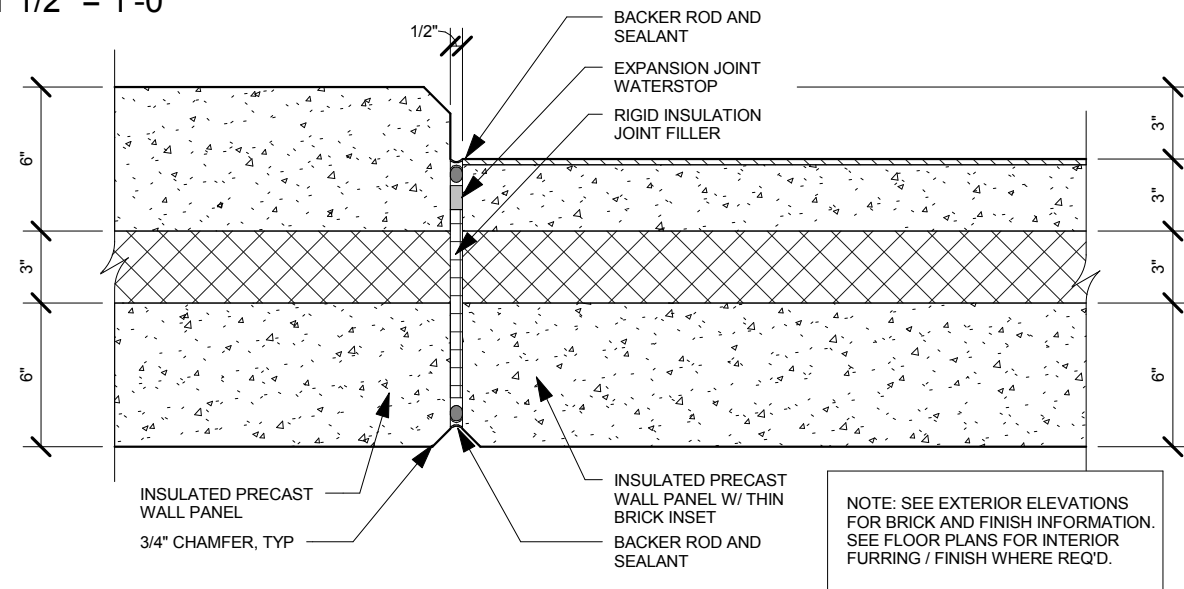
Drawing Title
Parapet Detail

From Sheet: **A-305** for CA use:

