



STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. BOX 778
DOVER, DELAWARE 19903

JENNIFER COHAN
SECRETARY

VIA WEBSITE POSTING AND OVERNIGHT DELIVERY

January 31, 2020

Contract No. T201880102.01
Bear Administration Building - Demolition and Reconstruction
New Castle County

Ladies and Gentlemen:

Enclosed is Addendum No. 3 for the referenced contract consisting of the following:

1. The Bid Proposal Cover, revised, to be substituted for the same page in the Proposal.
2. One (1) page, Completion Time, page i, revised, to be substituted for the same page in the Proposal. The Notice to Proceed date has been revised to March 17, 2020.
3. Eleven (11) pages, Special Provision, 710500 - Water Main and Accessories, revised to be substituted for the ten (10) pages in the Proposal.
4. Two (2) pages, Breakout Sheet for 710500, revised, to be substituted for the same pages in the Proposal.
5. One (1) page, Appendix A, Table of Contents, pages TOC-1, revised, to be substituted for the same page in the Appendix.
6. Eighteen (18) pages, Appendix A, Technical Specifications, Section 019113 - Commissioning General Requirements, revised, to be substituted for the thirteen (13) pages in the Appendix.
7. Thirteen (13) pages, Appendix A, Technical Specifications, Section 019115 - Exterior Enclosure Commissioning, pages 019115-1 through 019115-13, has been added to the Appendix.
8. One (1) page, Appendix A, Technical Specifications, Section 074646 - Fiber-Cement Siding, page 074646-4, revised, to be substituted for the same page in the Appendix.
9. Ten (10) pages, Appendix A, Technical Specifications, Section 087100 - Door Hardware, pages 087100-20, 087100-22 through 087100-30, revised, to be substituted for same pages in the Appendix.
10. Three (3) pages, Appendix A, Technical Specifications, Section 099113 - Exterior Painting, pages 099113-1, 099113-4 and 099113-6, revised, to be substituted for the same pages in the Appendix.
11. Eight (8) pages, Appendix A, Technical Specifications, Section 101419 - Dimensional Letter and Panel Signage, pages 101419-1 through 101419-8, revised, to be substituted for the seven (7) pages in the Appendix.
12. Thirty (30) sheets, Construction Plans, sheets 5, 6, 15, 22, 24, 27, 29, 32, 40, 41, 42, 43, 47, 48, 49, 53, 56, 57, 63, 76, 85, 90, 93, 94, 95, 102, 104, 107, 109 and 110, revised, to be substituted for the sheets in the Plans.
13. One (1) sheet, Construction Plans, sheet 25A, new, to be added to the Plans.

These sheets will not be displayed on the website. A determination has been made that the publication of these specific plans could compromise public safety and are not available pursuant to Delaware Code, Title 29, §10002 (1)(17)(a)(2) and (3).

Please note the revisions listed above and submit your bid based upon this information.

Sincerely,

~signature on file~

Connie Ivins

Competitively Bid Contracts Coordinator
Delaware Department of Transportation

STATE OF DELAWARE



DEPARTMENT OF TRANSPORTATION

BID PROPOSAL

for

CONTRACT T201880102.01

**BEAR ADMINISTRATION BUILDING
DEMOLITION AND RECONSTRUCTION**

NEW CASTLE COUNTY

ADVERTISEMENT DATE: December 9, 2019

COMPLETION TIME: 677 Calendar Days

**PROSPECTIVE BIDDERS ARE ADVISED THERE WILL BE A MANDATORY PRE-BID MEETING:
MONDAY JANUARY 6, 2020 AT 11:00 A.M. IN THE BEAR ADMINISTRATION BUILDING,
250 Bear-Christiana Road, Bear, DE 19701**

SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION
DELAWARE DEPARTMENT OF TRANSPORTATION
AUGUST 2016

Bids will be received in the Bidder's Room at the Delaware Department of Transportation's Administration Building, 800 Bay Road, Dover, Delaware prior to 2:00 P.M. local time THURSDAY JANUARY 23
TUESDAY, FEBRUARY 11, 2020

Contract No.T201880102.01

**BEAR ADMINISTRATION BUILDING DEMOLITION AND RECONSTRUCTION
NEW CASTLE COUNTY**

GENERAL DESCRIPTION

LOCATION

These improvements are located in New Castle County more specifically shown on the Location Map(s) of the enclosed Plans.

DESCRIPTION

The improvements consist of furnishing all labor and materials for this contract. This project consists of demolishing the existing administration building, constructing a new administration building, and Site Work, as well as other incidental construction in accordance with the location, notes and details shown on the plans and as directed by the Engineer.

COMPLETION TIME

All work on this contract must be complete within 677 Calendar Days. The Contract Time includes an allowance for 59 Weather Days. It is the Department's intent to issue a Notice to Proceed such that work starts on or about March 9 17, 2020.

PROSPECTIVE BIDDERS NOTES:

1. BIDDERS MUST BE REGISTERED with DelDOT and request a cd of the official plans and specifications in order to submit a bid. Contact DelDOT at dot-ask@delaware.gov, or (302) 760-2031. Bids will be received in the Bidder's Room at the Delaware Department of Transportation's Administration Building, 800 Bay Road, Dover, Delaware prior to 2:00 P.M. local time January 23, 2020 unless changed via addendum.
2. QUESTIONS regarding this project are to be e-mailed to dot-ask@delaware.gov no less than six business days prior to the bid opening date in order to receive a response. Please include T201880102 in the subject line. Responses to inquiries are posted on-line at <http://www.bids.delaware.gov>.
3. PERFORMANCE-BASED RATING SYSTEM - 29 Del.C. §6962 (12)(a) requires DelDOT to include a performance-based rating system for contractors. The Performance Rating for each Contractor shall **NEW** be used as a prequalification to bid at the time of bid. Refer to Contract '*General Notices*' for details.
4. **THE BID PROPOSAL software used by DelDOT has changed. We now use Bid Express.** This new software is an updated version of the previous software used and operates similarly. The cd you request from DelDOT contains the Bid Express file and its installation file. Bidders are to use the cd provided to enter their bid amounts into the Bid Express file. The Bid Express bid file must be printed and submitted in paper form along with the electronic bid file and other required documents prior to the Bid due date and time. (DelDOT is not utilizing web based electronic bidding for this project).
5. SURETY BOND - Each proposal must be accompanied by a deposit of either surety bond or security for a sum equal to at least 10% of the bid. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract.
6. DRUG TESTING - Regulation 4104; The state Office of Management and Budget has developed regulations that require Contractors and Subcontractors to implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds pursuant to 29 Del.C. §6908(a)(6). Refer to the full REVISED requirements at the following link: <http://regulations.delaware.gov/register/december2017/final/21 DE Reg 503 12-01-17.htm>

Note a few of the requirements;

- * At bid submission - Each bidder must submit with the bid a single signed affidavit certifying that the bidder and its subcontractors has in place or will implement during the entire term of the contract a Mandatory Drug Testing Program that complies with the regulation, *the form is attached*;

710500 WATER MAIN AND ACCESSORIES

Description:

This work consists of furnishing, transporting, installing, and testing the water main, line, laterals, and accessories in accordance with the locations, details and notes on the Contract Documents, and as directed by the Engineer. The work shall be performed in accordance with these Special Provisions, Delaware Standard Specifications, and the requirements of the Standards and Specifications of the Owner. The Owner of the water utility is the Artesian Water Company and for purposes of the water utility is referred herein as the Utility Owner. In case of conflict between these Special Provisions, Delaware Standard Specifications, and the Standards and Specifications of the Utility Owner, the Standards and Specifications and all other requirements of the Utility Owner shall prevail.

Special Requirements:

Coordinate all water service construction activities with DelDOT and the Owner including, but not limited to, requests for system shut downs and inspections. Provide the Owner with reasonable time to respond to requests for information and coordination. Submit (3 weeks prior to beginning the Work), for approval, a plan describing the logical sequence for water service shut-downs and tie-ins.

If necessary, furnish, install, and remove bypass and temporary services pipes to maintain water service to customers during the Work. Furnishing, installing services and other branches, maintaining, providing safety precautions and removal of temporary services is the responsibility of the Contractor. Use only the highest quality service pipe, connections and branches that are able to withstand 150 pounds per square inch pressures and all conditions of use. Ensure that all pipes and fittings are watertight and that care is exercised throughout the installation to avoid pollution of mains, hose services or temporary service pipe.

Place temporary service pipe in the gutters where possible. Provide pipe crossings at driveways with cold patch cover or other methods approved by the Engineer. At street crossings, place temporary pipe in shallow trenches covered with temporary surfacing or other methods approved by the Engineer. Use sanitary precautions that are satisfactory to both the Engineer and the Owner. Chlorinate the interior of temporary service pipe in accordance with the latest AWWA Manual C601-81 "AWWA Standard for Disinfecting Water Mains". Chlorine and bacteria testing will be performed by the Owner's inspector.

The Owner and the Engineer retain the sole right of determining the times that the Work can occur and the sequence of the Work. Do not begin Work until both the Owner and the Engineer grant permission to proceed. Notify the Owner a minimum of forty-eight (48) hours before beginning Work to allow the Owner to arrange inspection. Immediately notify both the Engineer and the Owner of all delays to the scheduled Work.

It is of prime importance that the Contractor, in the performance of the Work, does not disrupt the operation of the existing water facilities in any manner or at any time, without the expressed prior approval of the Owner. Construct, disinfect, maintain and remove, following construction, such temporary water bypasses as may be required during construction to maintain water mains in service. No separate payment will be made for such temporary water bypasses.

The Contractor will be permitted to close down specific water mains and services for a period of time not exceeding four (4) hours after obtaining approval from the Owner in order to make connections as shown in the Contract Documents. The schedule for making connections will be so arranged that the water users will be out-of-service for a minimum period of time. The Contractor will receive no additional compensation for working during off-peak hours.

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Before any shutdown, as specified above, the Contractor must give the utility owner and local 911 Center and Fire Department forty-eight (48) hours' notice; and the Contractor must also furnish written notice to all water users in the area, a minimum of forty-eight (48) hours in advance of the closing of any water valves which may interrupt customer water service.

Shutdowns are not permitted if tapping sleeves and valves are specified for making the connections.

Any and all emergency repairs required are the responsibility of the Contractor. Upon notification via telecommunication from the Owner, attend to any repairs immediately. In the event the Owner is unable to contact the Contractor or the Contractor fails to make the emergency repairs in a length of time determined by the Owner, the Owner reserves the right to attend to any or all emergency repair work. In such a case, the Contractor is responsible for reimbursements due to the Owner for the costs of the repairs.

Remove and replace or repair all Materials and Work, or parts thereof, which are deemed unsatisfactory as to any or all requirements of the Owner or the Engineer or as specified herein, at no expense to the State or the Owner.

Guarantee all workmanship, Materials and Work performed is in strict accordance with the Contract Documents, for a period of two years from and after the date of Completion and Acceptance of the Work. Repair, correct or replace as required, promptly and without charge, all Work, Equipment and Material, or parts thereof, which fail to meet the above guarantee, or which in any way fail to comply with or fail to be in strict accordance with the terms, provisions and requirements of the Contract during such two-year period.

Only designated Utility Owner personnel shall have the authority to operate any hydrants or valves that make up the Owner's water distribution system. Contractors shall not operate existing gate valves or hydrants. It is the Contractors responsibility to make arrangements for receiving water from public or private sources, secure necessary permits and pay regular charges. Under no circumstances shall existing hydrants be used to supply water other than to Utility Customers. The Contractor under the direction of the Utility Owner personnel shall do the initial filling of new water mains for service installations and testing. Disposal of any wastewater or any test water into New Castle County's sanitary sewer system is subject to New Castle County's charge. Prior written approval must be obtained from New Castle County.

Materials:

Provide Materials as specified in the following DelDOT Specifications:

Portland Cement Concrete, Class B	Section 1022
Backfill, Borrow Type C	Section 1001
Stone, Delaware No. 8	Section 1004

All the materials including pipe, fittings, and all other accessories as listed under this Special Provisions, shall conform to the material and quality requirements of the Standards and Specifications of the Utility Owner. The Utility Owner shall have right to inspect and reject the materials, if his/her specifications requirements are not met. It is recommended that the Contractor should contact the Utility Owner and get himself/herself familiarized with the applicable requirements of the materials required under this Contract before submitting his/her bid.

The Contractor shall be responsible for providing materials including pipe, fittings, and all other appurtenances necessary to make permanent connections to existing utility facilities of whatever material type encountered. Connections to the Artesian Water 12" main via a 12"x4" tee and 4" ductile iron pipe to new meter chamber, 4" Meter Vault, Including Internal Piping, Meter, Valves, Assemblies, etc within the meter chamber shall be purchased from Artesian Water unless otherwise directed by the Engineer.

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The Contractor shall transport, handle, and store pipe and fittings as recommended by manufacturer.

New pipe and fittings that are damaged before or during installation shall be repaired or replaced, as recommended by the manufacturer or required by the Utility Owner. The costs of such repair or replacement shall be borne by the Contractor and be accomplished prior to proceeding with the project.

The Contractor shall deliver, store and handle other materials as required to prevent damage. Materials that are damaged or lost shall be repaired or replaced by the Contractor at no additional expense to the Utility Owner or Department.

A. WATER LINE MATERIALS

All watermain pipes, hydrants, valves, fittings and all appurtenances shall be new materials and shall be of the type, size, strength, and quality as shown on the plans and as specified herein and/or as indicated in the Special Provisions. The contractor may be required to secure and deliver to the Engineer a written statement from the manufacturer assuring the quality and compliance to the applicable specification of all materials furnished and installed under this improvement project. This shall in no way relieve the Contractor of any responsibility as to the quality of materials furnished and installed.

The Contractor shall install pipe made of virgin materials. The new pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

All standards and specifications referenced shall be the latest edition and version thereof. This includes AWWA, ASTM, ANSI, NSF and Federal specifications and standards. All construction work related to the installation of potable water pipe shall be performed by a licensed and bonded Contractor. Permits and licenses must be obtained prior to construction.

Warranty and Acceptance: Materials and workmanship shall have a one-year warranty to be free from defects in workmanship and materials. The warranty will be from the date of completion of construction. If work has been done to the requirements of this specification, a letter of acceptance shall be provided to the contractor upon final inspection. If deficiencies are discovered during the warranty period, the Contractor shall be required to correct these deficiencies without additional charge to the Owner or his agent. The Project Engineer shall determine the need for warranty repair work to be performed by the Contractor. The Project Engineers determination of a deficiency will bind the Contractor to make a repair in accordance with this Contract.

1. PIPE BEDDING MATERIAL - Pipe bedding material shall be in accordance with DelDOT Standard details.
2. DUCTILE IRON PIPE (DIP) - Ductile iron water mains shall be push on, Class 52, unless otherwise specified. DIP shall be centrifugally cast in lengths not less than 12 feet and no more than 20 feet, conforming to ANSI/AWWA C151/A21.51-81. Provide a minimum cover of 42 inches. DIP shall be cement lined in accordance with the requirements of ANSI/AWWA C104/121.4-80. A bituminous seal coating shall be applied to the interior and exterior as soon as the cement lining has sufficiently dried.
 - a. Contractor shall purchase 4-inch DIP from Artesian Water unless directed otherwise by the Engineer.
3. HIGH DENSITY POLYETHYLENE PIPE (HDPE) - HDPE water mains shall be IPS DR 11, unless

otherwise specified. 2.5-inch HDPE shall conform to ASTM D3035, AWWA C901. 4-inch HDPE shall conform to ASTM D3035, AWWA C906. Provide a minimum cover of 42 inches.

4. GATE VALVES

- a. Main gate valves shall be Mueller A-2360 or H2370-20, open left, or approved equal
- b. Valves in meter pit shall be part of Badger FSAA-01 Domestic Service Water Meter Assemblies purchased from Artesian Water unless otherwise directed by the Engineer.

5. BUTTERFLY VALVES

- a. Main butterfly valves shall be Mueller Linesal III Class 150B or approved equal.

6. VALVE BOXES - Valve boxes shall be Mueller H-10350, or approved equal.

7. METER PIT - Meter pit shall be 4" Badger FSAA-01 Domestic Service Water Meter Assemblies purchased from Artesian Water unless otherwise directed by the Engineer. This shall include internal piping, meter, valves, assemblies, etc.

8. DIP FITTINGS - DIP Fittings shall be ductile iron casting and have mechanical joints, Class 350 conforming to AWWA specification C153, covering compact fittings. Mechanical joints shall conform to AWWA Specification C111, latest revision, with gaskets made from vulcanized crude rubber compound. Fittings shall be cement lined and bituminous coated. Mastic spray is to be used where any uncoated pipe or fitting is exposed such as welds, Megalugs, scraped coating, etc.

- a. Contractor shall purchase 4-inch DIP fittings, including 12"x4" tee and 90 degree bend, from Artesian Water unless directed otherwise by the Engineer.

9. HDPE FITTINGS - HDPE Fittings shall be in accordance with AWWA C901/906.

10. STIFFENERS INSERTS. Stainless steel stiffener inserts, ASTM 240, shall be used for all fittings and connections to HDPE pipe.

11. BOLTS, NUTS & RODDING - All underground installed bolts, T-bolts, nuts and any rodding required shall be stainless steel, ASTM F 593 Type 316 for all watermain fittings including mechanical joints, hydrants, valves, tees, bends, taps, etc. No other type of bolts, nuts or rodding will be allowed unless approved in writing by the City Engineer.

12. HYDRANTS - Hydrant laterals shall be retraining tee, 6 inch resilient wedge gate valve and box with 6 inch ductile iron pipe. Hydrants shall be Waterous Pacer WB-67-250. Valve opening shall be 5 ¼ inch, open left. The muzzle arrangement shall be two 2 ½ inch hose connections and one 4 ½ inch pump connections, National Standard Thread. Lateral connection shall be 6 inch mechanical joint. Operating nut shall be 1 ½ inch pentagon.

13. TAPPING SLEEVES AND VALVES - Tapping sleeves shall be Mueller H-615, Mueller Stainless H-304. Tapping valves shall be Mueller H-687, open left. Tapping sleeves shall be a minimum of 6 feet from pipe joints or other fittings.

14. BUILDING SERVICES AND SERVICE SADDLES - Contractor shall be responsible for locating

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all water services; determining is active or abandoned; and confirming size and material. Locating and determining active status shall be incidental to the service connection item.

- a. CURB STOPS - Curb stops shall be Mueller H-15204, or approved equal.
 - b. CURB BOXES - Curb boxes Mueller-H10350, or approved equal.
 - c. METER YOKES - Meter yokes shall be Mueller H1412, or approved equal.
 - d. WATER METER - The meter (Master Meter) shall be as determined by the Utility Owner.
15. POLYETHYLENE ENCASUREMENT MATERIAL - Polyethylene encasement material shall conform to the requirements of AWWA C-105 for tube type installation and 8 mil nominal film thicknesses.
16. BENDS - All bends shall be concrete buttressed or utilize locking gaskets. Refer to construction details in the drawings.
17. RESTRAINED JOINTS - Restrained joints shall be provided at all transition connections. Restrained joints shall be MEGA-LUG series 1100 or approved equal. At locations where bends are required pre-cast thrust blocks. For connection between HDPE and DIP pipe, Contractor shall use a MJ Adapter for connection. Contractor is responsible for restraining DIP joints and fittings at alignment changes; at valve locations where a future tie-in may occur; at valve locations where existing pipe will be removed and replaced during future operations; and as shown on the drawings or required based on requirements of the construction details.
18. Backflow Preventer and Basket Strainer for Temporary Water Main and Hydrostatic Testing: Reduced pressure principal type, flanged and supplied complete with integral valves, following the American Society of Safety Engineers Standard No. 1013 and AWWA C510.
- a. Materials: Bronze, or liquid epoxy coated cast iron body with bronze and stainless steel working parts.
 - b. Pressure Requirements: Suitable for supply pressure as high as 175 psi and hydrostatic test pressure of 350 psi.
 - c. Manufacturers: Conbraco, Febco, Zurn Industries, Watts Regulator or approved equal.
 - d. Basket Strainers.
 - i. Installation: Inlet side of backflow preventer following Drawings.
 - ii. Strainers: Flanged ends, unless otherwise noted.
 - (1) Strainer bodies: Ductile iron, gray iron, or bronze and designed to withstand maximum working pressure of 175 psi with tapped opening for flushing strained debris.
 - iii. Screens: Unless otherwise noted, stainless steel or brass sheet metal with ¼ inch perforations.
 - (1) Open area of screen: At least 4 times inside cross-sectional area of pipe.

- iv. Manufacturers: Hersey Products, Inc., Mueller Co., or approved equal.

Construction Methods:

The construction of the water main shall be a combination of open cut excavation and jack and bore.

A. WATER PIPE INSTALLATION

- 1. **WORKING HOURS** - The Utility Owner shall be notified at least 48 hours prior to commencing any work. Contractors are subject to being shut down and or having work rejected if proper notification is not given to the Utility Owner. A schedule of work shall be submitted to the Engineer and Utility Owner prior to construction defining which portions of the contract will occur at night or during the day. Changes to this schedule should be made throughout the construction and reported immediately to the Utility Owner and Engineer. The definition of "Work" also includes the starting of equipment and the delivery of materials to the job site.

- 2. **INSTALLATION OF PIPE AND FITTINGS** - Watermain and water services shall be placed with a minimum of 48 inches of finished ground cover from the top of pipe to finished grade. The laying and jointing of water pipe shall be in accordance with the Contract Documents and the requirements of the Utility Owner's Specifications and as stated herein. All pipe and fittings shall be thoroughly cleaned before laying, in accordance with AWWA Standard C601-81 or the now current standard, and shall be kept clean until acceptance of the Work. No Work may be performed except under the supervision of the Utility Owner's inspector.

At the close of the work each day, the end of the pipe shall be tightly closed to prevent dirt, foreign substances, or small animals from entering the line until Work is resumed.

Pipe and fittings shall be carefully handled and lowered into the trench. Special care shall be taken to make sure all pipes are well bedded on solid foundation. Any defects due to settlement shall be repaired by the Contractor at his/her expense.

Where the manufacturer's recommended pipe joint deflection is exceeded, mechanical joint bends shall be required and installed to the satisfaction of the Owner and the Engineer at the Contractor's expense.

Thrust blocks are to be made of Portland Cement Concrete, Class B with a Concrete minimum strength 3,000 psi. Thrust blocks of adequate size and weight shall be used on all pressure piping for all fittings and all bends equal to and greater than of 11 1/4 degrees to resist the force of water pressure and water hammer. Thrust blocks (buttresses) shall conform to the details shown on the Plans and/or the Owner's Standard Specifications. Thrust blocks must be used unless the Owner's specifications or the Contract Documents permit a different method to secure the fittings. All methods used to secure fittings, including, but not limited to, thrust blocks, couplings and service saddles are incidental to the fittings and no separate payment will be made for this Work.

No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the Owner or the Engineer shall deem that there is danger of frost penetration at the bottom of the excavation. Keep all excavations free from water or other liquids during the progress of the Work. Excavate and backfill trenches per the applicable requirements of Section 207. Remove all excess Material in accordance with Section 106.08.

3. The Contractor shall keep all excavation free from water or other liquids during the progress of the work; and backfilling of trenches shall meet the applicable requirements of Section 207 of the DelDOT Standard Specifications.
 - a. Installation of Polyethylene Pipe (PE) and their appurtenances shall conform to the requirements of AWWA C901/906. The installation shall be to the bedding and backfill conditions specified by the Manufacturer, Plans, Specifications, or Special Provisions.
 - b. Installation of ductile iron water mains (DIP) and their appurtenances shall conform to the requirements of AWWA C-600 Specifications, the Plans, Specifications and Special Provisions.

4. PIPE LAYING OPERATIONS - Trench excavation and bedding preparations shall proceed ahead of pipe placement so as to permit proper placement and joining of the pipe and fittings at the prescribed grade and alignment without unnecessary hindrance. All foreign matter or dirt shall be removed from the inside of the pipe and fittings before they are lowered into position in the trench, and they shall be kept clean by approved means during and after laying. The water main materials shall be carefully lowered into laying position by the use of suitable restraining devices. Under no circumstances shall the pipe be dropped or dumped into the trench. At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connections, but they shall be no larger than would be adequate to support the pipe throughout its length. No pipe material shall be laid in water or when the trench or bedding conditions are otherwise unsuitable or improper. When placement or handling precautions prove inadequate, in the Engineer's opinion, the Contractor shall provide and install suitable plugs or caps effectively closing the open ends of each pipe section before it is lowered into laying position, and they shall remain so covered until removal is necessary for connection of an adjoining unit. As each length of bell and spigot pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material, which shall be thoroughly compacted by tamping around the pipe to a height of at least 12 inches above its top.

Mechanically compact trenches in accordance with DelDOT standards. At all times when pipe laying is not in progress, including noon hour and overnight periods, all open ends of the pipe line shall be closed by watertight plugs or other means approved by the Engineer. If water is present in the trench, the seals shall remain in place until the trench is pumped completely dry. When connecting to existing stubs, the Contractor shall take every precaution necessary to prevent dirt or debris from entering the existing lines. All necessary work to make the connection shall be done at no additional compensation, except where noted otherwise.

5. POLYETHYLENE ENCASEMENT OF PIPELINE - For DIP water main, the pipeline, including valves, fittings, hydrant barrels, and appurtenances, shall be fully encased in polyethylene film meeting the requirements of these Specifications. The film shall be furnished in tube form for installation on pipe and all pipe-shaped appurtenances such as bends, reducers, off-sets, etc. Sheet film shall be provided and used for encasing all odd-shaped appurtenances such as valves, tees, crosses, etc. The polyethylene tubing shall be installed on the pipe prior to being lowered into the trench. Tubing length shall be sufficient to provide a minimum overlap at all joints of one foot or more. Overlap may be accomplished with a separate sleeve tube placed over one end of the pipe prior to connecting

another section of pipe, or by bunching extra overlap material at the pipe ends in accordion fashion. After completing the pipe jointing and positioning the overlap material, the overlap shall be secured in place with plastic adhesive tape wrapped circumferentially around the pipe not less than three turns. After encasement, the circumferential slack in the tubing film shall be folded over at the top of the pipe to provide a snug fit along the barrel of the pipe. The fold shall be held in place with plastic adhesive tape applied at intervals of approximately three feet along the pipe length. Also, any rips, punctures, or other damage to the tubing shall be repaired as they are detected. These repairs shall be made with adhesive tape and overlapping patches cut from sheet or tubing material.

At odd-shaped appurtenances such as gate valves, the tubing shall overlap the joint and be secured with tape, after which the appurtenant piece shall be wrapped with a flat film sheet or split length of tubing by passing the sheet under the appurtenance and bringing it up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Wherever encasement is terminated, it shall extend for at least two feet beyond the joint area. Openings in the tubing for branches, service taps, air valves and similar appurtenances shall be made by cutting an X-shaped slit and temporarily folding back the film. After installing the appurtenance, the cut tabs shall be secured with tape and the encasement shall be completed as necessary for an odd-shaped appurtenance.

6. REACTION BACKING - Reaction backing shall be provided at all watermain fittings and at the hydrant in accordance with the typical backing detail shown on the standard details. In any instance where the Engineer determines that solid backing against undisturbed earth is not obtainable for fittings or hydrants, the Contractor shall use stainless steel tie rods, ASTM F 593 Type 316 or mechanical joint retainer glands as directed by the Engineer. Valves on branch lines or in hydrant leads shall in all cases be tied to an adjacent tee or cross fitting or back one full length of pipe.
7. EXCAVATION AND TRENCHING Excavation shall be performed in accordance with Section 207 of the DelDOT Standard Specifications and Excavation and Backfill for Pipe Trenches herein. The bottom of the trench shall be cut true and even, so that the barrel of the pipe will have a bearing for the full length. The trenches for water mains shall be excavated to such depth as will provide pipe elevations as indicated on the Water Main Relocation Profiles. The trenches for water service connections shall be excavated to the minimum standard depth or to such depth as required to connect to existing mains or service pipes. For pipe under 24-inch, internal diameter, the excavation (excluding rock), backfill and backfilling shall be included in the price for installation of the water main(s). Furnishing and borrowing shall be performed in accordance with section 210 of the Standard Specifications.

The Engineer and the Owner shall have the right to limit the amount of trench opened in advance of pipe laid, and the amount of pipe laid in advance of backfilling. They shall be empowered at any time to require the refilling of open trenches over completed pipelines, if in their judgment, such action is necessary and the Contractor shall therefore have no claims for extra compensation, even though to accomplish such refilling, he/she is compelled to temporarily stop excavation or other work at any place.

If work is stopped on any trench or excavation for any reason and the excavation is left open for an unreasonable length of time (in the opinion of the Engineer) in advance of construction, the Contractor shall, if so directed, refill such trench or excavation at his/her own expense and shall not again open said trench until the Engineer determines that the Contractor is ready and able to progress the work.

Patches for all appurtenances adjusted after the paving operations will require a perimeter reservoir and will be sealed in accordance with Section 504.

Where rock is encountered and blasting is required for trenching, all rock excavation work shall be performed in accordance with Section 206.03.06 of the DelDOT Standard Specifications except as modified herein; and the trench shall be excavated an additional six inches below grade. After the excavation is completed, a bed six inches in depth of Borrow Type C shall be placed in the bottom of the trench, leveled off and thoroughly tamped. If blasting is required to remove the rock, perform blasting operations in accordance with Section 107.08 of the DelDOT Standard Specifications.

8. EMERGENCY REPAIRS TO DAMAGED UTILITIES

- a. Known or Field Located Utilities - In the event that the Contractor or his Subcontractor during the execution of the work breaks any known or field located pressure or gravity main causing the disruption of service and/or an eminent hazard, it shall be the responsibility of the Contractor/Subcontractor to immediately notify the Utility Owner at the designated emergency telephone number and immediately undertake measure to repair the damaged utility. To that effect the Contractor/Subcontractor shall ascertain prior to initiating the work that the necessary repair parts, tools, equipment, and labor are on ready and available onsite to complete the repair work without delays. The Utility Owner personnel and Engineer shall witness the repair work.
- b. If the Contractor/Subcontractor estimates or determines that he is not going to be able to restore service within a less than two-hour period, the Contractor shall immediately contact the Utility Owner's manager to initiate repair.
- c. The Utility Owner will undertake the repair work and will back charge the Contractor. The Utility Owner will submit an itemized bill within 30 calendar days from the occurrence of the event.
- d. Unknown or Inaccurately Located Utilities - If the utility was not field located or it was inaccurately located in accordance with the prescribed procedures under the Sunshine State One-Call guidelines and the Contractor/Subcontractor cause a line break during the execution of the work, the same notification procedure as above must be followed. The Utility PCU Operations will undertake the repair work at no cost to the Contractor.