Drawing #
A-305.1



12 Butt Joint at Free Standing Wall Panels
 1 1/2" = 1'-0"



13 Butt Joint at Wall Panel Thickness Change
 1 1/2" = 1'-0"

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OMAHA
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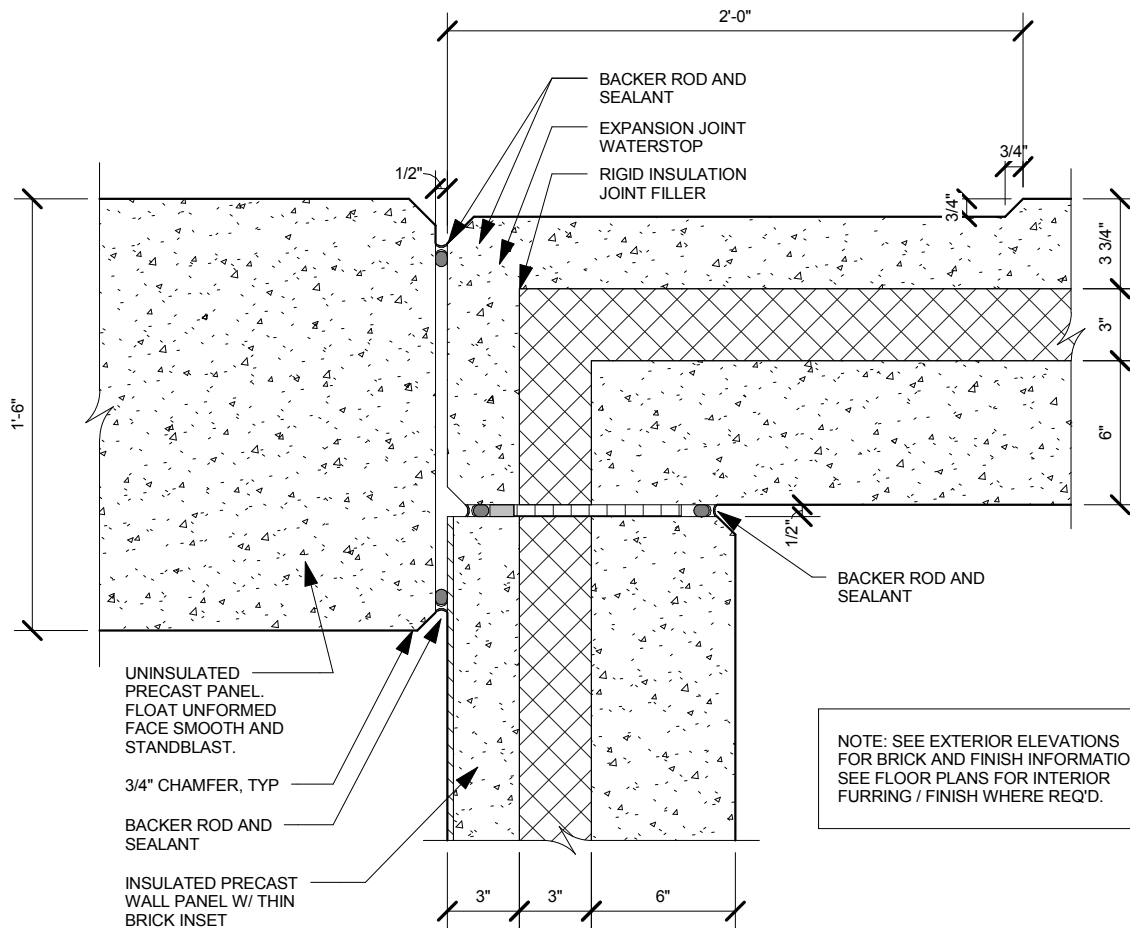
CLIENT INFORMATION
 Nebraska National Guard

PROJECT INFORMATION
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 Mead Training Site
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 Drawing Title
Precast Panel Joints

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14 Corner Joint at NW Corner of Library 126
 1 1/2" = 1'-0"

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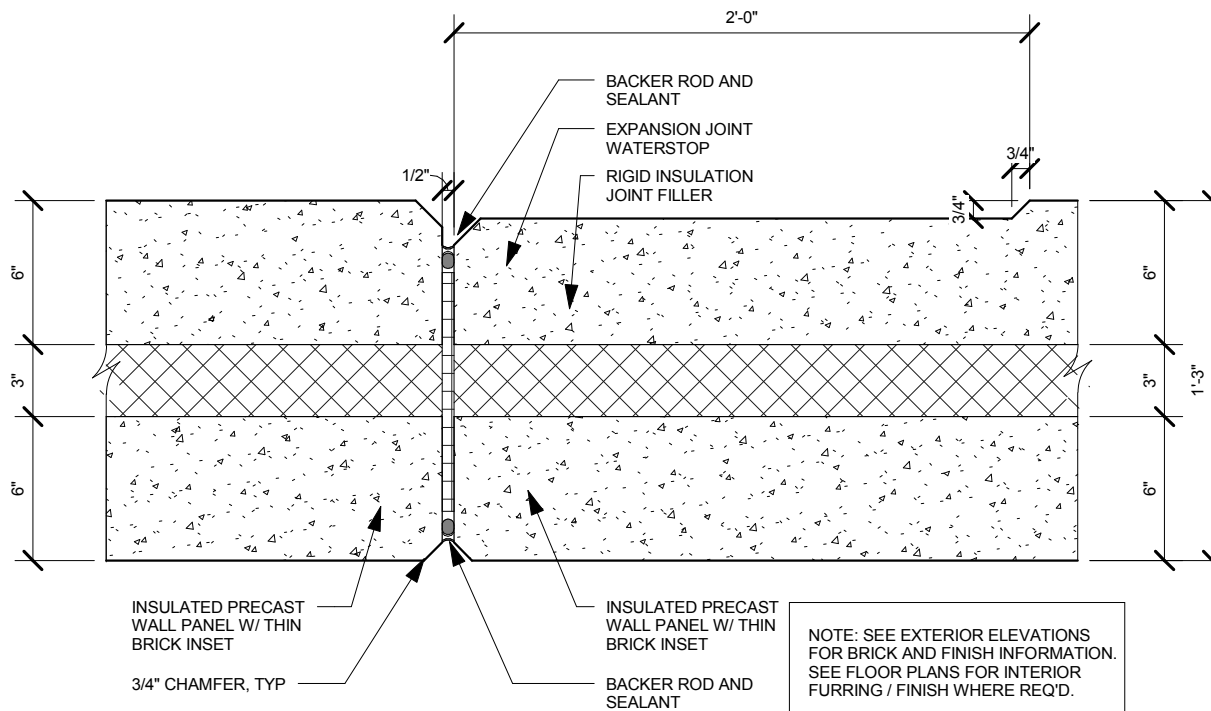
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15 Vertical Recess Butt Joint at Wall Panel
 1 1/2" = 1'-0"