9. CONNECTIONS TO EXISTING MAINS: Only District personnel shall make connection to the existing water mains when and as directed by the District Inspector at the contractor's expense. In no case shall the Contractor shut off the water or operate the fire hydrants or gate valves of the existing distribution system without the expressed permission of the District Inspector. In case it becomes necessary to delay the cut-off, such instructions shall be given and obeyed without recourse. In making connections to the old distribution system, valves shall be set as shown on the plan, or at such designated place as the Engineer may direct. If due to unforeseen conditions, these locations have to be changed or additional valves or fittings added, the Contractor shall install the valves or fittings at the new locations.

10. CONCRETE BLOCKING: All turns, fittings, fire hydrant connections, etc., that induce pressure which would cause separation of pipe, breakage, etc., shall be blocked with 3,000 lb. concrete. Blocking shall be formed and placed in such a manner that the pressure to be exerted at the

point of blocking shall be transferred to firm, undisturbed earth at a maximum load of 2,000 lbs. per square foot. The Contractor shall insure that blocking at all tees, bends, plugs, etc., shall be sufficient to contain all pressure exerted by the pipe up to a pressure of 200 lbs. per square inch hydraulic pressure within the pipe, i.e. pressure at plug = 200 x (area of pipe in inches). The Contractor shall also be responsible for any damage or repairs caused by blowouts of any insufficiently blocked pipe. The contractor shall wrap all fittings, fire hydrant connections, etc. with District approved plastic wrap before any and all concrete pouring is started.

11. WATERMAIN TESTING - In order to assure quality materials and workmanship, the following tests shall be required unless waived by the Engineer. The Engineer or designee shall be present for all tests and shall be notified at least 48 hours in advance of the specific test. Testing shall be completed after all the utility pipes have been installed in the area to be tested and prior to commencement of the street construction. All tests shall be in accordance with CEAM standards or what is stated within this specification. Individuals qualified to perform and evaluate such tests shall do all testing. The Contractor shall pay for all tests required in these guidelines. Copies of the results shall be submitted to the Utility Owner. If inspection or test shows defects, including visible leaks, such defective work or material shall be replaced at the expense of the Contractor, and inspection and tests shall be repeated. All repairs shall be made with new material; failure to meet the tests specified above will be sufficient cause to reject the work until the defects are satisfactorily repaired. All expenses and costs incurred in carrying out the specified tests shall be borne by the Contractor at no extra cost to the Utility Owner or to the State and shall be included in the Contract unit price per linear foot bid for the various sizes of installing water main.

- a. PRESSURE TESTING OF WATERMAIN - Hydrostatic pressure testing shall conform with AWWA C-605, latest revision as well as to the specifications of the Owner. Pressure testing shall be performed on all pipe, valves, hydrants, and fittings. The test shall be conducted on line segments from shut valve to shut valve in segments not exceeding 1,500 linear feet. The Contractor shall provide a suitable pump for applying pressure and an accurate gauge for measuring the pressure. The pipe shall be tested by applying one hundred fifty (150) pounds per square inch hydrostatic pressure for a period of two (2) hours with the Utility Owner's inspector present and to the full satisfaction of the Engineer. The maximum allowable leakage is in accordance with AWWA C605. Install any taps required at high points on the line to expel trapped air prior to testing. Following the tests, tightly plug all taps with suitable threaded brass plugs. Repair all visible leaks regardless of total leakage shown by test.
- b. CONDUCTIVITY TESTING OF WATERMAIN - Conductivity testing of DIP watermain, copper straps or copper tipped gaskets shall be required to run at 350 amps for 5 minutes. PVC/HDPE watermain tracer lines shall be tested using standard underground utility locator, demonstrating that the lines can be located with standard equipment.
- c. STERILIZATION OF WATERMAIN - The method to be used for sterilization shall comply with AWWA C 601-81, C 651, and Owner requirements, with the plugs used in the pressure test still installed in the pipe prior to placement into service. Extreme care is to be exercised in order to prevent the entrance of any contaminants into the main. All expenses and cost incurred in carrying out the specified sterilization work shall be borne by the Contractor at no extra cost to the Utility Owner or the State and shall be included in the contract unit price per linear foot bid for the Water Main Installation.

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- d. BACTERIA TESTING OF WATERMAIN - Provide an adequate blowoff for use in flushing of the main. Before the water is turned on for use by the consumer from the relocated mains, the Owner will conduct bacteriological tests on water samples taken from the blowoff. All expenses incurred in the performance of these tests by the Owner are borne by the Contractor. Upon final sanitary approval by the Owner, return water service for use by the consumer. Before the final connection is made, thoroughly clean all surfaces of the relocated line, including all gaskets and glands, and the existing water main that are to become part of the closing joint with a 5 percent solution of Sodium Hypochlorite. Exercise extreme care in order to prevent the entrance of any contaminants into the main. All expenses and cost incurred in carrying out the specified sterilization work is borne by the Contractor at no extra cost to the Owner or the State and is included in the Contract Unit Price per linear foot bid for the Item for the various sizes. Plug adjacent pipe openings as required in accordance with the Section 202.03.2.
12. AS-BUILT / FINAL LOCATION DRAWINGS Within thirty (30) days after completion of required work, the Contractor shall submit an accurate print or prints showing the horizontal and vertical location of mains, bends and other appurtenances to the Engineer and the Utility Owner. Services, fittings, fire hydrants and all other reconstructions to the replaced pipes shall be identified and marked in the construction drawings by the Contractor. The Contractor shall be responsible for marking the construction drawings in reference to at least two fixed and easily found points.

Method of Measurement and Basis of Payment:

Price and payment for water service Items includes furnishing, transporting and installing the Materials; adjusting, relocating or repairing the services, testing of the water main system; for repairing leaks and defects, including defects to settlement, connecting to existing water main systems and services; maintaining service as required; excavating; disposing of excess excavated Material; backfilling; furnishing Material for backfilling; furnishing and installing concrete thrust blocks, joint restraints, pipe bedding, sheeting and shoring, temporary support of existing Utilities, dewatering; abandoning existing pipes, cutting and capping new or existing lines and for all labor, Equipment, tools and necessary incidentals to achieve and accept an operational water main system.

No separate payment shall be made for salvaging or abandoning or removing and disposing of existing water mains and cost for such required work shall be incidental to the respective sizes for installing water main.

A breakout sheet attached to the Proposal lists the different elements of work or materials involved in completing this item. The Contractor shall fill in a unit price for each item and the cost (unit price times the proposed quantity). The Lump Sum cost for Item 710500, shall be derived from the total sum of the cost of all items listed. The breakout sheet shall be attached to the Bid Proposal. Failure to submit the breakout sheet with the Bid Proposal will result in the bid being declared non-responsive and rejected.

The Department reserves the right to delete from the Contract one or more items listed and the right to add or subtract from the quantity of each item. The total price to be paid will be adjusted in accordance with the Contractor's unit prices as required above. There will be no extra compensation or increase in unit prices in the breakout sheet if such additions and/or deletions are made to the quantities.

1/29/2020

BREAKOUT SHEET - 1		CONTRACT NO. T201880102			
Item Number 710500 – Water Services					
ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
1	161	LF	Ductile Iron Pipe Class 52, Cement Lined, 12"	\$	\$
2	413	LF	Ductile Iron Pipe Class 52, Cement Lined, 6"	\$	\$
3	366	LF	HDPE IPS DR-11, 4"	\$	\$
4	1	EA	Relocate Fire Hydrant	\$	\$
5	1	EA	12"x6" Tee	\$	\$
6	1	EA	12" Gate Valve with C.I. Box and Cover	\$	\$
7	1	EA	6" Gate Valve with C.I. Box and Cover	\$	\$
8	1	EA	4" Meter Vault, Including Internal Piping, Meter, Valves, Assemblies, Etc to be purchased from Artesian Water.	\$	\$
9	1	EA	12" M.J. Sleeve	\$	\$
10	1	EA	6" M.J. Sleeve	\$	\$
11	9	EA	12" Bend, 45 Degrees	\$	\$
12	1	EA	12" Bend, 11.25 Degrees	\$	\$
13	4	EA	6" Bend, 90 Degrees	\$	\$
14	3	EA	6" Bend, 45 Degrees	\$	\$
15	2	EA	6" Bend, 11.25 Degrees	\$	\$
16	4	EA	4" Bend, 90 Degrees, HDPE IPS DR-11	\$	\$
17	2	EA	4" Bend, 11.25 Degrees, HDPE IPS DR-11	\$	\$

BREAKOUT SHEET - 1		CONTRACT NO. T201880102			
Item Number 710500 – Water Services					
ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
18	1	EA	4"x2.5" Reducer	\$	\$
19	2	EA	2" Cap	\$	\$
20	1	EA	12"x4" Tee	\$	\$
21	1	EA	4" DIP Bend, 90 Degrees	\$	\$
22	19	LF	Ductile Iron Pipe Class 52, Cement Lined, 6" to be purchased from Artesian Water	\$	\$
<p>TOTAL ITEM NUMBER 710500 – Water Services \$ _____ (LUMP SUM BID PRICE FOR ITEM 710500– Water Services)</p>					

Bear Administration Building

This specification is for the work associated with the Canal District Administration Building.

<u>SECTION</u>	<u>SECTION TITLE</u>
<u>DIVISION 01</u>	<u>GENERAL REQUIREMENTS</u>
011000	Summary
012600	Contract Modification Procedures
012900	Payment Procedures
013100	Project Management and Coordination
013300	Submittal Procedures
014000	Quality Requirements
016000	Product Requirements
017300	Execution
017320	Cutting and Patching
017419	Construction Waste Management
017700	Closeout Procedures
017823	Operation and Maintenance Data
017839	Project Record Documents
018155	Air Barrier System Testing
018200	Demonstration and Training
019113	Commissioning General Requirements
019115	Exterior Enclosure Commissioning
<u>DIVISION 03</u>	<u>CONCRETE</u>
033000	Cast-In-Place Concrete
<u>DIVISION 04</u>	<u>MASONRY</u>
042200	Unit Masonry
<u>DIVISION 05</u>	<u>METALS</u>
051200	Structural Steel Framing
053100	Steel Decking
054000	Cold-Formed Metal Framing
055000	Metal Fabrications
055113	Metal Pan Stairs
<u>DIVISION 06</u>	<u>WOOD, PLASTICS, AND COMPOSITES</u>
061053	Miscellaneous Rough Carpentry
061600	Sheathing
064116	Plastic-Laminate-Clad Architectural Cabinets

SECTION 019113

COMMISSIONING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections apply to this Section.
- B. Section 230800 – Commissioning of Mechanical Systems
- C. Section 250800 – Commissioning of Integrated Automation Systems
- D. Section 260800 – Commissioning of Electrical Systems
- E. Commissioning Plan

1.2 DESCRIPTION OF WORK

- A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of commissioning is to provide the Owner and Operators of the facility with a high level of assurance that each commissioned system has been installed in the prescribed manner and operates within the performance guidelines set forth in the design. The Commissioning Agent shall provide the Owner with an unbiased, objective view of the system's installation, operation, and performance. This commissioning process shall not take away or reduce the responsibility of the System Design Professional(s) or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Agent will be a member of the construction team, cooperating and coordinating all commissioning activities with the Owner, Design Professionals, Construction Manager or General Contractor, Subcontractors, Manufacturers and Equipment Suppliers.

1.3 DEFINITIONS

- A. Commissioning Agent: The Commissioning Agent is a third-party consulting company interested in providing quality control to the project and quality assurance to the Owner. The Commissioning Agent provides a non-biased perspective of issues. The goal of the Commissioning Agent is to discover equipment and system issues early and resolve them quickly for an overall smooth construction process and to keep costs down for both the Owner and Contractor(s).

- B. Commissioning Team: The Commissioning Team is a group of individuals selected by each company to represent that company for direct involvement in the commissioning activities during the construction phase of the project. A minimum of one individual must be included to represent every company. Companies include but are not limited to; Commissioning Agent, Owner, Architect, System Design Engineer, Construction Manager or General Contractor, and all Sub-Contracting Companies.
- C. System Design Professional(s): The System Design Professional(s) are the designers and design firm representatives for the mechanical, electrical, plumbing, telecommunications and other systems outside of the scope of the Architect. Typically, the System Design Professional(s) do not include structural and civil design representatives unless structural or civil systems are specifically included within, or are associated with the systems being commissioned.
- D. Contractor(s): The term Contractor(s) utilized herein refers to the primary contracting party responsible for the specific item being referenced. Contractor(s) may refer to one or more of the general contractors, construction managers, sub-contractors and/or vendors whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems to be Included in Commissioning.
- E. Subcontractors: The term Subcontractors utilized herein refers to the any and all subcontracting companies or vendors whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems to be Included in Commissioning. Subcontracting parties outside of the scope of the systems being commissioned are not included.

1.4 ROLES AND RESPONSIBILITIES

- A. Owner
 - 1. The commissioning roles and responsibilities of the Owner are outlined within the Commissioning Plan. The Owner is not contractually obligated to complete any tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are highly recommended for the successful completion of Commissioning.
 - 2. The Owner's Project Requirements have been outlined, documented, and provided to the Commissioning Agent. This document establishes the goals towards which each of the commissioning tools implemented will drive the final product.
 - 3. The Owner shall review many Commissioning Forms prior to their completion. The Owner will verify that the forms are constructed and being utilized in the most effective way for their own benefit. Commissioning documentation should only provide information which will be useful to the Owner and their Operations and Maintenance throughout the construction process and in the future.
- B. Commissioning Agent

1. Schedule the Construction Phase Commissioning Kick-Off meeting within 90 days of the award of the contract, at some convenient location and at a time suitable to the Contractor and System Design Professional(s). This meeting shall be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for system orientation and inspections, O&M submittals, training sessions, system flushing and testing, job completion, test, adjust and balance (TAB) work, and verification and functional performance testing.
2. Prepare the Commissioning Plan after the Commissioning Kick-Off meeting. Include list of all contractors for commissioning events by name, firm and trade specialty.
3. Coordinate the integration of Commissioning Activities into the Construction Schedule.
4. Review all documentation regarding changes to the Contract Documents or Clarifications. These include Meeting Minutes, Addendums, RFI's, Change Orders, ASI's, etc. for their effect on Commissioning. The Commissioning Agent shall receive a copy of all submittals pertaining to the systems being commissioned from the Contractor(s). The Commissioning Agent shall review all submittals for approval. Commissioning submittal review shall be coordinated with the System Design Professional(s) review to avoid redundancy. Submittal approval by the Commissioning Agent shall not supersede any submittal comments or rejection by the System Design Professional(s) and vice versa.
5. Review submittals associated with systems to be commissioned (e.g. equipment, ductwork, piping, automatic controls, and TAB procedures, etc.) for their affect on the commissioning process and the final performance of the Mechanical system.
6. The Commissioning Agent shall receive a copy of all controls submittals from the Contractor(s). The Commissioning Agent shall perform an explicit review of these submittals to verify their compliance with the design sequence of events and Owner's Project Requirements.
7. Provide Pre-Functional Checklists for the purposes of verifying proper installation. Checklists shall be based upon submitted documentation and updates to the Construction Documents.
8. The Commissioning Agent shall conduct Commissioning Meetings throughout the construction phase. Meetings shall be held more frequently as Commissioning Activities increase. Meetings are typically held monthly until systems are prepared for verification testing. The Commissioning Agent shall prepare minutes for every Commissioning Meeting and distribute copies to all attendees and other interested parties.
9. Attend select Coordination Meetings, aside from Commissioning Meetings, held between the Owner, System Design Professional(s) and Contractor(s).
10. The Commissioning Agent shall conduct periodic inspections of work in progress and shall generate and distribute a report for each inspection. The Commissioning Agent shall also perform select site visits for the explicit purpose of witnessing duct and piping pressure test procedures. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing piping system cleaning and flushing procedures. All issues and discrepancies found

during these inspections shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.

11. Submit detailed installation checklists entitled Pre-Functional Checklists. These checklists shall be developed by the Commissioning Agent specific to the project and shall be required to be completed by the installing contractors. The Commissioning Agent is required only to spot-check these checklists upon completion of the installations.
12. Submit detailed Functional Performance Test procedures for review and acceptance by the Commissioning Team. These tests are specifically custom designed by the Commissioning Agent for verifying each system operates per the design intent and meets both the Basis of Design (BOD) and the Owner's Project Requirements (OPR.)
13. Upon receipt of notification from the System Design Professional(s) that the mechanical systems have been completed and are operational, the Commissioning Agent shall proceed to verify on a random basis the TAB report and operation of the control systems in accordance with the Commissioning Specification. The Commissioning Agent shall recommend acceptance of the Final Test, Adjustment and Balance Report.
14. Oversee Functional Performance Testing which shall be performed by the installing contractors. All issues and discrepancies found during Functional Performance Testing shall be listed on the Commissioning Issues Log, maintained by the Commissioning Agent.
15. The Commissioning Agent shall not perform any site visits for the purpose of witnessing Functional Performance Testing until the installing contractor has verified that the system is ready for Functional Performance Testing and made proper notice to the Commissioning Agent with appropriate lead time.
16. Witness repeated conducting of Functional Performance Tests if deficiencies are found during the original testing. The Commissioning Agent will invoice the Owner or Contractor for additional time required for any retesting. If invoiced, the Owner at his discretion may deduct this cost from the Contractor's Application for Payment. It is the Contractors' responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.
17. Prepare the Final Commissioning Report. Submit completed Functional Performance Tests as part of Final Report to the owner. Recommend acceptance of the Final Product, by the Owner, based upon the results of Commissioning.
18. Repeat Functional Performance Tests to accommodate seasonal tests.

C. Construction Manager / General Contractor

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Include commissioning requirements in the plumbing subcontracts, mechanical subcontracts, electrical subcontracts, and all other subcontracts relating to the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems to be Included in Commissioning. Ensure full cooperation of all contracting, manufacturing and testing parties required to participate in commissioning.

3. Include cost for commissioning requirements in the contract price. Include specific line items within the Schedule of Values according to Specification 019113 Section 2.2 – Schedule of Values.
4. Provide copies of the Project Schedule to the Commissioning Agent as outlined within Specification 019113 Section 2.1 – Project Schedule. Update the overall project schedule to reflect all Commissioning Activities. Ensure cooperation by subcontractors in coordinating the inclusion of subcontractor activities related to commissioning into the overall Project schedule.
5. Provide all submittals to the Commissioning Agent as outlined within Specification 019113 Section 2.3 – Submittals.
6. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents.
7. Provide a representative to regularly attend every Commissioning Meeting. Ensure all Subcontractors also provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.
8. Coordinate all scheduled commissioning activities with the Commissioning Agent. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include but are not limited to: System Start-up, Equipment Start-up, Duct Pressure Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.
9. Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics and Functional Performance Test results.
10. Much of the commissioning documentation will be available online to the contractor using a program called Facility Grid. There isn't any cost to the contractor to acquire or use this software, but the contractor is responsible for providing a machine (PC, Mac, Tablet, Notebook, etc.) which contains an updated web-browser software (Microsoft Edge, Safari, Chrome, etc.) to access the documents. A log-in and password will be made available to the proper team members who have a responsibility to complete various commissioning documentation.
11. The Construction Manager/General Contractor must verify all PFC's and FPT's are complete. Sign all completed PFC's and FPT's prior to inviting the Commissioning Agent to witness and sign-off on these documents.
12. Evaluate performance deficiencies identified in the completed FPT's for non-conformance with contract documents. Remedy all contractual deficiencies identified in through Functional Performance Testing and other verification tests.
13. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by a Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

D. Subcontractors

1. Subcontractor responsibilities are outlined within respective Commissioning Specification Sections.
 - a. Mechanical Subcontractor responsibilities are outlined in Section 230800 – Commissioning of Mechanical Systems.
 - b. Controls Subcontractor responsibilities are outlined in Section 250800 – Commissioning of Integrated Automation Systems
 - c. Electrical Subcontractor responsibilities are outlined in Section 260800 – Commissioning of Electrical Systems.
 - d. All Subcontractors are additionally responsible for all requirements outlined within this Specification Section 019113 – Commissioning General Requirements.
2. Provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.
3. All Subcontractors must follow the same procedure for the completion of Pre-Functional Checklists as organized by the Construction Manager/General Contractor.
4. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by any Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

1.5 SYSTEMS TO BE INCLUDED IN COMMISSIONING

- A. For the systems listed, all requirements specified within the Commissioning Specifications Sections 019113, 230800, 250800, and 260800 shall apply including but not limited to:
1. All system related documentation shall be tracked within forms provided by the Commissioning Agent.
 2. All required equipment and component submittals shall be copied to the Commissioning Agent per Specification 019113 Section 2.3 – Submittals.
 3. All system related documentation shall be copied by the Contractor and provided to the Commissioning Agent for inclusion into the Commissioning Record Documents.
 4. All systems shall be inspected by the Commissioning Agent while under construction and all issues discovered by the Commissioning Agent shall be corrected or otherwise addressed by the contractor.
 5. All systems shall have Pre-Functional Checklists and Functional Performance Tests provided by the Commissioning Agent and completed by the Contractor(s) as per Specification 019113 Sections 2.4 – Pre-Functional Checklists and 2.6 – Functional Performance Tests.

B. The following systems, equipment and components shall be commissioned:

System No.¹	System	Associated Equipment & Description	Functionally Test²
Plumbing Systems			
221100	Domestic Cold-Water Systems	BFP, RPZ, Piping, Pressure Regulators, Booster Pumps, Associated Controls	Yes
Refrigeration			
236400	Water Cooled Chilled Water Generation Systems	Chillers, Primary Chilled Water Pumps, Piping, VFD's, Associated Controls	Yes – 100%
236401	Chilled Water Distribution Systems	Secondary Circulation Pumps, Piping, VFD's, Associated Controls	Yes – 100%
236500	Condenser Water Systems	Cooling Towers, Condenser Water Pumps, Piping, Associated Controls, VFD's	Yes – 100%
Process Exhaust Systems			
233400	General Exhaust Systems	Exhaust Fans, Ductwork, VFD's, Associated Controls	Yes – 20%
233813	Laboratory Exhaust Systems	Exhaust Fans, Ductwork, VFD's, Associated Controls	Yes – 20%
Terminal Equipment			
233600	General Terminal Units	Terminal Units used to support Central Station AHU's, Packaged Air Conditioning Systems, and Process Exhaust Systems, Ductwork, & Associated Controls	Yes – 20%
238200	Terminal Heating Components	AC units used to support local climate conditions downstream of a Central or Packaged system (i.e. OR type systems), Humidifiers, Unit Heaters, Fan Coils, Associated Controls	Yes – 20%
Central Station AHU's			
237390	Central Air Handling Systems	Custom & Modular AHU's, Supply & Return Fans, VFD's Humidifiers, Ductwork, & Associated Controls	Yes – 100%
Packaged Air Conditioning Systems			
238100	Split A/C Systems	Split A/C Systems, Ductwork, Piping, & Controls	Yes – 100%
Process Systems			
235205	Heating Hot Water Generation	Boilers, Heat Exchangers, Circulation Pumps, VFD's, Piping, Associated Controls	Yes – 100%

System No.¹	System	Associated Equipment & Description	Functionally Test²
336100	Heating Hot Water Distribution	Secondary Circulation Pumps, VFD's, Piping, Associated Controls	Yes – 100%
Instrumentation & Controls			
230900	Energy Management & Control System (EMCS)	Overall Control System Test to verify the interconnected systems are integrated together properly and proper graphics are displayed, Verify Sequences, GUI, Etc.	Yes
Electrical Systems			
260526	Grounding System	Conductors, Relays, Bus Bars, Grids, Loops, Etc.	Yes
262701	Low Voltage Normal Power Systems	Transformers, Switchboards, Switchgear, MCC's, Circuit Breakers, Panel Boards, Conductors, Termination Devices, Load Break Elbows, Splice Kits, etc.	Yes
262703	Low Voltage Emergency Power Systems	Transformers, Switchboards, Switchgear, MCC's, Circuit Breakers, Panel Boards, Conductors, Termination Devices, Load Break Elbows, Splice Kits, Power Generators, Paralleling Switchgear, ATS, etc.	Yes
Lighting Controls			
260923	Scheduled Lighting Controls	Fixtures, Switches, Light Sensors	Yes
260936	Occupancy Sensor Controls	Control Panels, Sensors, Fixtures	Yes

Notes:

1. System numbers indicated in the table above are Functional Performance Test Numbers for Tracking Test Documents only. These values shall not be associated with specific specification sections.
2. Systems indicated with 20% sampling rate will be 20% or 5 units whichever is greater.

1.6 COORDINATION

- A. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- B. The Architect, System Design Professional(s) and Contractor(s) shall submit to the Commissioning Agent a copy of all construction documents, addenda, change orders, overall project schedule, and any approved submittals, shop drawings, value engineering proposals and training plan related to commissioned systems.

- C. The Commissioning Agent's primary responsibility is to the Owner, and as such, shall regularly apprise the Contractor and the Owner of progress, pending problems and/or disputes, and shall provide regular status updates on progress with each system.
- D. The Commissioning Agent shall coordinate the schedule of commissioning activities with the construction schedule with assistance from the Owner, Architect, System Design Professional(s) and Contractor(s).
- E. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include: System Start-up, Duct Pressure Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.

1.7 SCHEDULE

- A. Commissioning of systems shall proceed per the criteria established in the specific sections that follow, with activities to be performed on a timely basis. Site visits which are specifically scheduled for the purpose of demonstrating system functionality shall be coordinated by the Contractor(s) such that all required parties are present during the visit. The Contractor(s) shall be responsible for demonstrating system functionality during these scheduled periods.
- B. All Commissioning activities which require the presence of the Commissioning Agent shall be scheduled such that the Commissioning Agent is made aware of the required site visit with a minimum of two weeks (14 days) notice.
- C. Upon the discovery of deficient items during inspection or testing, the Contractor(s) shall be notified via distribution of an updated Commissioning Issues Log. Additional visits to the site for re-inspection or re-testing shall be scheduled as required, however the contractor may be responsible for the cost of additional testing or inspections. Prior to these additional visits, related deficiencies shall be rectified by the responsible party. The Contractor(s) shall be responsible for ensuring that all required corrective actions are performed in a timely manor in order to maintain the project schedule.
- D. Contractor schedules and scheduling is the responsibility of the Contractor(s). The Commissioning Agent shall provide commissioning scheduling information to the Construction Manager or General Contractor for incorporation into the main CPM schedule for review and planning activities.
- E. Prior to substantial completion, all Functional Performance Tests must be successfully completed and documented by the Commissioning Agent, such that each tested system has proven full and efficient functionality.

1.8 RELATED WORK SPECIFIED ELSEWHERE

- A. Commissioning requires support from the contractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner prior to commissioning any system.

- B. Refer to Sections 230800, 250800, and 260800 for contractor responsibilities relative to the commissioning process.

PART 2 - PRODUCTS

2.1 PROJECT SCHEDULE

- A. Contractor(s) shall submit two copies of a complete project schedule to the Commissioning Agent. The Contractor(s) must submit the schedule no later than two weeks after the Commissioning Kick-Off Meeting.
- B. Contractor(s) shall be required to incorporate all Commissioning Activities into the overall project schedule.

2.2 SCHEDULE OF VALUES

- A. The Contractor(s) shall include within the Schedule of Values, specific line items to reflect Commissioning progress. For each system to be commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, a line item shall be listed in the Schedule of Values for the following:
 - 1. Pre-Functional Checklist
 - a. System Start-Up
 - b. Functional Performance Test
 - c. Equipment/System Training
- B. The Contractor(s) shall submit two copies of the Schedule of Values to the Commissioning Agent for review. The Commissioning Agent shall review and comment online items relevant to commissioning and systems to be commissioned. Any comments by the Commissioning Agent will be forwarded to the System Design Professional(s) for review and inclusion.

2.3 SUBMITTALS

- A. Contractor(s) shall submit two copies of all equipment and component submittals to the Commissioning Agent for each of the Systems to Be Commissioned as outlined within this specification section. Any comments by the Commissioning Agent will be forwarded to the System Design Professional(s) for review and inclusion.
- B. Manufacturer's Product Data: The Contractor(s) shall provide to the Commissioning Agent all product data as required within each individual specification section.
- C. Coordination Drawings: The Contractor(s) shall provide to the Commissioning Agent all Coordination Drawings as required within each individual specification section.

- D. **Manufacturer's Installation Instructions:** The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of installation instructions for every piece of equipment and accessory included as part of a commissioned system.
- E. **Manufacturer's Controls Calibration Instructions:** The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of calibration instructions for each type of control device to be installed. Submit only control device calibration instructions for devices which have been approved by the System Design Professional(s).

2.4 PRE-FUNCTIONAL CHECKLISTS

- A. **Pre-Functional Checklists (PFC)** shall be issued by the Commissioning Agent to the Commissioning Team using the Facility Grid software. Each member of the Commissioning Team representing a project contractor shall receive access to the system so they may complete the associated PFC's issued by the Commissioning Agent. The PFC's shall consist of a series of installation checklist items, required to be completed by the installing contractors. Each PFC is customized for each type of equipment or system component.
- B. A series of checklist items must be completed for every single piece of equipment and system component included within the systems being commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning.
- C. It is the contractor's responsibility to estimate the extent and depth of the PFC requirements, based upon the level of involvement required to install each individual piece of equipment or system component. Each contractor shall be responsible for providing a cost associated with Pre-Functional Checklists based upon this extent and depth.
 - 1. The number of checklist items for each piece of equipment or system component shall range from approximately 30 checklist items up to approximately 100 checklist items with respect to the level of complexity required by the contractors. For example, a PFC with approximately 30 checklist items would represent a piece of equipment which requires only to be connected to an inlet and outlet pipe such as a strainer or other pipe accessory. A PFC of approximately 100 checklist items is more involved and requires in depth installation and adjustment by multiple contractors, such as a Variable Volume Terminal Reheat Box.
 - 2. All checklist items on a PFC are static installation requirements. Proper storage and installation methods may be included within the PFC checklists. Operational checklist items and test, adjustment and balance items shall NOT be included. PFC's may include checklist items requiring submittals to be completed which indicate operational characteristics have been verified. These submittals shall only be included within a PFC if they are a requirement of the contract documents.
 - 3. Equipment PFC's shall list for comparison the manufacturer's data of the equipment as per the design, approved submittal and the installed equipment. These items are initially blank on the forms provided to the contractors by the

Commissioning Agent. The Contractors are responsible for obtaining this information and filling in these blanks.