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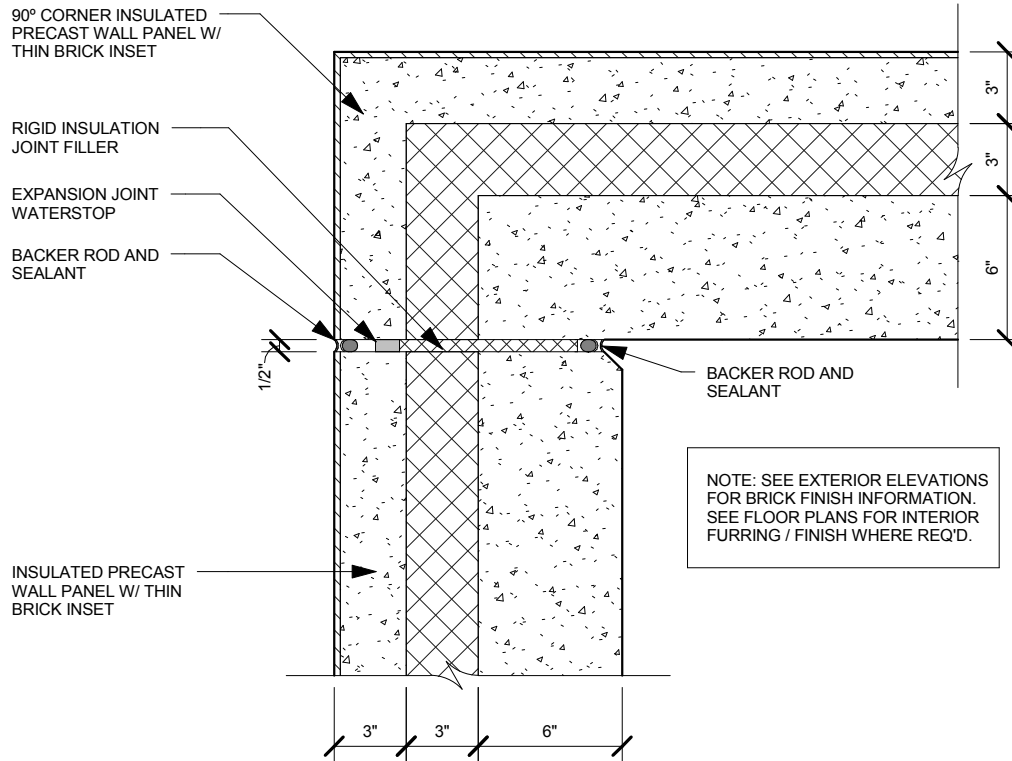
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16 Corner Joint at Thin Brick Faced Wall Panel
 1 1/2" = 1'-0"