- a. Design: The manufacturer's data shall be filled in by the contractor according to the design criteria outlined within the design specifications or equipment schedules.
 - b. Submitted: The manufacturer's data shall be filled in by the contractor according to the product submittal, submitted by the contractor and approved of by the design representative
 - c. Installed: The manufacturer's data shall be filled in by the contractor according to the actual piece of equipment installed in the field nameplate data.
4. The contractor shall remain responsible for completing all manufacturer's data. PFC manufacturer's data are not considered checklist items and are not included in the range of installation checklist items defined in Specification 019113 Section 2.4 – Pre-Functional Checklists.
 5. PFC's shall not require an extension of the project schedule. PFC's require no additional installation work above and beyond the scope of the contract documents. PFC checklist items shall be checked-off as equipment is being installed according to the project schedule. PFC's shall be completed in conjunction with the completion of equipment installations.
- D. PFC's are multi-discipline and therefore must be partially completed by multiple contractors. The division of each PFC is the contractor's responsibility. Division of project work is determined by the CM and subcontractors and is not within the jurisdiction of the Commissioning Agent. Therefore, the division of work outlined within each PFC is generalized and has not taken into account the true scope of each individual sub-contracting company. Each contractor must review every PFC to determine their own obligation to the installation checklist items described therein.
- E. PFC's shall include full calibration documentation of all field calibrated devices as required by the specifications of equipment or controls.
- F. In the event, the Commissioning Agent has omitted a piece of equipment or system component from its applicable PFC form, which is included within the systems to be commissioned. The sub-contractor shall remain responsible for completing a column of checklist items within the appropriate PFC form for that particular piece of equipment or system component. The contractor may bring the omitted item to the attention of the Commissioning Team or Commissioning Agent, whom may in turn provide an additional form for the omitted item. The contractor shall otherwise copy an existing blank PFC form and alter the equipment or system component designation at the top of one column of checklist items to represent the omitted item. The contractor shall then complete the column of checklist items and include the form within the master PFC.
- G. Each PFC checklist item shall be checked by the responsible contractor. Upon completion of any contractor's portion of checklist items, the responsible manager or field superintendent for that company shall sign their full signature in all required places indicated on the PFC.

- H. The CM shall be responsible to verify any general contracting items, for which the sub-contractors are not responsible. The CM shall be responsible for determining these checklist items within each PFC and completing them in kind.
- I. The CM shall be responsible to verify all sub-contractors complete each checklist item for which they are responsible. The CM may complete any outstanding checklist items which have not been completed by the sub-contractors, understanding that by checking and initialing any blank item, the CM accepts responsibility for the truthful state of that installation item.
- J. Checklist items within a PFC shall not require any additional work or installation above and beyond that which is called for in the project construction documents or manufacturer's installation requirements.
- K. Prior to proceeding with any particular system Functional Performance Test, all PFC's associated with equipment or system components which fall under the scope of that particular system, shall be 100% complete and approved by the Commissioning Agent.
- L. The Commissioning Agent shall require the following for the approval of each Pre-Functional Checklist: Each checklist item shall be checked or noted otherwise. Each checklist item shall bear a three-letter initial next to it if an initial space is provided. Each piece of manufacturer's data shall be complete and accurate. Each device calibration checklist shall be complete. Every space on each PFC which requires a signature shall bear the appropriate signature. All marks shall be black and legible according to the Owner or Commissioning Agent.

2.5 START-UP AND TEST REPORTS

- A. Contractor(s) shall submit and upload to Facility Grid copies of all start-up reports for systems to be commissioned, test reports and any additional reports relating to work performed by subcontractors and manufacturers as required by the project specifications. Reports shall be attached/uploaded to the appropriate Pre-Functional Checklists. Reports shall include but are not limited to: equipment start-up, weld tests, pressure tests, system flushing, system cleaning, chemical treatment, equipment repair, feeder tests, grounding tests, electrical equipment tests, gauge calibration, etc.

2.6 FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Tests (FPT's) shall be issued by the Commissioning Agent to the Commissioning Team through the commissioning software. Each system FPT shall consist of a multitude of operational procedures which shall encompass all operational procedures for which that system is required to be capable of performing per the contract documents. Each FPT is customized for each system according to the specifications, contract drawings and equipment submittals.
- B. A Functional Performance Test must be completed for each of the systems to be commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning.

- C. It is the contractor's responsibility to estimate the extent and depth of the FTP requirements, based upon the level of involvement required to perform each individual sequence of operations. Each contractor shall be responsible for providing a cost associated with Functional Performance Testing based upon this extent and depth.
1. Functional Performance Tests shall be composed of a very detailed series of step-by-step procedures required to be performed by the installing contractors in order to prove the sequence of operations has been properly met according to the construction documents.
 2. FPT's shall include functional test procedures for each operational piece of equipment within a system. Each piece of equipment shall be individually tested for correct operation and load capabilities according to the contract documents. These shall be tested by both the remote BAS control system as well as any localized controls. Local controls may range from a fully programmable control panel down to a simple disconnect switch. Equipment which has been adjusted by the TAB contractor shall be tested against the information provided by the TAB Contractor within the TAB Report. Certain parameters may be required for Functional Performance Testing which are not fully encompassed within the Test, Adjustment and Balance scope if these parameters are essential for verifying equipment operational characteristics or performance.
 3. Every sequence of operation shall be tested as identified within the contract documents. Various sequence requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Sequences tested shall verify equipment integration and overall system performance. Items identified during system testing include correct order of operations and system efficiencies. System sequence of operations testing shall test every sequence of operations for every case-scenario possible. Each sequence of operations shall be tested for each piece of redundant equipment. Each sequence of operations which has a reverse process shall be tested through the reverse process. Sequence of operations test shall encompass all controls devices as well as all major equipment.
 4. Each auxiliary system requirement shall be tested as identified within the contract documents. Various auxiliary requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Auxiliaries tested shall verify system alarms, notifications and operation of auxiliary equipment. Equipment failures shall be tested to verify system response. Sub-systems to large systems which have not been functionally tested elsewhere shall be tested, such as a refrigerant pump-out system to a chilled water system.
- D. The contractor must account for performing each Functional Performance Test two (2) times:
1. Upon receipt of each Functional Performance Test, the contractor shall be responsible for reviewing all steps and procedures within, to verify each test is congruent to the applicable system as installed. The contractor is responsible for updating the Commissioning Team and Commissioning Agent of any and all changes within the project which may have an effect on the sequence of

operations of any system as it is tested by Functional Performance Test. It is important that the Final Functional Performance Tests, performed in the field and witnessed by the Commissioning Agent are in-fact finalized drafts which encompass all changes made to the systems.

2. The contractor shall be responsible for performing all steps within a Functional Performance Test prior to issuing a formal request for the Commissioning Agent to witness functional testing. The contractor shall utilize the Functional Performance Tests as received from the Commissioning Agent to internally verify all sequences are fully operational. This is referred to by Pre-Verification Testing (PVT.) Upon successful completion of each Pre-Verification Test, the contractor may request the presence of the Commissioning Agent to witness the test. The Commissioning Agent shall then witness each Functional Performance Test in its entirety.
3. Redundant Equipment: A Functional Performance Test shall be provided to test every piece of redundant equipment. The contractor shall be responsible for testing every unit to verify correct operation. All redundant equipment shall not necessarily be retested and witnessed by the Commissioning Agent. The Commissioning Agent will select a certain percentage of redundant equipment to be tested. These units shall be chosen at random by the Commissioning Agent, during functional testing. A failure of a certain percentage (typically 10%) or greater of the redundant equipment tested shall indicate improper installation and performance and shall result in system failure. Terminal Reheat Boxes are an example of redundant equipment which are typically tested by random sampling.

2.7 TAB VERIFICATION

- A. The Test, Adjustment and Balance Report is to be spot-checked by the Commissioning Agent. The TAB Contractor shall be required to repeat measurements selected at random by the Commissioning Agent to confirm the accuracy of the submitted report. See Specification 230800 – Commissioning of Mechanical Systems for detailed TAB Contractor requirements. TAB Verifications shall be included within the scope of the Functional Performance Testing. Repeated measurements shall be taken using the original instruments utilized by the TAB Contractor.

2.8 TEST EQUIPMENT

- A. All industry standard test equipment required for performing the specified tests shall be indicated by the Commissioning Agent within the testing protocol documents and provided by the contractors. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.
- B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the control vendor (at no cost) to the Commissioning Agent.
- C. The instrumentation provided by the contractor shall meet the following standards:
 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.

2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument
3. Be maintained in good repair and operating condition throughout the duration of use on this project.
4. Be immediately replaced if dropped and/or damaged in any way during use on this project.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN AND SCHEDULE

- A. The Contractor(s) shall submit to the Commissioning Agent a copy of the overall project schedule. The Contractor(s) shall be responsible for submitting updated copies of this schedule to the Commissioning Agent.
- B. The Commissioning Agent will, in coordination with the Commissioning Team, develop a general commissioning schedule with the ideal time frame for implementation of the various commissioning tasks. The Commissioning Schedule will be reviewed with the Owner, the System Design Professional(s) and Construction Manager or General Contractor for integration into the overall project construction schedule. All commissioning tasks as well as critical milestone dates will be tracked on the master project schedule.
- C. The Construction Manager/General Contractor and Contractor(s) shall be responsible for providing periodic updates to the commissioning tasks within the master schedule, identifying areas where commissioning is falling behind schedule.
- D. After the pre-construction meeting, a Commissioning Kick-Off Meeting will be held and attended by all Contractor(s) involved in the commissioning process. A commissioning plan will be distributed at this meeting to the Construction Manager or General Contractor, System Design Professional(s), and prime contractors outlining the specific commissioning process for this project and the names and contact information, to be determined at this meeting, of all commissioning team members. A final plan will be issued soon after the meeting listing all team contact information.

3.2 CONSTRUCTION OBSERVATION

- A. The Architect and System Design Professional(s) shall make standard construction inspection site visits as required by their respective contracts with the Owner.
- B. Construction observation by the Commissioning Agent is required as part of the commissioning and coordination process. A specific number of scheduled site visits will be provided during construction and prior to Functional Performance Testing. Functional Performance Testing shall not be for the purposes of installation inspection and shall be scheduled separately.

3.3 TEST AND BALANCE

- A. See Specification 230800 Section 1.5 – Roles and Responsibilities for the requirements of the Test, Adjustment and Balance Contractor as related to Commissioning.

3.4 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. Pre-functional checklists and functional performance test will be provided by the Commissioning Agent after equipment submittal and start-up information is provided by the contractors to the Commissioning Agent. The contractors shall use only PFC and FPT forms provided by the Commissioning Agent. PFC and FPT forms are required to be completed by the Contractor(s) and approved by the Commissioning Agent.

3.5 PRE-FUNCTIONAL CHECKLISTS - OBSERVATION

- A. The pre-functional test forms shall be completed by the installing contractor, manufacturer's, and all others with related involvement with the commissioned equipment. The test forms shall be signed verifying completion by the Construction Manager or General Contractor and all related contractors and sub-contractors. The Commissioning Agent shall spot check forms to verify completion. If the spot check reveals discrepancies, the contractors will be required to redo the forms. The Commissioning Agent again spot check the forms and will invoice the Owner for additional time required for any retesting required due to failed PFC's, and the Owner at his discretion may deduct this cost from the Construction Manager or General Contractor's Application for Payment. It is the contractor's responsibility to properly install equipment and components and verify such prior to inviting the Commissioning Agent to spot check these installations.
- B. Checklists shall be completely comprehensive and to the extent necessary to enable the Commissioning Agent to assure the Owner and System Design Professional(s) that the systems are installed correctly.

3.6 FUNCTIONAL PERFORMANCE TESTING - OBSERVATION

- A. The functional performance testing shall be performed by the installing contractor. The Commissioning Agent shall direct and witness final testing. The Contractor(s) shall initiate the tests provided by the Commissioning Agent, debug the systems, and verify compliance prior to requesting the tests be witnessed by the Commissioning Agent. The Commissioning Agent shall require complete retesting upon witness of any system functional deficiency. The Commissioning Agent will invoice the Owner for additional time required for any retesting required due to failed FPT's, and the Owner at his discretion may deduct this cost from the CM's Application for Payment. It is the contractor's responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.
- B. Tests shall be completed comprehensively and to the extent necessary to enable the Commissioning Agent to assure the Owner and System Design Professional(s) that the systems do perform per the design intent.

3.7 EXCLUSIONS

- A. Responsibility for construction means and methods: The Commissioning Agent is not responsible for construction means, methods, job safety, or any construction management functions on the job site.
- B. Hands-on work by the Commissioning Agent: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Agent shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

3.8 PREREQUISITES TO SUBSTANTIAL COMPLETION

- A. All commissioning of mechanical and electrical systems must be complete prior to Substantial Completion. Exceptions to this are the planned control system training performed after occupancy and any required seasonal or approved deferred testing. Prerequisites include for all systems, but are not limited to:
 - 1. Completed and signed start-up and pre-functional checklist documentation
 - 2. Submission of final approved TAB report
 - 3. Completion of all functional testing
 - 4. Required training of Owner personnel completed and approved
 - 5. Submission of the approved O&M manuals
 - 6. All identified deficiencies have been corrected or are approved by the Owner for substantial completion.
- B. The Owner's Project Manager will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Substantial Completion.
- C. Commissioning activities are non-compensable and cannot be a cause for delay claims. Failure of the contractors to complete all work, including commissioning activities, in a timely manner resulting in overall project delays shall be the fault of the contractor.

END OF SECTION

SECTION 019115

EXTERIOR ENCLOSURE COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. The work under this section is subject to requirements of the Contract Documents, including the Owner's General Conditions and articles of the General Contractor's General Conditions.
- B. This section includes the commissioning requirements for the Building Enclosure systems.
 - 1. The commissioning requirements for the Building Enclosure systems given in this Section are entirely separate from, and in addition to, the General Commissioning Requirements for this project. The General Contractor (GC), Subcontractors, and Suppliers are required to participate in both commissioning processes as required along with any supplemental General Commissioning requirements.
 - 2. The Commissioning Authority and Building Enclosure Commissioning Agent will provide separate documentation for each commissioning process.
- C. This section includes the Building Enclosure Commissioning requirements and the Functional Performance Testing Requirements for the building enclosure systems.

1.3 GENERAL DESCRIPTION

- A. Building Enclosure Commissioning (BECx) is a systematic process of ensuring all building enclosure systems responsible for environmental separation perform interactively according to the Owner's Project Requirements (OPR) and the Architect's Basis of Design (BOD). The BECx process is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify and document proper installation and performance of building enclosure materials and systems.
 - 2. Provide Owner with functional building enclosure systems that meet the OPR.
- B. Commissioning does not take away from, or reduce the responsibility of, system designers or installing contractors to provide a finished and fully functioning product.

- C. This Section shall in no way diminish the responsibility of Division 03, 04, 07, 08, and 09 Contractors, Subcontractors, and Suppliers in performing all aspects of work and testing as outlined in the Contract Documents. Any requirements outlined in this Section are in addition to requirements outlined in Division 03, 04, 07, 08, and 09.

1.4 RELATED WORK AND DOCUMENTS

- A. Specific building enclosure commissioning requirements are provided in this Specification. The following Specification Sections are related to the commissioning work specified in this Section:
 - 1. General Commissioning Requirements: *Refer to Section 01 91 13*
 - 2. Concrete Requirements: *Refer to Division 03*
 - 3. Masonry Requirements: *Refer to Division 04*
 - 4. Thermal and Moisture Protection Requirements: *Refer to Division 07*
 - 5. Openings Requirements: *Refer to Division 08*
 - 6. Finish Requirements: *Refer to Division 09*
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section. Division 3, 4, 7, 8, and 9 Specification Sections also apply to this Section. Where conflicts arise regarding building enclosure testing, this Section shall supersede other Sections where contradictions occur.

1.5 ABBREVIATIONS

- A. The following are common abbreviations used in this Section:
 - 1. A/E – Architect and Design Engineers
 - 2. BECx – Building Enclosure Commissioning
 - 3. BECxA – Building Enclosure Commissioning Agent
 - 4. BOD – Basis of Design
 - 5. CxA – Commissioning Authority – *Refer to Section 01 91 13*
 - 6. GC – General Contractor
 - 7. CT – Commissioning Team
 - 8. Cx – Commissioning
 - 9. Cx Plan – Commissioning Plan
 - 10. FPT – Functional Performance Test
 - 11. OPR – Owner’s Project Requirements
 - 12. OR – Owner’s Representative
 - 13. O&M – Operations & Maintenance
 - 14. RFI – Request for Information
 - 15. BECxT – Building Enclosure Commissioning Testing Agency
 - 16. QA – Quality Assurance
 - 17. QC – Quality Control
 - 18. MFG – Manufacturer

1.6 DEFINITIONS

- A. Approval: Acceptance that a material or system has been properly installed and is functioning in tested modes according to the Contract Documents.
- B. Architect/Engineer (A/E): Prime consultant (architect) and sub-consultants who comprise the design team, generally the Architect of Record and any Design Sub-consultants.
- C. Basis of Design (BOD): Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions, and methods chosen to meet the OPR.
- D. Building Enclosure Commissioning Agent (BECxA): Contracted through the Owner. The BECxA directs and coordinates day-to-day building enclosure commissioning activities independently from CxA.
- E. Commissioning Authority (CxA): Contracted to Owner. CxA directs and coordinates day-to-day commissioning activities excluding BECx activities. CxA reports directly to Owner.
- F. Commissioning Plan (Cx Plan): Overall plan developed after bidding that provides structure, schedule, and coordination planning for commissioning process. The BECx plan will be provided separately from other Cx plans.
- G. Contract Documents: Documents binding on parties involved in construction of this project (e.g. drawings, specifications, change orders, amendments, contracts, etc.).
- H. Deficiency: Condition of a building enclosure material or system that is not in compliance with Contract Documents (i.e. does not perform properly or is not complying with design intent).
- I. Functional Performance Test (FPT): Test of installed (either mock-up or field) building enclosure materials and systems. Systems are tested under various simulated environmental conditions.
- J. Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the usage and operational expectations. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.
- K. Simulated Condition: Condition created for testing a component or system (e.g., applying pressure differential across the building enclosure concurrent with water spray to simulate a wind-driven rain).
- L. Specifications: Construction specifications of Contract Documents.
- M. Mock-up: The activities where systems or materials are initially constructed and tested. Mock-ups are to be free standing (separate from the building) and approved prior to commencing full-scale construction.

- N. First Installation Mock-up: The activities where systems or materials are initially constructed and tested on the building. First installation mock-ups must be approved prior to commencing full-scale construction.
- O. Sub-contractor: Contractors of GC, and their Sub-contractors, who provide and install building enclosure components and systems.

1.7 COORDINATION

- A. Commissioning Team: Members of the Commissioning Team (CT) will consist of:
 - 1. Commissioning Authority (CxA)
 - 2. Building Enclosure Commissioning Agent (BECxA)
 - 3. Building Enclosure Commissioning Testing Agency (BECxT)
 - 4. Owner's Representative(s) (OR)
 - 5. General Contractor (GC)
 - 6. Architect and Design Engineers (A/E)
 - 7. Building Enclosure Subcontractors
- B. Management: Owner will contract services of the BECxA and BECxT through the CxA. The BECxA will direct and coordinate commissioning activities and report to the OR. All members of the Commissioning Team shall cooperate to fulfill contracted responsibilities and objectives of the Contract Documents.
- C. Scheduling:
 - 1. BECxA will work with commissioning team to establish required commissioning activities to incorporate in preliminary commissioning schedule. The GC will integrate commissioning activities into master construction schedule. Necessary notifications are to be made in a timely manner in order to expedite commissioning.

1.8 SUBMITTALS

- A. A/E or General Contractor shall provide BECxA with documentation required for commissioning work. At minimum, documentation shall include: General Commissioning Requirements and performance data and any performance test procedures. BECxA shall review submittals concurrent with the A/E for conformance as it relates to commissioning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SYSTEMS TO BE COMMISSIONED

A. Building Enclosure

1. Below Grade Systems, Roofing Systems, Opaque Wall/Cladding Systems, Weather Resistive Barrier Systems, Fenestration Systems, and all other systems responsible for providing the following building enclosure functions:
 - a. Water Control
 - b. Air Control
 - c. Vapor Control
 - d. Thermal Control

3.2 RESPONSIBILITIES OF COMMISSIONING TEAM MEMBERS DURING CONSTRUCTION PHASE

A. Architect/Engineer (A/E)

1. Document design intent of systems.
2. Review and incorporate building enclosure commissioning specification which includes functional performance test requirements into the construction documents.
3. Provide construction documents electronically.
4. Review BECxA comments on construction documents and shop drawings.
5. Assist in dispute resolution regarding building enclosure items.
6. Review BECxA and BECxT reports.

B. Building Enclosure Commissioning Agent (BECxA)

1. Review and comment on the Design Intent and Basis of Design for the project and assist in creating the Owner's Project Requirements (OPR) document for the building enclosure after the initial kick-off meeting with the project team.
2. Review and comment on all Design Development and other pertinent documents, including the energy model, glazing report, and other reports related to the building enclosure.
3. Review and comment on cost estimates prepared by the Construction Manager when requested.
4. Contribute to the design of enclosure systems, details, and materials selection.
5. Develop and submit the Building Enclosure Commissioning Plan, coordinating the Plan with the CxA and the rest of the team.
6. Develop Enclosure Commissioning specification which includes requirements for Functional Performance Testing for building enclosure systems for incorporation into the project documents.

7. Develop and maintain an Enclosure Design Issues Log, documenting identified issues, responses, and resolution.
8. Attend regularly scheduled meetings/conference calls/web-based interfaces (when contracted to do so) at milestones appropriate for the complexity of the project and to maintain schedule milestones.
9. Provide technical reviews of the Construction Documents.
10. Conduct a BECx kick-off meeting with the Owner, Design Team, Construction Manager, and Subcontractors, including preparing meeting minutes.
11. Review construction sequencing and verify material assembly and compatibility through shop drawings and project submittals. BECxA review of the shop drawings and submittals pertinent to the building enclosure will be conducted prior to, or in conjunction with, the review by the Design Team. The Design Team will have the ability to incorporate the BECxA review comments for approval.
12. Review and comment on enclosure related RFIs, bulletins, and change order proposals.
13. Review proposed substitutions and value engineering.
14. Review and document construction of the mock-up against the design documents, shop drawings, recommended manufacturer's installation instructions, and the industry accepted standard of care. All mock-up testing will be witnessed and documented, and BECxA will provide assistance for diagnosing performance problems. At the completion of the mock-up, BECxA will assemble their notes, photos, sketches, manufacturer's details, project information and design changes into a mock-up manual that will be distributed to the project team. This manual is intended to define the standard of care demonstrated in the mock-up for use on the remainder of the project.
15. Review and comment on construction scheduling and sequencing.
16. Lead a pre-installation conference for building enclosure trades and issue meeting minutes to the project team. During the meeting, BECxA will review trade sequencing, ownership, constructability, and compatibility of work.
17. Verify and document field QA/QC tasks, perform site visits, and track the progress of resolving on-going deficiency list items. During the QA site visits, BECxA will review the exterior enclosure for conformance to the design documents, shop drawings, recommended manufacturer's installation instructions, and the industry accepted standard of care. The BECxA reporting system is to individually track each condition observed in the field with the intent on completing the project with no unaddressed items.
18. Update the BECx plan throughout the construction phase, as required. BECxA will also integrate RFIs and change orders into the BECx plan and coordinate BECx plan items with relevant parties.
19. Observe and witness functional performance testing and retesting by others. BECxA will attempt to schedule test observations during site inspection visits. The BECxA will prepare and distribute written and illustrated reports to the project team including concerns and recommendations.
20. Prepare a draft and final commissioning report of all work and final acceptance.
21. Review as-built drawings and O&M manuals.
22. Visit the site approximately 10 months post occupancy to review the performance and observe the condition of the exterior building elements. Upon completion of this site visit the BECxA will update the final commissioning report.

C. General Contractor (GC)

1. Attend all commissioning meetings.
2. Incorporate commissioning activities into the construction schedule.
3. Periodically update commissioning activities in the construction schedule.
4. Facilitate cooperation of Sub-contractors in commissioning work.
5. Submit copies of initial and final A/E approved submittals for commissioned systems to BECxA for review.
6. Review BECxA submittal comments
7. Verify building enclosure materials and assemblies are ready for functional performance testing.
8. Submit maintenance logs of all interim maintenance and/or repair tasks performed by Sub-contractors.
9. Ensure resolution of non-compliance and deficiencies in construction and/or test results. Obtain written documentation of completion from the appropriate Sub-contractors.
10. Provide letters of compatibility for adjacent building enclosure materials and assemblies.
11. Facilitate all repairs and retesting of failed condition(s) and pay for all associated costs.
12. Provide all warrantee information to BECxA.

D. Subcontractors/Vendors

1. Review BECx Plan.
2. Attend commissioning kick-off meeting and other commissioning team meetings.
3. Notify GC and BECxA of work completion.
4. Attend all required material and systems testing.
5. Execute all periodic maintenance and/or repairs as required on systems from initial mock-up to final acceptance by Owner to prevent material warranties from being voided.
6. Ensure installation work is complete, is in compliance with Contract Documents, and is ready for Functional Performance Testing. Notify GC that systems are ready for Functional Performance Testing.
7. Provide all warrantee information to GC.

E. Building Enclosure Commissioning Testing Agency (BECxT)

1. Attend commissioning kick-off meeting and other commissioning team meetings.
2. Provide on-site technician and equipment to complete Functional Performance Testing.
3. Prepare and submit reports at the conclusion of all testing.
4. Perform retesting and prepare corresponding reports.

3.3 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

A. Documentation

1. BECxA will summarize the results of FPT.
2. BECxT will perform and report results of FPT as required by the specified standard.
3. BECxA will provide status reports to GC, A/E, and Owner as needed.
4. BECxA shall provide a final summary report to Owner.

B. Non-Conformance

1. BECxT shall submit all test reports to the BECxA, GC, CxA, A/E and Owner as needed.
2. Corrections of minor deficiencies identified may be made during tests at discretion of BECxA. In such cases, deficiency and resolution will be documented.
3. Every effort will be made to expedite testing and minimize unnecessary delays, while not compromising integrity of tests. BECxA shall not overlook deficient work or loosen acceptance criteria to satisfy scheduling or cost issues unless directed to do so by the Owner.
4. Deficiencies are handled in the following manner:
 - a. When there is no dispute about a deficiency and Sub-contractor accepts responsibility for remedial action:
 - i. BECxA documents deficiency and Sub-contractors' response and intentions and they go on to another test or installation. BECxA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC. Sub-contractor corrects deficiency and certifies that material or assembly is ready to be retested. GC informs CT of retesting schedule.
 - ii. GC reschedules test with BECxA/ BECxT.
 - b. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - i. BECxA documents deficiency and Contractor's response. BECxA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC.
 - ii. GC facilitates resolution of deficiency. Other parties are brought into discussions as needed. Final interpretive authority is with A/E. Final acceptance authority is with the Owner.
 - iii. GC documents resolution process.
 - iv. Once interpretation and resolution have been decided, appropriate party corrects deficiency, GC reschedules test, and test is repeated until satisfactory performance is achieved.

C. Cost of Testing

1. Costs for the initial testing located within this specification shall be the responsibility of the contractor. The contractor is to provide access to the test specimens to the CT. Access may include, but is not limited to, hoists, scaffolding, swing stage, extended lifts, etc.

D. Cost of Retesting

1. Costs for all retesting will be the full responsibility of the GC and Sub-contractors. These costs include all access, equipment, labor, and materials required to complete the retesting.

3.4 FUNCTIONAL PERFORMANCE TESTING

A. Objectives and Scope:

1. The objective of Functional Performance Testing is to demonstrate each system is operating according to documented design intent and Contract Documents. Functional Performance Testing facilitates bringing systems from a state of substantial completion to fully operational. Additionally, during Functional Performance Testing, areas of deficient performance are identified and corrected, improving operation and functioning of systems.

B. Development of Test Procedures

1. The purpose of a specific test is to verify and document compliance of the installed enclosure systems with the OPR.

C. Coordination and Scheduling

1. GC will provide sufficient notice to BECxA regarding completion schedule for materials and systems. GC will schedule Functional Performance Tests with CT. BECxA shall witness and document functional testing of enclosure systems. BECxT shall execute tests under direction of BECxA.