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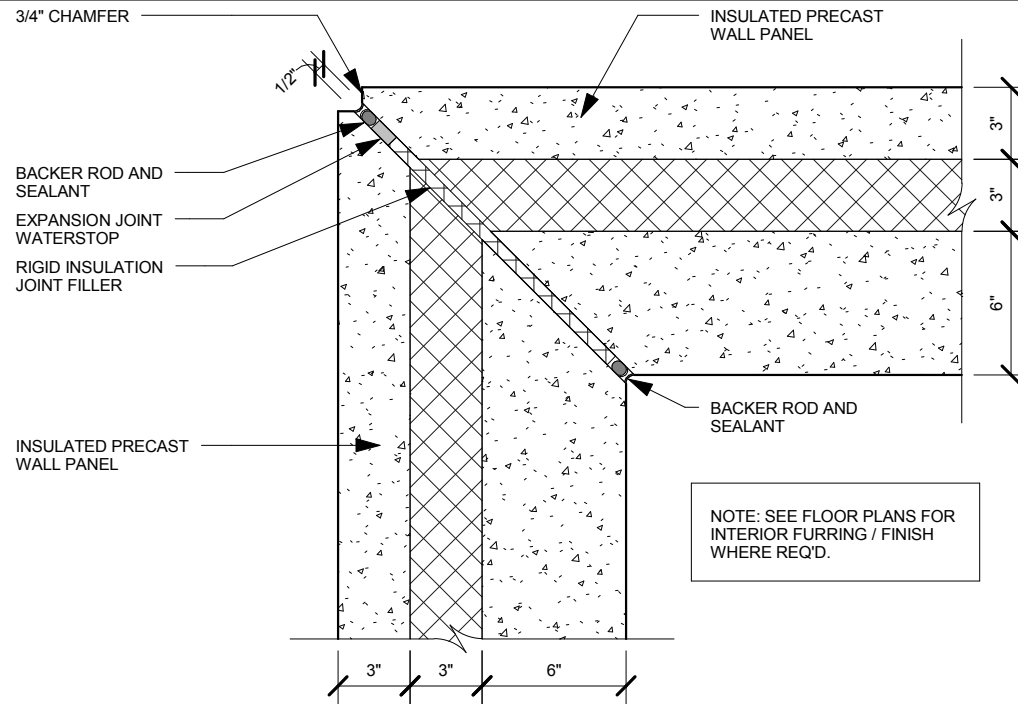
PROJECT INFORMATION
Titan Readiness Center

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 Mead, Nebraska

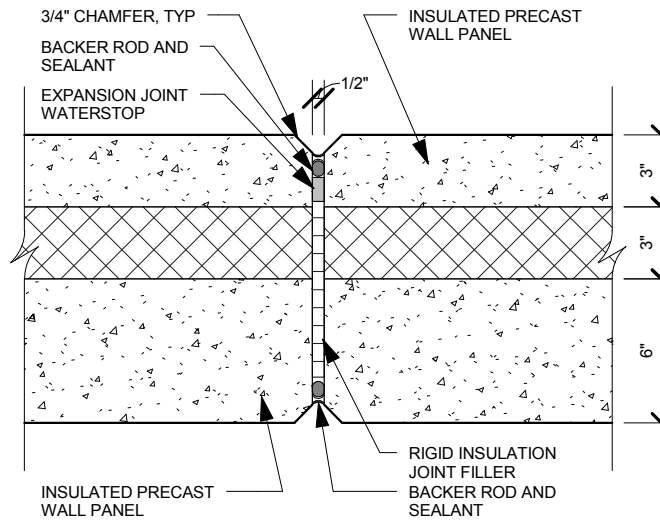
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17 Typical Wall Panel Corner Joint
 1 1/2" = 1'-0"



NOTE: SEE FLOOR PLANS FOR INTERIOR FURRING / FINISH WHERE REQ'D.

18 Typical Wall Panel Butt Joint
 1 1/2" = 1'-0"

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CLIENT INFORMATION

Nebraska National Guard

PROJECT INFORMATION

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