D. Field Functional Performance Testing Requirements

1. All functional performance tests shall be conducted to project performance requirements as set forth herein and within the Construction Documents. Unless specifically noted below or within the individual specification sections, all costs to perform the complete field testing shall be borne by the Contractor.
2. Satisfactory results of these tests do not in any way relieve the Contractor from conforming with all requirements of the Contract Documents, shop drawings, and project specifications. Installation of the work on the remainder of the building is to be done exactly as in the area checked unless otherwise instructed in writing.
3. No pretesting of prepared area is permitted.
4. Field functional performance testing shall be performed in accordance with referenced methods as specified below.
 - a. ASTM E1186-03 (2009), *Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems*, Section 4.2.1 *Building Depressurization or Depressurization with Infrared Scanning Techniques*
 - b. ASTM E1186-03 (2009), *Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems*, Section 4.2.2 *Smoke Tracer in Conjunction with Building Pressurization or Depressurization*
 - c. ASTM E1186-03 (2009), *Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems*, Section 4.2.6 *Chamber Pressurization or Depressurization in Conjunction with Smoke Tracers*

- d. *ASTM E1186-03 (2009), Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, Section 4.2.7 Chamber Depressurization in Conjunction with Leak Detection Liquid*
- e. *ASTM E1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference*
- f. *AAMA 501.1-05, Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors using Dynamic Pressure*
- g. *AAMA 501.2-09, Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems*
- h. *ASTM E783-02 (2010), Standard Test Method for Field Measurement of Air Leakage Through Exterior Windows and Doors*
- i. *ASTM D4541-09e1, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers*
- j. *ASTM C1521-13, Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints*
- k. *ASTM C1153-10(2015), Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging*
- l. *ASTM D5957-98(2013), Standard Guide for Flood Testing Horizontal Waterproofing Installations*
- m. *ABAA, Standard Method for Building Enclosure Airtightness Compliance Testing*

5. Field Functional Performance Testing Procedure:

- a. Self-Adhered Air (Vapor) Barrier and Waterproofing Membrane Testing:
 - i. ASTM D4541: Pull-off adhesion testing
 - a. Testing Extent: Perform a minimum of 12 adhesion tests on separate facades, separate air/water barrier materials as applicable.
 - ii. ASTM E1186, 4.2.7: Chamber depressurization in conjunction with leak detection liquid
 - b. Testing Extent: Perform a minimum of 20 air leakage tests on the opaque wall. Conduct testing on separate wall assemblies as applicable.
 - iii. ASTM D5957: Flood testing of all horizontal surfaces above occupied space and/or as directed by owner based on the testing contract:
 - a. Minimum of two inches of water at all conditions.
 - b. All identified breaches shall be repaired.
- b. Sealant Testing:
 - i. ASTM C1521, Method A Tail Procedure
 - ii. Perform two tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - iii. Perform one test for every 1000 feet of joint length thereafter or one test per each floor per elevation.
 - iv. Testing may be conducted by the sealant MFG or as contracted by the owner.
- c. Fenestration and Air Barrier Assemblies Testing:

- i. ASTM E783/E1105; static pressure air and water testing; minimum of five (5) areas of the building, including each fenestration system. Testing shall be performed at 10%, 50%, and 90% completion for a total of 15 tests.
 - ii. ALTERNATE to the above: AAMA 501.1; dynamic pressure water testing at each location. (Note: This testing is limited to the first three floors due to equipment reach.) BECxP will determine where AAMA 501.1 can be performed in lieu of ASTM E1105.
 - iii. AAMA 501.2; nozzle spray testing; test 500 linear feet of building enclosure system interfaces. Testing shall be performed at 10%, 50%, and 90% completion for a total of 1500 linear feet.
- d. Roofing Testing:
- i. ASTM D5957; Flood testing of all roof surfaces above occupied space.
 - a. Minimum of two inches of water at all conditions as contracted by the owner.
 - b. All identified breaches shall be repaired.
 - ii. ASTM C1153, Non-destructive testing; Infrared Thermography
 - a. Do not perform infrared thermography until rain of sufficient intensity to cause leakage, but after all substantial completion of all roof level construction.
 - b. Perform infrared thermography at all roof areas.
 - iii. Test 10% of drains for proper flow and drainage
- e. ABAA, Standard Method for Building Enclosure Airtightness Compliance Testing:
- i. Testing shall be completed immediately after the building enclosure air barrier system is complete. All penetrations through the air barrier system must be sealed.
 - ii. The building enclosure will be tested excluding HVAC related openings (*reference Section 10.12, Table 1*).
 - iii. Testing will be conducted utilizing the Multipoint Regression Method (*reference Section 11*).
 - iv. A diagnostic evaluation will be performed whether or not the building meets performance requirements to identify building enclosure air leakage sites and thermal losses in accordance with following standards. Results shall be included the testing report.
 - a. Infrared Thermography ASTM E1186, 4.2.1 / ISO 6781.
 - b. There shall be a minimum inside to outside temperature differential of 10°F.
 - c. Interior scanning: Accessible interior surfaces shall be scanned when the building is depressurized to a minimum pressure differential 0.42 psf (20 Pa).
 - d. Exterior scanning: Accessible exterior surfaces shall be scanned when the building is pressurized to a minimum pressure differential 0.42 psf (20 Pa).
 - e. Smoke tracers ASTM E1186, 4.2.2: Smoke tracer is waved across the accessible interior and exterior surfaces when the building is pressurized or depressurized to a minimum pressure differential 0.42 psf (20 Pa).

3.5 FUNCTIONAL PERFORMANCE TEST REQUIREMENTS

A. The performance criteria below apply to the mock-up and field testing of exterior enclosure components. The Owner reserves the right to add in additional testing at the Owner’s expense.

B. Air and water performance criteria summary table according to each component:

Component	Building Performance Criteria		
	Air	Water	Adhesion Testing
Curtain Wall and Storefront Glazing	ASTM E1186 (4.2.6) – No major air leaks at an air pressure differential of 1.57 psf (75 Pa). A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s).	AAMA 501.1/ASTM E1105 – No uncontrolled water leakage when tested under a pressure difference of 6.24 psf (575 Pa). AAMA 501.2 – No uncontrolled water leakage. AAMA 511, Optional Sill Dam Test- No water leakage	ASTM C 1521 – Perimeter joint sealant must maintain adhesion and achieve 100% cohesive failure.
	ASTM E783 – Maximum air leakage of 0.09 cfm/sq. ft. at an air pressure differential of 1.57 psf (300 Pa).		
Self-Adhered Weather Barrier and Waterproofing Membrane Assemblies	ASTM E1186 (4.2.7) – Pass/fail criteria shall be no bubbles observed in the leak detection liquid at a pressure differential of 1.57 psf (75 Pa).	AAMA 501.1/ASTM E1105 – No uncontrolled water leakage when tested under a pressure difference of 12.00 psf (575 Pa).	ASTM D4541 – Measured air barrier adhesion strength shall be >16 psi
	ASTM E783 – Maximum air leakage of 0.04 cfm/sq. ft. at an air pressure differential of 1.57 psf (75 Pa).	ASTM D5957 – No water leakage when tested for a minimum of 48 hours.	
	ASTM E1186 (4.2.6) – No major air leaks at an air pressure differential of 1.57 psf (75 Pa). A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s).		
Roofing Systems	N/A	ASTM C1153 – Pass/fail criteria shall be no thermal anomalies indicative of water penetration detected through infrared (IR) thermography.	
		ASTM D5957 – No water leakage when tested for a minimum of 24 hours.	
Whole Building	ABAA, Standard Method for Building Enclosure Airtightness Compliance Testing (Multipoint Regression Method) – The mean value of the pressurization and depressurization air leakage flow calculated from the measured data at pressure differential of 1.57 psf (75 Pa) must not exceed 0.25 cfm/ft ² of the building enclosure surface area.		ASTM C1153– Pass/fail criteria shall be no anomalies indicative of water penetration.
	The following diagnostic evaluation standards shall be performed in conjunction with the air leakage testing outlined above:		
	ASTM E1186 (4.2.1) / ISO 6781 – Accessible interior and exterior surfaces are scanned at minimum pressure differential 0.42 psf (20 Pa) and minimum inside to outside temperature differential of 10°F.		
	ASTM E1186 (4.2.2) – Smoke tracer is waved across the accessible interior and exterior surfaces at minimum pressure differential 0.42 psf (20 Pa).		
	AAMA 501.1/ASTM E1105 – No systemic leaks and all isolated leaks resolved within 3 months post occupancy.		

3.6 COMMISSIONING DOCUMENTATION

A. Final Report Details

1. Final commissioning report will include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope, and general description of testing and verification methods. Report will contain evaluation regarding:
 - a. Conformance to specifications and design intent
 - b. Material/system installation
 - c. Functional performance
2. All outstanding non-compliance items will be specifically listed.
3. Recommendations for improvement to system and/or operations, future actions, etc. will also be listed.

END OF SECTION

2.3 FIBER-CEMENT PANEL TYPE 2

- A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Nichiha; Illumination, as indicated on Drawings or comparable product by one of the following:
 - a. James Hardie Building Products, Inc.
 - b. Nichiha Fiber Cement.
 - c. Approved Equal.
- B. Dimensions: AWP-3030: 17-7/8" x 119-5/16".
- C. Nominal Thickness: Not less than 5/8 inch
- D. Pattern: Smooth texture.
- ~~E. Factory Priming: Manufacturer's standard acrylic primer. Sealed on six sides.~~
- F. Factory Finishing: Manufacturer's standard finish. Sealed on six sides.

2.4 ACCESSORIES

- A. Siding Accessories, General: Provide starter tracks, panel clips, corner clips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 - 1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
- B. Flashing: Provide stainless-steel flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
- C. Fasteners:
 - 1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
 - 2. For fastening fiber cement, use stainless-steel fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

Set: 2 – Stair

Doors: 1stb1, 2sta1, 2stb

3 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Exit Device	12 43 8815 F x 715-8 ETMD	US32D	SA
1 Closer	422 CTB2	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
<i>(For door 1stb1 only)</i>			
1 Door Stop	481	US26D	RO
3 Silencer	608-RKW		RO

Set: 3 – Exterior Stair

Doors: 1stb2

1 Continuous Hinge	CFM83HD1		PE
1 Continuous Hinge	MCK-25HD x 83"	Clear	MK
1 Exit Device	12 43 8810 F	US32D	SA
1 Closer	351 P3	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Overhead Stop	59XS x 90 deg	US26D	SA
1 Threshold	171 A x DOW x MS & ES25		PE
1 Gasketing (Set)	316 AS x DOW x DOH		PE
1 Door Bottom Seal	345 AV x DOW		PE
1 Drip Strip	346 C x DOW + 4"		PE
1 Door Position Switch	DPS-M-BK		SU

Set: 4 – Exterior Terrace

Doors: 2sta2, 213

1 Continuous Hinge	CFM83HD1		PE
1 Continuous Hinge	MCK-25HD x 83"	Clear	MK
1 Power Transfer	EL-CEPT		SU
1 ElectroLynx Harness	QC-C1500P		MK
<i>(Install between power transfer and junction box)</i>			
1 Electrified Lockset (Fail Secure)	21 8271 LNMB x 24VDC	US26D	SA
1 ElectroLynx Harness	QC-CXXX x required length		MK
<i>(Install between power transfer and electrified lockset)</i>			
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Door Stop	481	US26D	RO
1 Overhead Stop	69XS x 90 deg	US26D	SA
<i>(For door 213 only)</i>			
1 Threshold	1715 A x DOW x MS & ES25		PE
1 Gasketing (Set)	S88 BL x DOW x DOH		PE

2	Pivot (Set)	147	626	RF
1	Intermediate Pivot	M19	626	RF
1	Electrified Intermediate Pivot <i>(For active leaf of pair only)</i>	E-M19 x QC-12	626	RF
1	ElectroLynx Harness <i>(Install between electric intermediate pivot and junction box)</i>	QC-C1500P		MK
1	Electric Latch Retraction Exit Device (Fail Secure)	16 21 43 56 AD8410 F x less pull x24VDC	US32D	SA
1	ElectroLynx Harness <i>(Install between electric intermediate pivot and electric latch retraction exit device)</i>	QC-CXXX x required length		MK
3	Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1	Exit Device	16 21 43 AD8410 F x DG1 x MK	US32D	SA
2	Pull	RM201 x Type 12HD mounting	US32D	RO
2	Closer	351 P10 x 581-2	EN	SA
2	Mounting Plate	351-D	EN	SA
2	Overhead Stop	69XS x 90 deg	US26D	SA
1	Threshold	170 A x DOW x MS & ES25		PE
2	Door Bottom Seal	321 CN x DOW		PE
1	Astragal (Set)	(2) 297 AS x DOH		PE
1	Card Reader	Furnished and installed by security contractor		OT
2	Door Position Switch	DPS-M-BK		SU
1	Power Supply	AQD4-1R		SU
1	Wiring Diagram	WD-SYSPK		RU

Gasketing furnished by frame manufacturer

Card reader to be used by authorized persons to gain entry from the pull side of the opening

Card reader to be used to retract the latch of the electric latch retraction exit device

Push bar of exit devices always free for immediate egress

Set: 6 – Elevator Machine Room

Doors: 101a

2	Hinge	<u>T4A3786 5"</u> FA2714-4-1/2" x 4-1/2"	US26D	MK
1	Electric Hinge <i>(Install at middle hinge)</i>	<u>T4A3786 5"</u> FA2714-4-1/2" x 4-1/2" QC-12	US26D	MK
1	ElectroLynx Harness <i>(Install between electric hinge and junction box)</i>	QC-C1500P		MK
1	Mortar Box	MG-16	US2C	MK
1	Electrified Lockset (Fail Secure)	21 86 8271 LNMB x 24VDC	US26D	SA
1	ElectroLynx Harness <i>(Install between electric hinge and electrified lockset)</i>	QC-CXXX x required length		MK
1	Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1	Closer	351 O	EN	SA
1	Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1	Wall Stop	406	US32D	RO
1	Threshold	151 A x DOW x MS & ES25		PE

1 Gasketing (Set)	S88 BL x DOW x DOH	PE
1 Door Bottom Seal	234 AV x DOW	PE
1 Card Reader	Furnished and installed by security contractor	OT
1 Door Position Switch	DPS-W-BK	SU
1 Power Supply	AQD4-1R	SU
1 Wiring Diagram	WD-SYSPK	RU

Card reader to be used by authorized persons to gain entry from the push side of the opening
 Card reader to be used to unlock the push side lever of the electrified lockset
 Pull side lever of the electrified lockset always free for immediate egress

Set: 7 – Janitor

Doors: 101b, 209

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lockset	21 8204 LNMB	US26D	SA
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 8 – Corridor Storage

Doors: 102a, 130

3 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lockset	21 8204 LNMB	US26D	SA
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
1 Gasketing (Set)	S88 BL x DOW x DOH		PE

Set: 9 – Office

Doors: 103, 104, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, ~~132~~, 133, 134, 135, 136, 137, 140, 141, 142, 143, 144, 145, 146, 147, 148, 205, 206, 214, 215, 217, 218, 219, 220

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Office Lockset	21 8255 LNMB	US26D	SA
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Wall Stop	406	US32D	RO
1 Coat Hook	RM802	US26D	RO

Set: 10 – Exterior Corridor

Doors: 105b

1 Pivot (Set)	147	626	RF
1 Electrified Intermediate Pivot	E-M19 x QC-12	626	RF
1 ElectroLynx Harness	QC-C1500P		MK
<i>(Install between electric intermediate pivot and junction box)</i>			
1 Electric Latch Retraction Exit Device (Fail Secure)	21 43 56 LD AD8504 F x less pull x 24VDC	US32D	SA
1 ElectroLynx Harness	QC-CXXX x required length		MK
<i>(Install between electric intermediate pivot and electric latch retraction exit device)</i>			
1 Rim Cylinder	100400XX x MK	US26D	MC
1 Pull	RM201 x Type 12HD mounting	US32D	RO
1 Closer	351 P10 x 581-2	EN	SA
1 Mounting Plate	351-D	EN	SA
1 Overhead Stop	69XS x 90 deg	US26D	SA
1 Threshold	170 A x DOW x MS & ES25		PE
1 Door Bottom Seal	345 AV x DOW		PE
1 Drip Strip	346 C x DOW + 4"		PE
1 Card Reader	Furnished and installed by security contractor		OT
1 Door Position Switch	DPS-M-BK		SU
1 Power Supply	AQD4-1R		SU
1 Wiring Diagram	WD-SYSPK		RU

Gasketing furnished by frame manufacturer

Card reader to be used by authorized persons to gain entry from the exterior side of the opening

Card reader to be used to retract the latch of the electric latch retraction exit device

Push bar of electric latch retraction exit device always free for immediate egress

Set: 11 – Training

Doors: 106a, 106b, 106c

3 Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US26D	MK
1 Exit Device	16 21 43 8813 F x 713-8 ETMD	US32D	SA
2 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 P10	EN	SA
1 Mounting Plate	351-D	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Door Stop & Holder	494R	US26D	RO
<i>(Install at top of door)</i>			
3 Silencer	608-RKW		RO

Set: 12 – Corridor Conference

Doors: 107

3 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lockset	21 8237 LNMB	US26D	SA
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Door Stop & Holder (Install at top of door)	494R	US26D	RO
3 Silencer	608-RKW		RO

Set: 13 – Group Toilet

Doors: 108, 109, 210, 211

3 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Push Plate	70C 4 x 16	US32D	RO
1 Pull Plate	110 x 70C 4 x 16	US32D	RO
1 Closer	422 CTB2	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 14 – Shower

Doors: 108a, 109a

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Set & Indicator	49 8265 LNMB	US26D	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 15 – Utility

Doors: 110

3 Hinge	TA2714 4-1/2" x 4-1/2"	USP	MK
1 Storeroom Lockset	21 8204 LNMB	US26D	SA
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Door Stop	481	US26D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 15.1 – Utility

Doors: 212

3 Hinge	TA2714 4-1/2" x 4-1/2" NRP	US26D	MK
1 Storeroom Lockset	21 8204 LNMB x DG1 x MK	US26D	SA
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer/Stop	351 CPS	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
3 Silencer	608-RKW		RO

Set: 16 – Personal/Corridor Toilet

Doors: 111, 132, 208

3 Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Set & Indicator	49 8265 LNMB	US26D	SA
1 Closer	422 CTB2	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1 Door Stop	481	US26D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 17 – Mechanical Room

Doors: 112

2 Hinge	TA2714 4-1/2" x 4-1/2"	USP	MK
1 Electric Hinge	TA2714 4-1/2" x 4-1/2" QC-12	USP	MK
	<i>(Install at middle hinge)</i>		
1 ElectroLynx Harness	QC-C1500P		MK
	<i>(Install between electric hinge and junction box)</i>		
1 Mortar Box	MG-16	US2C	MK
1 Electrified Lockset (Fail Secure)	21 8271 LNMB x 24VDC	US26D	SA
1 ElectroLynx Harness	QC-CXXX x required length		MK
	<i>(Install between electric hinge and electrified lockset)</i>		
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
1 Threshold	151 A x DOW x MS & ES25		PE
1 Gasketing (Set)	S88 BL x DOW x DOH		PE
1 Automatic Door Bottom	420 APKL x DOW		PE
1 Card Reader	Furnished and installed by security contractor		OT
1 Door Position Switch	DPS-M-BK		SU
1 Power Supply	AQD4-1R		SU
1 Wiring Diagram	WD-SYSPK		RU

Card reader to be used by authorized persons to gain entry from the push side of the opening
Card reader to be used to unlock the push side lever of the electrified lockset
Pull side lever of the electrified lockset always free for immediate egress

Set: 18 – Utility

Doors: 113

2 Hinge	TA2714 4-1/2" x 4-1/2"	USP	MK
1 Electric Hinge <i>(Install at middle hinge)</i>	TA2714 4-1/2" x 4-1/2" QC-12	USP	MK
1 ElectroLynx Harness <i>(Install between electric hinge and junction box)</i>	QC-C1500P		MK
1 Mortar Box	MG-16	US2C	MK
1 Electrified Lockset (Fail Secure)	21 8271 LNMB x 24VDC	US26D	SA
1 ElectroLynx Harness <i>(Install between electric hinge and electrified lockset)</i>	QC-CXXX x required length		MK
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO
1 Card Reader	Furnished and installed by security contractor		OT
1 Door Position Switch	DPS-M-BK		SU
1 Power Supply	AQD4-1R		SU
1 Wiring Diagram	WD-SYSPK		RU

Card reader to be used by authorized persons to gain entry from the push side of the opening

Card reader to be used to unlock the push side lever of the electrified lockset

Pull side lever of the electrified lockset always free for immediate egress

Set: 18.1 – IT

Doors: 216

5 6 Hinge	TA2714 4-1/2" x 4-1/2" NRP	US26D	MK
1 Electric Hinge <i>(Install at middle hinge-active leaf only)</i>	TA2714 4-1/2" x 4-1/2" QC-12	US26D	MK
1 ElectroLynx Harness <i>(Install between electric hinge and junction box)</i>	QC-C1500P		MK
1 Mortar Box	MG-16	US2C	MK
1 Electrified Lockset (Fail Secure)	21 8271 LNMB x 24VDC	US26D	SA
1 ElectroLynx Harness <i>(Install between electric hinge and electrified lockset)</i>	QC-CXXX x required length		MK
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
2 Flush Bolt	555 x 12"	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Closer <i>(For active leaf of pair only)</i>	351 P10	EN	SA
1 Kickplate	K1050 8" x 1" LDW 4BE CSK	US32D	RO

1 Wall Stop	406	US32D	RO
<u>1 Overhead Stop</u>	<u>59XS x 90 deg</u>	<u>US26D</u>	<u>SA</u>
<i>(For inactive leaf of pair only)</i>			
2 Silencer	608-RKW		RO
1 Card Reader	Furnished and installed by security contractor		OT
2 Door Position Switch	DPS-W-BK		SU
1 Power Supply	AQD4-1R		SU
1 Wiring Diagram	WD-SYSPK		RU

Wood astragal furnished by door manufacturer
Card reader to be used by authorized persons to gain entry from the pull side of the opening
Card reader to be used to unlock the pull side lever of the electrified lockset
Push side lever of the electrified lockset always free for immediate egress

Set: 19 – Exterior Utility

Doors: 114

<u>1 Continuous Hinge</u>	<u>CFM83HD1</u>		<u>PE</u>
1 Continuous Hinge	MCK-25HD x 83"	Clear	MK
1 Power Transfer	EL-CEPT		SU
1 ElectroLynx Harness	QC-C1500P		MK
<i>(Install between power transfer and junction box)</i>			
1 Electrified Lockset (Fail Secure)	21 8271 LNMB x 24VDC	US26D	SA
1 ElectroLynx Harness	QC-CXXX x required length		MK
<i>(Install between power transfer and electrified lockset)</i>			
1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Closer	351 O	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Door Stop	481	US26D	RO
1 Threshold	1715 A x DOW x MS & ES25		PE
1 Gasketing (Set)	S88 BL x DOW x DOH		PE
1 Door Bottom Seal	345 AV x DOW		PE
1 Drip Strip	346 C x DOW + 4"		PE
1 Card Reader	Furnished and installed by security contractor		OT
1 Door Position Switch	DPS-M-BK		SU
1 Power Supply	AQD4-1R		SU
1 Wiring Diagram	WD-SYSPK		RU

Card reader to be used by authorized persons to gain entry from the exterior side of the opening
Card reader to be used to unlock the exterior side lever of the electrified lockset
Pull side lever of the electrified lockset always free for immediate egress

Set: 20 – Open Office

Doors: 115

2 Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US26D	MK
1 Electric Hinge	T4A3786 4-1/2" x 4-1/2" QC-12	US26D	MK

(Install at middle hinge)

1 ElectroLynx Harness	QC-C1500P		MK
<i>(Install between electric hinge and junction box)</i>			
1 Mortar Box	MG-16	US2C	MK
1 Electrified Exit Device (Fail Secure)	21 43 55 LD 8876 F x 776-8 ETMD x24VDC	US32D	SA
1 ElectroLynx Harness	QC-CXXX x required length		MK
<i>(Install between electric hinge and electrified exit device)</i>			
1 Rim Cylinder	100400XX x MK	US26D	MC
1 Closer/Stop	351 CPS x 581-2	EN	SA
1 Mounting Plate	351-D	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
2 Card Reader	Furnished and installed by security contractor		OT
1 Door Position Switch	DPS-W-BK		SU
1 Power Supply	AQD4-1R		SU
1 Wiring Diagram	WD-SYSPK		RU

Pull side card reader to be used by authorized persons to gain entry from the pull side of the opening

Pull side card reader to be used to unlock the pull side lever of the electrified exit device

Push side card reader to be used by authorized persons to exit from the push side of the opening

Push side card reader to be used to shunt the alarm

Depressing the push bar of the exit device without use of the push side card reader will activate the alarm

Push bar of electrified exit device always free for immediate egress

Set: 21 – Exterior Open Office

Doors: 115a

1 Continuous Hinge	CFM83HD1		PE
1 Continuous Hinge	MCK 25HD x 83"	Clear	MK
1 Exit Device	16 21 43 8804 F x 704 ETMD	US32D	SA
1 Rim Cylinder	100400XX x MK	US26D	MC
1 Closer	351 P3	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Overhead Stop	59XS x 90 deg	US26D	SA
1 Threshold	171 A x DOW x MS & ES25		PE
1 Gasketing (Set)	316 AS x DOW x DOH		PE
1 Door Bottom Seal	345 AV x DOW		PE
1 Drip Strip	346 C x DOW + 4"		PE
1 Door Position Switch	DPS-M-BK		SU

Set: 22 – Storage

Doors: 116

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lockset	21 8204 LNMB	US26D	SA

1 Mortise Cylinder	100200X x Z20 x MK	US26D	SA
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Set: 23 – Conference

Doors: 117, 138, 203, 204

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Passage Set	8215 LNMB	US26D	SA
1 Wall Stop	406	US32D	RO

Set: 24 – Open Office

Doors: 131a, 131b

2 Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US26D	MK
1 Electric Hinge <i>(Install at middle hinge)</i>	T4A3786 4-1/2" x 4-1/2" QC-12	US26D	MK
1 ElectroLynx Harness <i>(Install between electric hinge and junction box)</i>	QC-C1500P		MK
1 Mortar Box	MG-16	US2C	MK
1 Electrified Exit Device (Fail Secure)	16 21 43 8876 F x 776-8 ETMD x24VDC	US32D	SA
1 ElectroLynx Harness <i>(Install between electric hinge and electrified exit device)</i>	QC-CXXX x required length		MK
1 Rim Cylinder	100400XX x MK	US26D	MC
1 Closer <i>(For door 131b only)</i>	351 P10 x 581-2	EN	SA
1 Closer/Stop	351 CPS x 581-2	EN	SA
1 Mounting Plate	351-D	EN	SA
1 Kickplate	K1050 8" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop <i>(For door 131b only)</i>	406	US32D	RO
1 Card Reader	Furnished and installed by security contractor		OT
1 Door Position Switch	DPS-W-BK		SU
1 Power Supply	AQD4-1R		SU
1 Wiring Diagram	WD-SYSPK		RU

Card reader to be used by authorized persons to gain entry from the pull side of the opening
Card reader to be used to unlock the pull side lever of the electrified exit device
Push bar of electrified exit device always free for immediate egress

Set: 25 – Workroom

Doors: 207

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Passage Set	8215 LNMB	US26D	SA

SECTION 099113
EXTERIOR PAINTING

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 surface preparation and the application of paint systems on the following exterior substrates:

- 1. ~~Fiber cement board.~~
- 2. Steel.
- 3. Galvanized metal.
- 4. Plastic.

- B. Related Requirements:

- 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. ~~Fiber Cement Board: 12 percent.~~
 3. Masonry (Clay and CMUs): 12 percent.
 4. Wood: 15 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. ~~Fiber Cement Substrates:~~

1. ~~High Performance Architectural Latex System MPI EXT 3.3K:~~

a. ~~Prime Coat: Primer, Alkali Resistant, Water Based, MPI #3.~~

- 1) ~~Benjamin Moore; Ultra Spec Int/Ext Acrylic High Build Primer~~
- 2) ~~PPG; Int/Ext Acrylic Universal Primer~~
- 3) ~~Sherwin Williams; Int/Ext Latex Primer~~

b. ~~Intermediate Coat: Latex, exterior, high performance architectural, matching topecoat.~~

e. ~~Topcoat: Latex, exterior, high performance architectural (MPI Gloss Level 3-4), MPI #315.~~

- 1) ~~Benjamin Moore; Regal Select Exterior High Build Low Lustre Finish~~
- 2) ~~PPG; Weather King Exterior 100% Acrylic Latex Lo Lustre Paint~~
- 3) ~~Sherwin Williams; Super Paint Exterior Acrylic Latex Satin~~

SECTION 101419

DIMENSIONAL LETTER AND PANEL SIGNAGE

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:
 - 1. Fabricated channel dimensional characters.
 - 2. Illuminated, fabricated channel dimensional characters.

1.3 DEFINITIONS

- A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Dimensional Characters: Half-size Sample of dimensional character.
 - 2. Exposed Accessories: Half-size Sample of each accessory type.

3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.

D. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article ~~<Insert sign designations>~~.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Deterioration of finishes beyond normal weathering.
- b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) according to structural performance requirements.
- B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
 - 1. Uniform Wind Load: As indicated on Drawings.
 - 2. Concentrated Horizontal Load: As indicated on Drawings.
 - 3. Other Design Load: As indicated on Drawings.
 - 4. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F ambient; 180 deg F, material surfaces.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DIMENSIONAL CHARACTERS

- A. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.
 - 1. Illuminated Characters: Backlighted character construction with LED lighting, including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
 - a. Power: As indicated on electrical Drawings.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior characters. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
 - 2. Character Material: Sheet or plate aluminum.
 - 3. Material Thickness: 0.050 inch thick for face and 0.031 inch thick for returns.
 - 4. Character Height: 10 inch nominal.
 - 5. Character Depth: 1-1/2" nominal.

6. Finishes:
 - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
 - b. Overcoat: Manufacturer's standard baked-on clear coating.
7. Mounting: Manufacturer's standard concealed mounting for size and design of character.
 - a. Hold characters at 2-inch distance from wall surface.
8. Typeface: Century Gothic.

2.3 PANEL SIGNS

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 1. Illuminated Panel Sign: Backlighted construction with lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.
 - a. Power: As indicated on electrical Drawings.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior signs. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
 2. Solid-Sheet Sign and Returns: Aluminum sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:
 - a. Thickness: Manufacturer's standard for size of sign.
 3. Mounting: Manufacturer's standard concealed mounting for size and design of character.
 - a. Hold characters at 2-inch distance from wall surface.
 4. Surface Finish and Applied Graphics:
 - a. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
 - b. Overcoat: Manufacturer's standard baked-on clear coating.
 5. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

2.4 DIMENSIONAL CHARACTER AND PANEL MATERIALS

- A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.5 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish nonferrous-metal, stainless-steel or hot-dip galvanized devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 - 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.

2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

2.8 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and

nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION