U.S. DEPARTMENT OF ENERGY
OAK RIDGE ENVIRONMENTAL MANAGEMENT

Y-12 National Security Complex
Oak Ridge, Tennessee

TECHNICAL REQUIREMENTS

for the construction of the

OUTFALL 200 MERCURY TREATMENT FACILITY

Contract No. ________

Volume 1 of 3 (Divisions 01 through 22)

****

Specifications

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UCOR
URS | CH2M
Oak Ridge LLC

June 2017

Project No. 662886

Copy No. __________________
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END OF SECTION
TECHNICAL SPECIFICATIONS
Claude E. Buttram, III

Digitally signed by Claude E. Buttram, III
Date: 2017.06.16 15:30:52 -04'00'

UCOR-FM-001, REV. 0 - SPECIFICATION COVER SHEET

Specification Document Control No.: 01 31 13
Revision No.: 0
Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: General
Specification Division: 1 - General Requirements
Date: 6/16/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Project Coordination

Revision History:

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Document Review & Approval:

Originator:

W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

W. Laird Ellis, Jr.

SIGNATURE

Design Verification Complete:

Dennis J. Thomas PE/I&C Lead

NAME/POSITION

SIGNATURE

Approved:

Claude E. Buttram III, PE/Project Manager

NAME/POSITION

Claude E. Buttram, III

SIGNATURE
PART 1   GENERAL

1.01 RELATED WORK AT SITE

A. General:
   1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
   2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
   3. Include sequencing constraints specified herein as a part of Progress Schedule.

B. Applications Software Development:
   1. Engineer will perform programming of applications software for certain portions of Process Instrumentation and Control Subsystem (PICS). Refer to Section 40 90 00, Instrumentation and Control for Process Systems, for detailed information pertaining to Engineer programming.
      a. Coordinate and deliver to Engineer’s office hardware and standard software components, as specified for PICS.
      b. Sequencing: Include sequencing constraints specified herein as part of Progress Schedule.
      c. Engineer will confirm delivery date with Contractor 10 days prior to scheduled delivery, and within 24 hours of expected delivery time.
   2. Deliver hardware specified in Section 40 94 13, Digital Process Control Computers, to Engineer within constraints detailed in Section 40 90 00, Instrumentation and Control for Process Systems, but no later than 120 days after Effective Date of the Agreement.
   3. Return delivery of hardware to Project Site within constraints detailed in Section 40 90 00, Instrumentation and Control for Process Systems.
   4. Allowance for interruptions to the Work because of testing by Engineer of Engineer-developed applications software:
      a. During Functional Testing and Performance Testing, Contractor shall plan for interruption of testing of the Work to allow Engineer to investigate software problems, make software configuration changes, and conduct additional testing.
      b. Allowance for Interruptions: 20 days total.
      c. When applications software testing is delayed because of altered equipment interfaces or receipt of incorrect Shop Drawing information, duration of delay will be excluded from interruption allowance, unless notified otherwise by Engineer.
PART 2   PRODUCTS (NOT USED)

PART 3   EXECUTION (NOT USED)

END OF SECTION
PART 1       GENERAL

1.01      REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Article 3 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.

B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.

C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.

D. It shall be understood that the most recent version of a particular standard applies to the work.

E. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.

F. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.

G. Copies of standards and specifications of technical societies:

1. Copies of applicable referenced standards have not been bound in these Contract Documents.

2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor’s personnel, Subcontractors, Owner, and Engineer.

1.02      ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to
which references may be made in the Contract Documents, with abbreviations used.

1. AA  Aluminum Association
2. AABC  Associated Air Balance Council
3. AAMA  American Architectural Manufacturers Association
4. AASHTO  American Association of State Highway and Transportation Officials
5. ABMA  American Bearing Manufacturers’ Association
6. ACI  American Concrete Institute
7. AEIC  Association of Edison Illuminating Companies
8. AGA  American Gas Association
9. AGMA  American Gear Manufacturers’ Association
10. AI  Asphalt Institute
11. AISC  American Institute of Steel Construction
12. AISI  American Iron and Steel Institute
13. AITC  American Institute of Timber Construction
14. ALS  American Lumber Standards
15. AMCA  Air Movement and Control Association
16. ANSI  American National Standards Institute
17. APA  APA – The Engineered Wood Association
18. API  American Petroleum Institute
19. APWA  American Public Works Association
20. AHRI  Air-Conditioning, Heating, and Refrigeration Institute
21. ASA  Acoustical Society of America
22. ASABE  American Society of Agricultural and Biological Engineers
23. ASCE  American Society of Civil Engineers
25. ASME  American Society of Mechanical Engineers
26. ASNT  American Society for Nondestructive Testing
27. ASSE  American Society of Sanitary Engineering
28. ASTM  ASTM International
29. AWI  Architectural Woodwork Institute
30. AWPA  American Wood Preservers’ Association
31. AWPI  American Wood Preservers’ Institute
32. AWS  American Welding Society
33. AWWA  American Water Works Association
34. BHMA  Builders Hardware Manufacturers’ Association
35. CBM  Certified Ballast Manufacturer
36. CDA  Copper Development Association
37. CGA  Compressed Gas Association
38. CISPI  Cast Iron Soil Pipe Institute
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<td>Insulated Cable Engineers’ Association</td>
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<td>Institute of Electrical and Electronics Engineers, Inc.</td>
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<td>Nationally Recognized Testing Laboratories</td>
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<td>NWWDA</td>
<td>National Wood Window and Door Association</td>
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<td>103.</td>
<td>OSHA</td>
<td>Occupational Safety and Health Act (both Federal and State)</td>
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<td>Porcelain Enamel Institute</td>
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<td>PPI</td>
<td>Plastic Pipe Institute</td>
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<td>107.</td>
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<td>Product Standards Section-U.S. Department of Commerce</td>
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<td>108.</td>
<td>RMA</td>
<td>Rubber Manufacturers’ Association</td>
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<td>Rural Utilities Service</td>
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<td>112.</td>
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<td>Steel Joist Institute</td>
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<td>Society of the Plastics Industry</td>
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<td>116.</td>
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<td>The Society for Protective Coatings</td>
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<td>117.</td>
<td>STI/SPFA</td>
<td>Steel Tank Institute/Steel Plate Fabricators Association</td>
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<td>SWI</td>
<td>Steel Window Institute</td>
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<td>No.</td>
<td>Acronym</td>
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<td>120</td>
<td>TCA</td>
<td>Tile Council of North America</td>
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<td>121</td>
<td>TDEC</td>
<td>Tennessee Department of Environment and Conservation</td>
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<td>122</td>
<td>TDH</td>
<td>Tennessee Department of Health</td>
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<td>Tennessee Department of Transportation</td>
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<td>124</td>
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<td>Uniform Building Code</td>
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<td>127</td>
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<td>USBR</td>
<td>U.S. Bureau of Reclamation</td>
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<td>WCLIB</td>
<td>West Coast Lumber Inspection Bureau</td>
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<td>131</td>
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<td>Wood Institute</td>
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<td>132</td>
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<td>Western Wood Products Association</td>
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**PART 2**  PRODUCTS (NOT USED)

**PART 3**  EXECUTION (NOT USED)

END OF SECTION
Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Manufacturers’ Field Services

Revision History:

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<td>June 16, 2017</td>
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Document Review & Approval:

**Originator:**
Steven R. Polson, P.E./Lead Process Mechanical

**Design Verification Complete:**
Qingshan Wang, P.E./Process Mechanical QC Reviewer

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager
PART 1  GENERAL

1.01  DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02  SUBMITTALS

A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.

2. Lesson Plan: Submit, in accordance with requirements of this Specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.

1.03  QUALIFICATION OF MANUFACTURER’S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.

B. Representative subject to acceptance by Owner and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2  PRODUCTS (NOT USED)

PART 3  EXECUTION

3.01  FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers’ services, when required by an individual specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers’ services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.

C. Schedule manufacturer’ services to avoid conflict with other onsite testing or other manufacturers’ onsite services.
D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.

F. When specified in individual specification sections, manufacturer’s onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor’s assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer’s Certificate of Proper Installation.
3. Providing, on a daily basis, copies of manufacturers’ representatives field notes and data to Engineer.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer’s products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner’s personnel in the operation and maintenance of respective product as required.

3.02 MANUFACTURER’S CERTIFICATE OF PROPER INSTALLATION

A. When so specified, a Manufacturer’s Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer’s representative.

B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

3.03 TRAINING

A. General:

1. Furnish manufacturers’ representatives for detailed classroom and hands-on training to Owner’s personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and
familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.

3. Manufacturer’s representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.

4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
   a. Respective manufacturer.
   b. Estimated dates for installation completion.
   c. Estimated training dates.

2. Allow for multiple sessions when several shifts are involved.

3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers’ representatives. Adjust schedule for interruptions in operability of equipment.

4. Coordinate with Contracting Requirements, and UCOR-4931, Outfall 200 Mercury Treatment Facility Startup Test Plan.

C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:

1. Title and objectives.

2. Recommended attendees (such as, managers, engineers, operators, maintenance).

3. Course description, outline of course content, and estimated class duration.

4. Format (such as, lecture, self-study, demonstration, hands-on).

5. Instruction materials and equipment requirements.

6. Resumes of instructors providing training.

D. Prestartup Training:

1. Coordinate training sessions with Owner’s operating personnel and manufacturers’ representatives, and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.

2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner’s operating personnel by respective manufacturer’s representatives.
3.04 SUPPLEMENTS

A. The supplement listed below, following “End of Section”, is part of this specification.

1. Form: Manufacturer’s Certificate of Proper Installation.

END OF SECTION
MANUFACTURER’S CERTIFICATE OF PROPER INSTALLATION

OWNER ___________________________ EQPT SERIAL NO: __________________
EQPT TAG NO: ____________________ EQPT/SYSTEM: ________________________
PROJECT NO: ______________________ SPEC. SECTION: _______________________

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

☐ Installed in accordance with Manufacturer’s recommendations.
☐ Inspected, checked, and adjusted.
☐ Serviced with proper initial lubricants.
☐ Electrical and mechanical connections meet quality and safety standards.
☐ All applicable safety equipment has been properly installed.
☐ Functional tests.
☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _______________________________________________________________

______________________________________________________________

______________________________________________________________

I, the undersigned Manufacturer’s Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _______________________________, 20___

Manufacturer: ________________________________

By Manufacturer’s Authorized Representative: ________________________________

(Authorized Signature)
**Specification Title & Description:**

(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Special Inspection, Observation, and Testing

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### Document Review & Approval:

- **Originator:**
  - Harry W. Elliott PE / Lead Structural Engineer
  - NAME/POSITION: 
  - Signature: 
  - Date: June 21, 2017

- **Design Verification Complete:**
  - Alex Firth/Senior Structural Engineer
  - NAME/POSITION: 
  - Signature: 
  - Date: June 16, 2017

- **Approved:**
  - W. Laird Ellis, Jr. PE/Design Manager
  - NAME/POSITION: 
  - Signature: 
  - Date: June 21, 2017
PART 1    GENERAL

1.01    SUMMARY

A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2012 International Building Code and is in addition to and supplements requirements included in Statement of Special Inspections (Plan) shown on Drawings.

1.02    REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. International Code Council (ICC):
   b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

1.03    DEFINITIONS

A. Agencies and Personnel:

1. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
2. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the Project is to be constructed.
3. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of the building official for inspection of a particular type of construction or operation requiring Special Inspection.

B. Special Inspection:

1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in the area where the Work is being performed.
3. Special Inspection, Periodic: Part-time or intermittent observation of work requiring Special Inspection by an approved Special Inspector who is present in the area where the Work has been or is being performed, and at the completion of the Work.

C. Structural Systems and Components:
1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of a diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to the plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

D. Nonstructural Components:
1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to the structure, including braces, frames, struts, and attachments.
2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to the structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical Component Supports: Structural members or assemblies which transmit loads and forces from mechanical equipment to the structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.
E. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Requirements are indicated on Statement of Special Inspections (Plan) provided on Drawings.
3. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces and deep foundation elements by a registered design professional for general conformance to Contract Documents.
4. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Contract Documents.
5. Statement of Special Inspections (Plan): Detailed written procedure contained on Drawings establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.

1.04 SUBMITTALS

A. Informational Submittals:

1. Contractor’s Statement of Responsibility: Form shall be completed by each contractor responsible for construction of a main wind-force-resisting system, main seismic-force-resisting system, wind-resisting component, and seismic-resisting component listed in Statement of Special Inspections (Plan). Refer to Article Supplements located at end of section.
2. Seismic Qualification of Mechanical and Electrical Equipment Certificate of Compliance Form: Submit for mechanical and electrical components having a Component Importance Factor of 1.5 as designated hereinafter. Refer to Article Supplements located at end of section.

1.05 STATEMENT OF SPECIAL INSPECTIONS (PLAN) REQUIREMENTS

A. Designated Systems for Inspection:

1. Seismic-force-resisting systems designated under IBC Section 1705 and subject to Special Inspection under Section 1707: See Drawings for basic lateral load resisting systems for each structure and other designated seismic systems.
2. Wind-force-resisting systems designated under IBC Section 1705: See Drawings for basic lateral load resisting systems for each structure and other designated wind-resisting components.
3. Architectural, Mechanical, and Electrical Components subject to Special Inspection and testing under IBC Section 1707 for Seismic Resistance: as listed in Table below:

<table>
<thead>
<tr>
<th>Facility</th>
<th>Component</th>
<th>Component Importance Factor, IP</th>
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<tbody>
<tr>
<td>09—Electrical Site Work</td>
<td>Standby Engine Generators</td>
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<td>09—Electrical Site Work</td>
<td>Switchgear</td>
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<td>09—Electrical Site Work</td>
<td>Secondary Unit Substation</td>
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<td>31—Pump Station</td>
<td>Fire Protection Equipment</td>
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<td>44—Operations Building</td>
<td>Lab HVAC Distribution Systems for Hazardous Materials</td>
<td>1.5</td>
</tr>
<tr>
<td>44—Operations Building</td>
<td>Lab Piping Distribution Systems for Hazardous Materials</td>
<td>1.5</td>
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</tbody>
</table>

B. Statement of Special Inspections (Plan):

1. As included in Drawings and in support of the building permit application, the Project specific plan was prepared by the registered design professional in responsible charge. The following identifies elements of the inspection, observation and testing program to be followed in construction of the Work:
   a. Designated seismic systems and main seismic force and wind force resisting systems and components that are subject to Special Inspection and Structural Observation for lateral load resistance.
   b. Special Inspection and testing required by IBC Section 1705, and other applicable sections and referenced standards therein.
   c. Type and frequency of Special Inspection required.
   d. Type and frequency of testing required.
   e. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Engineer, Contractor, building official, and Owner.
   f. Geotechnical Observation to be Performed: Required frequency and distribution of Geotechnical Observation reports by registered design professional to Contractor, building official, and Owner.
   g. Structural Observations to be Performed: Required frequency and distribution of Structural Observation reports by registered design professional to Contractor, building official, and Owner.
C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency. Owner will secure and pay for the services of the agency to perform Special Inspection and associated testing.

D. Owner’s plan for code required Special Inspection with associated testing and Professional Observation, as provided in Statement of Special Inspections (Plan) on Drawings and further provided in this section, is for the sole benefit of Owner and does not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of material before acceptance.
3. Constitute or imply acceptance.

E. The presence or absence of code required Special Inspector and Professional Observer does not relieve Contractor from Contract requirements.

F. Contractor is responsible for additional costs associated with Special Inspection and Testing and Observation when Work is not ready at time identified by Contractor, and Special Inspectors and Professional Observer are on Site but not able to provide contracted services.

G. Contractor is responsible for associated costs for additional Special Inspection and Testing and Professional Observation by Special Inspectors and Professional Observers required due to rejection of materials of in place Work that cannot be made compliant to Contract Document without additional Site visits or testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Provide access to shop or Site for Special Inspection and Testing and Professional Observation.

B. Notify Engineer in advance of required Special Inspection and Professional Observation no later than 48 hours prior to date of Special Inspection and Professional Observation.

C. When required by Registered Design Professional, provide access for mechanical and electrical component inspections for those items requiring certification.
D. Materials and systems, inclusive, shall be inspected during placement where Continuous Special Inspection is required.

E. Materials and systems shall be inspected during or at completion of their placement where Periodic Special Inspection is allowed.

1. Periodic Special Inspection shall be performed so that Work inspected after, but not during, its placement can be corrected prior to other related Work proceeding and covering inspected Work.

2. Periodic Special Inspection does not allow sampling of a portion of the Work. All Work shall be inspected.

3.02 MECHANICAL AND ELECTRICAL COMPONENTS CERTIFICATION

A. Provide certificate of compliance for mechanical and electrical component testing and certification on form located at end of section.

3.03 TESTING

A. Component and attachment testing shall be required of component manufacturers included in table above for mechanical and electrical components subject to Special Inspection for seismic resistance. Component and attachment testing shall be in accordance with applicable provisions of IBC Section 1705.12.3. Seismic testing and certification is in addition to functional and performance testing required for new equipment for field quality control or start-up testing as indicated in equipment technical specification.

B. Mechanical and electrical components listed in the table above shall be certified on the basis of tests on a shaking table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces as provided in Section 01 88 15, Anchorage and Bracing, experience data demonstrating acceptable seismic performance, or by more rigorous analysis. Submitted testing and experience data shall meet requirements of ASCE 7-05 Section 13.2.5 and Section 13.2.6, respectively.

3.04 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification:

1. Contractor’s Statement of Responsibility.

END OF SECTION
CONTRACTOR’S STATEMENT OF RESPONSIBILITY

(Project)

(Name of Contracting Company)

(Business Address)

(_____)  (_____) __________________________
(Telephone)  (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing and Professional Observation requirements contained in Contract Documents for this Project for wind and seismic force-resisting systems, and for components including architectural, mechanical, and electrical components, as listed in Statement of Special Inspections (Plan) on Drawings, and that:

1. I, (We) are responsible for implementation of the Statement of Special Inspections (Plan) for the construction of the following systems:

<table>
<thead>
<tr>
<th>Facility</th>
<th>Lateral Force-Resisting System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Water Tank</td>
<td>Flat-bottom, Self-anchored, Steel Tank</td>
</tr>
<tr>
<td>Headworks Electrical Building</td>
<td>Ordinary Steel Moment Frames (main frames) and Ordinary Steel Concentrically Braced Frames (sidewall bracing)</td>
</tr>
</tbody>
</table>

2. and I, (We) are responsible for construction of the following components:

<table>
<thead>
<tr>
<th>Facility</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>09—Electrical Site Work</td>
<td>Switchgear</td>
</tr>
</tbody>
</table>

3. Control of this Work will be exercised to obtain conformance with the Contract Documents approved by the building official.

4. Procedures to be used for exercising control of the Work, the method and frequency of reporting, and distribution of reports required under the Statement of Special Inspections (Plan) for this Project are attached.
5. I, (We) will provide 48-hour notification to Engineer and approved agency as required for structural tests and Special Inspection for this Project.

6. The following person is hereby identified as exercising control over the requirements of this section for the Work designated above:

   Name:______________________________________________________

   Qualifications:______________________________________________

   ____________________________________________________________

   ____________________________________________________________

   (Print name and official title of person signing this form)

   Signed by:______________________________________________

   Date:____________________________________________________

   Project Name:____________________________________________
COMPONENT MANUFACTURER’S SEISMIC CERTIFICATE OF COMPLIANCE

(Component under Certification) ____________________________ (Name of Manufacturer) ____________________________

(Tag Number or Equipment ID) ____________________________ (Business Address) ____________________________

(Drawing/Detail Number) ____________________________ (Telephone) ____________________________

This is to certify that above-referenced component meets or exceeds requirements of the 2012 IBC for seismic qualification. Basis of qualification is by:

(Check Applicable)

☐ Shake-table Test
☐ Three-dimensional Shock Test
☐ Analytical Method
☐ Experience Data
☐ Other ____________________________

under the acceptance criteria of:

☐ ICC-ES AC156, “Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems”

☐ IEEE 693, “IEEE Recommended Practice for Seismic Design of Substations”

☐ IEEE 344, “IEEE Recommended Standard Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations” for experience data

☐ ASCE 7-10 Chapter 13 for analytical methods

☐ Other ____________________________

for the following earthquake hazard rating:

IEEE Seismic Qualification Level: ____________________________

Mapped MCE, 5 Percent Damped, Short Period Spectral Response Acceleration, $S_s$: ____________________________

Design, 5 Percent Damped, Short Period Spectral Response Acceleration, $S_{ds}$: ____________________________
Component Importance Factor, $I_p$: ______________________________

Component Response Modification Factor, $R_p$: ________________________

Height of Point of Attachment as Factor of Average Roof Height, $z/h$: ______________________________

Required mounting and anchorage details are shown on the attached Seismic Outline Drawing for the most seismically vulnerable component covered by this Certification.

Signed by: _______________________________________________________

Address: _________________________________________________________

Date: ____________________________________________________________

Project Name: ____________________________________________________
Common Product Requirements
SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1   GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.

2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.

3. Items identified by manufacturer’s product name, including make or model designation, indicated in manufacturer’s published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of International Building Code (IBC) by International Code Council.

1. Wind: Basic wind speed, V: 120 mph, with exposure category B.

2. Snow Load: Basic ground snow load pg 10 psf, and an importance factor, I, of 1.1.

3. Seismic: Importance factor, I, of 1.25, Site Class Definition D, mapped maximum considered earthquake, 5 percent damped, spectral response at short periods, SS 0.375, mapped maximum considered earthquake, 5 percent damped, spectral response at a period of 1 second, S1 0.121, unless specified otherwise.

4. See additional structural design criteria Sheet S941001-F-0001.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 950 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of minus 17 degrees F to 105 degrees F.
1.04 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as required by individual Specifications.
2. Schedule:
   a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
   b. Transfer to Owner shall occur immediately subsequent to Contractor’s acceptance of equipment from Supplier.
3. Packaging and Shipment:
   a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
   b. Prominently displayed on each package, the following:
      1) Manufacturer’s part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
      2) Applicable equipment description.
      3) Quantity of parts in package.
      4) Equipment manufacturer.
4. Deliver materials to Site. Notify Construction Manager upon arrival for transfer of materials.
5. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.

D. Request a minimum 7-day advance notice of shipment from manufacturer.

E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver
anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer’s original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer’s instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer’s written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with the Contracting Requirements. Provide manufacturer’s recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Manufacturer’s instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.


PART 2 PRODUCTS

2.01 GENERAL

A. Provide manufacturer’s standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer’s products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer’s services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

E. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

F. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

G. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or
other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

H. Equipment Finish:

1. Provide manufacturer’s standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with finish as approved by Owner.

I. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

J. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

K. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.
B. Lubrication System:
   1. Require no more than weekly attention during continuous operation.
   2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
   3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
   4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL
   A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.
   B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
   C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION
   A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor’s control.

3.02 MANUFACTURER’S CERTIFICATE OF COMPLIANCE
   A. When so specified, a Manufacturer’s Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.
   B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

No shimming between machined surfaces is allowed.

Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

Repaint painted surfaces that are damaged prior to equipment acceptance.

Do not cut or notch any structural member or building surface without specific approval of Engineer.

Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer’s instructions, and as may be specified. Retain a copy of manufacturers’ instruction at Site, available for review at all times.

3.04 FIELD FINISHING

In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 SUPPLEMENTS

The supplement listed below, following “End of Section”, is part of this specification.

1. Form: Manufacturer’s Certificate of Compliance.

END OF SECTION
MANUFACTURER’S CERTIFICATE OF COMPLIANCE

OWNER: __________________________  PRODUCT, MATERIAL, OR SERVICE
SUBMITTED: ______________________
PROJECT NAME: ____________________
PROJECT NO: _______________________

Comments: __________________________________________
____________________________________________________
____________________________________________________
____________________________________________________
____________________________________________________
____________________________________________________

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown.

Date of Execution: _________________________________, 20____
Manufacturer: _______________________________________
Manufacturer’s Authorized Representative (print): ________________
____________________________________________________

(Authorized Signature)
Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Operation and Maintenance Data

Revision History:

<table>
<thead>
<tr>
<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Issue for Construction</td>
<td>June 16, 2017</td>
<td>All</td>
</tr>
</tbody>
</table>

Document Review & Approval:

**Originator:**
Steven R. Polson, P.E./Lead Process Mechanical

**Design Verification Complete:**
Qingshan Wang, P.E./Process Mechanical QC Reviewer

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Detailed information for the preparation, submission, and Engineer’s review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

A. Preliminary Data: Initial and subsequent submissions for Engineer’s review.

B. Final Data: Engineer-accepted data, submitted as specified herein.

C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.03 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
   b. Submit prior to shipment date.

2. Final Data: Submit Instructional Manual Formatted data not less than 30 days prior to installation of equipment or system. Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.

B. Materials and Finishes Data:

1. Preliminary Data: Submit at least 15 days prior to request for final inspection.

2. Final Data: Submit within 10 days after final inspection.

1.04 DATA FORMAT

A. Prepare preliminary and final data in the form of an instructional manual. Prepare final data on electronic media.
B. Instructional Manual Format:

1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
2. Size: 8-1/2 inches by 11 inches, minimum.
3. Cover: Identify manual with typed or printed title “OPERATION AND MAINTENANCE DATA” and list:
   a. Project title.
   b. Designate applicable system, equipment, material, or finish.
   c. Identity of separate structure as applicable.
   d. Identify volume number if more than one volume.
   e. Identity of equipment number and Specification section.
4. Spine:
   a. Project title.
   b. Identify volume number if more than one volume.
5. Title Page:
   a. Contractor name, address, and telephone number.
   b. Subcontractor, Supplier, installer, or maintenance contractor’s name, address, and telephone number, as appropriate.
      1) Identify area of responsibility of each.
      2) Provide name and telephone number of local source of supply for parts and replacement.
6. Table of Contents:
   a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
   b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
8. Text: Manufacturer’s printed data, or neatly typewritten.
9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Data Compilation Format:

1. Compile all Engineer-accepted preliminary O&M data into a hard-copy, hard-bound set.
2. Each set shall consist of the following:
   a. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
   b. Cover: Identify each volume with typed or printed title “OPERATION AND MAINTENANCE DATA, VOLUME NO. ___ OF ___”, and list:
      1) Project title.
      2) Contractor’s name, address, and telephone number.
3) If entire volume covers equipment or system provided by one Supplier include the following:
   a) Identity of general subject matter covered in manual.
   b) Identity of equipment number and Specification section.

c. Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

d. Table of contents neatly typewritten, arranged in a systematic order:
   1) Include list of each product, indexed to content of each volume.
   2) Designate system or equipment for which it is intended.
   3) Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

e. Section Dividers:
   1) Heavy, 80 pound cover weight, tabbed with numbered plastic index tabs.
   2) Fly-Leaf:
      a) For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.
      b) List with Each Product:
         (1) Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
         (2) Identify area of responsibility of each.
         (3) Provide local source of supply for parts and replacement.
   c) Identity of separate structure as applicable.

f. Assemble and bind material, as much as possible, in same order as specified in the Contract Documents.

D. Electronic Media Format:

1. Portable Document Format (PDF):
   a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on CD.
   b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
   c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.
1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit two copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.

2. Preliminary Data:
   a. Submit three copies for Engineer’s review.
   b. If data meets conditions of the Contract:
      1) One copy will be returned to Contractor.
      2) One copy will be forwarded to Resident Project Representative.
      3) One copy will be retained in Engineer’s file.
   c. If data does not meet conditions of the Contract:
      1) All copies will be returned to Contractor with Engineer’s comments (on separate document) for revision.
      2) Engineer’s comments will be retained in Engineer’s file.
      3) Resubmit two copies revised in accordance with Engineer’s comments.

3. Final Data: Submit two copies in format specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.
   f. Original manufacturer’s parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
   g. Spare parts ordering instructions.
   h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).

2. As-installed, color-coded piping diagrams.

3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
   a. Format:
      1) Provide reinforced, punched, binder tab; bind in with text.
      2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
      3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
      4) Identify Specification section and product on Drawings and envelopes.
   b. Relations of component parts of equipment and systems.
   c. Control and flow diagrams.
   d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.

5. Instructions and Procedures: Within text, as required to supplement product data.
   a. Format:
      1) Organize in consistent format under separate heading for each different procedure.
      2) Provide logical sequence of instructions for each procedure.
      3) Provide information sheet for Owner’s personnel, including:
         a) Proper procedures in event of failure.
         b) Instances that might affect validity of guarantee or Bond.
   b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
   c. Operating Procedures:
      1) Startup, break-in, routine, and normal operating instructions.
      2) Test procedures and results of factory tests where required.
      3) Regulation, control, stopping, and emergency instructions.
      4) Description of operation sequence by control manufacturer.
      5) Shutdown instructions for both short and extended duration.
      6) Summer and winter operating instructions, as applicable.
      7) Safety precautions.
      8) Special operating instructions.
   d. Maintenance and Overhaul Procedures:
      1) Routine maintenance.
      2) Guide to troubleshooting.
      3) Disassembly, removal, repair, reinstallation, and re-assembly.

6. Guarantee, Bond, and Service Agreement: In accordance with Contracting Requirements.
B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
   a. Function, normal operating characteristics, and limiting conditions.
   b. Performance curves, engineering data, nameplate data, and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
   d. Interconnection wiring diagrams, including control and lighting systems.

2. Circuit Directories of Panelboards:

3. Electrical service.

4. Control requirements and interfaces.

5. Communication requirements and interfaces.

6. List of electrical relay settings, and control and alarm contact settings.

7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.

8. As-installed control diagrams by control manufacturer.

9. Operating Procedures:
   a. Routine and normal operating instructions.
   b. Startup and shutdown sequences, normal and emergency.
   c. Safety precautions.
   d. Special operating instructions.

10. Maintenance Procedures:
    a. Routine maintenance.
    c. Adjustment and checking.
    d. List of relay settings, control and alarm contact settings.

11. Manufacturer’s printed operating and maintenance instructions.

12. List of original manufacturer’s spare parts, manufacturer’s current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.

2. Format:
   a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
   b. Each Maintenance Summary may take as many pages as required.
   c. Use only 8-1/2-inch by 11-inch size paper.
   d. Complete using typewriter or electronic printing.

3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. **Recommended Spare Parts:**
   a. Data to be consistent with manufacturer’s Bill of Materials/Parts List furnished in O&M manuals.
   b. “Unit” is the unit of measure for ordering the part.
   c. “Quantity” is the number of units recommended.
   d. “Unit Cost” is the current purchase price.

1.07 **DATA FOR MATERIALS AND FINISHES**

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer’s data, giving full information on products:
   a. Catalog number, size, and composition.
   b. Color and texture designations.
   c. Information required for reordering special-manufactured products.

2. Instructions for Care and Maintenance:
   a. Manufacturer’s recommendation for types of cleaning agents and methods.
   b. Cautions against cleaning agents and methods that are detrimental to product.
   c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer’s data, giving full information on products:
   a. Applicable standards.
   b. Chemical composition.
   c. Details of installation.

2. Instructions for inspection, maintenance, and repair.

1.08 **SUPPLEMENTS**

A. The supplements listed below, following “End of Section”, are part of this Specification.

1. Forms: Maintenance Summary Form.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF SECTION**
MAINTENANCE SUMMARY FORM

PROJECT: ___________________________ CONTRACT NO.: ___________________________

1. EQUIPMENT ITEM _____________________________________________________________

2. MANUFACTURER ____________________________________________________________

3. EQUIPMENT/TAG NUMBER(S) ________________________________________________

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) ____________________

5. NAMEPLATE DATA (hp, voltage, speed, etc.) ________________________________

6. MANUFACTURER’S LOCAL REPRESENTATIVE ________________________________
   a. Name ___________________________ Telephone No. ______________
   b. Address __________________________

7. MAINTENANCE REQUIREMENTS

<table>
<thead>
<tr>
<th>Maintenance Operation Comments</th>
<th>Frequency</th>
<th>Lubricant (If Applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>List briefly each maintenance operation required and refer to specific information in manufacturer’s standard maintenance manual, if applicable. (Reference to manufacturer’s catalog or sales literature is not acceptable.)</td>
<td>List required frequency of each maintenance operation.</td>
<td>Refer by symbol to lubricant required.</td>
</tr>
</tbody>
</table>
8. LUBRICANT LIST

<table>
<thead>
<tr>
<th>Reference Symbol</th>
<th>Shell</th>
<th>Exxon Mobile</th>
<th>Chevron Texaco</th>
<th>BP Amoco</th>
<th>Or Equal</th>
</tr>
</thead>
<tbody>
<tr>
<td>List symbols used in No. 7 above.</td>
<td>List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. RECOMMENDED SPARE PARTS FOR OWNER’S INVENTORY.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
</tr>
</thead>
</table>

Note: Identify parts provided by this Contract with two asterisks.
Anchorage and Bracing
PART 1  GENERAL

1.01  SUMMARY

A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the ICC 2012 International Building Code (IBC), for seismic, wind, gravity, soil, and operational loads.

1.02  REFERENCES

A. The following is a list of standards which may be referenced in this section:


1.03  DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

B. Designated Seismic System: Architectural, electrical, and mechanical system or their components for which component importance factor is greater than 1.0.

1.04  DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in the State of Tennessee.
2. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section,
unless a design is specifically provided within Contract Documents or where exempted hereinafter.

3. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.

4. Piping and ductwork, whether exempt or not exempt for this section, shall be anchored and braced so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.

5. Architectural Components: Includes, but are not limited to, nonstructural walls and elements, partitions, cladding and veneer, access flooring, signs, cabinets, suspended ceilings, and glass in glazed curtain walls and partitions.

6. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.

7. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.

8. Design anchorage and bracing for:
   a. Equipment and components that weigh more than 400 pounds and have center of mass located 4 feet or less above adjacent finished floor.
   b. Equipment weighing more than 20 pounds that has center of mass located more than 4 feet above adjacent finished floor.
   c. Mechanical and electrical components that are not provided with flexible connections between components and associated ductwork, piping, or conduit.
   d. Distribution systems that weigh more than 5 pounds per foot that have center of mass located more than 4 feet above adjacent finished floor.

9. Design seismic anchorage and bracing for Designated Seismic Systems regardless of weight or mounting height.
   a. Component Important Factor:
      1) \( Ip = 1.0 \), unless noted otherwise.
      2) \( Ip \) shall be taken as 1.5 if any of the following conditions apply:
         a) Component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems and egress stairways.
         b) Component contains hazardous materials.

10. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.
B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for exposed architectural components and exterior and wind-exposed mechanical and electrical equipment. Alternately, manufacturer certification may be provided for components such as roofing and flashing to verify attachments meet Project-specific design criteria.
3. Operational:
   a. For loading supplied by equipment manufacturer for IBC required load cases.
   b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
   c. Locate braces to minimize vibration to or movement of structure.
   d. For vibrating loads, use anchors meeting requirements of Section 05 50 00, Metal Fabrications, for anchors with designated capacities for vibratory loading per manufacturer’s ICC-ES report.
4. Hydraulic: Design of anchorage for submerged gates and other mechanical equipment shall include hydrostatic and hydrodynamic loads determined in accordance with Section 15.7 of ASCE 7-10.
5. Seismic:
   a. In accordance with 2012 IBC, Section 1613, and Chapter 13 of ASCE 7.
   b. Design anchorage and bracing for design criteria listed on General Structural Notes on Drawings.
   c. Design forces for anchors in concrete or masonry shall be in accordance with ASCE 7, Section 13.4.2 as applicable for Project Seismic Design Category.

C. Seismic Design Requirements:

1. Nonstructural Components: Design as nonbuilding structures for components with weights greater than or equal to 25 percent of effective seismic weight of overall structure.
2. Analyze local region of body of nonstructural component for load transfer of anchorage attachment if component Ip = 1.5.
3. The following are exempt from requirements for provision of seismic anchorages and bracing, in addition to those items specifically exempted in ASCE 7, Part 13.5 for architectural components and Part 13.6 for electrical and mechanical equipment:
   a. Furniture, except storage cabinets and bookshelves over 6 feet tall.
   b. Temporary or movable equipment.
4. Fire protection sprinkler systems designed and constructed in accordance with NFPA 13 shall be considered to meet requirements of Chapter 13 of ASCE 7.

5. Support drawings and calculations for electrical distribution components shall be provided if any of the following conditions apply:
   a. \( I_p \) is equal to 1.5 and conduit diameter is greater than 2.5-inch trade size.
   b. \( I_p \) is equal to 1.5 and the total weight of bus duct, cable tray, or conduit supported by trapeze assemblies exceeds 10 pounds per foot.
   c. Supports are cantilevered up from floor.
   d. Supports include bracing to limit deflection and are constructed as rigid welded frames.
   e. Attachments utilize spot welds, plug welds, or minimum size welds as defined by AISC.

6. Other seismic design and detailing requirements identified in ASCE 7, Chapter 13 are required to be provided for new architectural, mechanical and electrical components, systems, or equipment.

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. List of architectural, mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
   b. Manufacturers’ engineered seismic hardware product data.
   c. Seismic attachment assemblies’ drawings; include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
   d. Submittal will be rejected if proposed anchorage method would create an overstressed condition of supporting member. Revise anchorages and strengthening of structural support so there is no overstressed condition.

B. Informational Submittals:

1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer’s specific criteria used for design; sealed by a structural engineer registered in the State of Tennessee.

2. Manufacturer’s hardware installation requirements.
C. Deferred Submittals:

1. Submitted seismic anchorage drawings and calculations for Designated Seismic Systems are identified as IBC deferred submittals and will be submitted to and accepted by AHJ prior to installation of component, equipment or distribution system.

2. Submit deferred action submittals such as shop drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

1.06 SOURCE QUALITY CONTROL

A. Contractor and supplier responsibilities to accommodate Owner-furnished shop fabrication related special inspections and testing are provided in Project’s Statement of Special Inspections on Drawings and Section 01 45 33, Special Inspection, Observation, and Testing.

B. All other specified, regulatory required, or repair verification inspection and testing that are not listed in Statement of Special Inspections, are to be provided by Contractor.

C. Source Quality Control for shall be in accordance with Section 05 50 00, Metal Fabrications.

PART 2 PRODUCTS

2.01 GENERAL

A. Attachments and supports transferring seismic loads to structure shall be designed and constructed of materials and products suitable for application and be in accordance with design criteria shown on Drawings and nationally recognized standards.

B. Provide anchor bolts and concrete and masonry anchors for anchorage of equipment to concrete or masonry in accordance with Section 05 50 00, Metal Fabrications. Size of anchor bolts and anchors, required minimum embedment, and spacing shall be based on calculations submitted by Contractor.

C. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors, for nonvibration isolated mechanical equipment rated over 10 horsepower.
PART 3 EXECUTION

3.01 GENERAL

A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.

B. Overall seismic anchorage system shall provide restraint in all directions, including vertical, for each component or system so anchored.

C. Components mounted on vibration isolation systems shall have snubbers in each horizontal direction and vertical restraints where required to resist overturning.

D. Anchor piping in such a manner as to ensure piping system has adequate flexibility and expansion capabilities at flexible connections and expansion joints.

1. Piping and ductwork suspended more than 12 inches below supporting structure shall be braced for seismic effects to avoid significant bending of hangers and their attachments.

E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.

F. Do not attach architectural, mechanical, or electrical components to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Do not make such attachments across building expansion and contraction joints.

3.02 INSTALLATION

A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

B. Notify Engineer upon completion of installation of seismic restraints in accordance with Section 01 45 33, Special Inspection, Observation, and Testing.

3.03 FIELD QUALITY CONTROL

A. In accordance with Section 05 50 00, Metal Fabrications.

B. Contractor responsibilities to accommodate Owner-furnished special inspections and testing are provided in Project’s Statement of Special Inspections on Drawings and Section 01 45 33, Special Inspection, Observation, and Testing.
C. Any other specified, regulatory required, or repair verification inspection and testing that are not listed in Statement of Special Inspections, are to be provided by Contractor.

END OF SECTION
Demolition
PART 1  GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

4. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40: 
   b. Part 82—Protection of Stratospheric Ozone.

1.02 DEFINITIONS

A. ACM: Asbestos-containing material.
B. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof.
C. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.
D. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on the Drawings.
E. Renovation: Altering a facility or one or more facility components in any way.
F. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.
G. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.

H. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.03 SUBMITTALS

A. Informational Submittals:

1. Submit proposed Demolition/Renovation Plan, in accordance with requirements specified herein, for approval before such Work is started.
2. Schedule of demolition activities.
3. Submit copies of any notifications, authorizations and permits required to perform the Work.

1.04 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor’s safety requirements shall conform to ANSI A10.6.

C. Furnish timely notification of this demolition project to applicable federal, state, regional, and local authorities in accordance with 40 CFR 61-Subpart M.

1.05 DEMOLITION/RENOVATION PLAN

A. Demolition/Renovation Plan shall provide for safe conduct of the Work and shall include:

1. Detailed description of methods and equipment to be used for each operation.
2. The Contractor’s planned sequence of operations, including coordination with other work in progress.
3. Procedures for removal and disposition of materials specified to be salvaged.
4. Disconnection schedule of utility services.

1.06 SEQUENCING AND SCHEDULING

A. The Work of this Specification shall not commence until Contractor’s Demolition/Renovation Plan has been approved by Engineer.
B. Include the Work of this Specification in the progress schedule, as specified in the Contract.

C. Areas in which the Work is to be accomplished will be available in accordance with the Contract.

1.07 ENVIRONMENTAL PROTECTION

A. See Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

A. Facilities: Structures and adjacent designated areas scheduled for complete demolition are as shown.

B. Structures:

1. Existing above-grade structures indicated shall be removed to minimum of 1 foot below grade.
2. Interior walls, other than retaining walls and partitions, shall be removed to minimum of 1 foot below grade or to top of concrete slab on ground.
3. Foundations and underground vaults shall be completely removed unless noted otherwise and backfilled with compacted material.
4. Partition walls shall be removed as shown.
5. Core drill concrete slabs and other concrete improvements scheduled to remain in place below ground, or break holes at the structure’s lowest point to allow water to freely migrate through.
6. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

C. Substructure: Extract conflicting existing pilings prior to driving new piles.

D. Utilities and Related Equipment:

1. Notify Owner or appropriate utilities to turn off affected services at least 10 working days before starting demolition activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Engineer.
3. When utility lines are encountered that are not indicated on the Drawings, notify Engineer and Owner prior to further work in that area.
4. Remove meters and related equipment and deliver to a location as determined by the Owner.
5. Excavate and remove utility lines serving buildings to be demolished to a distance as shown or to the project boundary.
6. Provide a permanent leak-proof closure for water and gas lines.
7. Plug sewer lines with concrete to a minimum plug length of 1.5 feet to prevent groundwater infiltration.

E. Paving and Slabs:

1. Remove concrete and asphaltic concrete paving and slabs to a depth of aggregate base or subgrade.
2. Provide neat sawcuts at limits of pavement removal as indicated.

F. Masonry: Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new Work. Where new masonry adjoins existing, the new Work shall abut or tie into the existing construction as indicated.

G. Concrete: Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Where new concrete adjoins existing, the new Work shall abut or tie into the existing construction as indicated.

H. Patching:

1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
3. Patching shall be as specified and indicated, and shall include:
   a. Fill holes and depressions left as a result of removals in existing walls with an approved patching material, applied in accordance with the manufacturer’s printed instructions.

I. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.

4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.

5. Raceways and cabling not scheduled for reuse.

6. Inaccessibly Concealed: Cut off and abandon in place.

7. Exposed or Concealed Above Accessible Ceilings: Remove.


9. Relocating Equipment: Extend existing wiring or run new wiring from the source.

10. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.

11. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).


J. Universal Waste Lamps and Thermostats: Manage in accordance with the Contract.

3.02 ELECTRIC UTILITIES DEMOLITION

A. Assembly Units:

1. Remove for reuse by Owner prior to commencement of demolition.

2. Remove from existing lines, disassemble into material items, and transport materials to Owner’s designated area.

B. Poles:

1. Do not remove ground wire or pole numbering attached to pole.

2. Remove pole and backfill, tamp, and mound holes, unless holes will be reused.

C. Pole-Top Assemblies:

1. Remove assembly. Resag and retie conductors when existing assembly will be replaced and when existing conductor will be reused.

2. Included: Holding and handling of main line, tap conductors, angles, and dead ends.
D. Conductor Unit:
   1. Remove conductor or cable without cutting and reel for reuse by Owner; measure in 1,000-foot increments.
   2. Retain as Salvage: Jumpers, tie wire, armor rods, connectors, and other conductor accessories.

E. Guys: Remove to minimum of 1 foot belowgrade.

F. Anchors: Remove anchor rods; leave anchors in ground. If rod cannot be unscrewed, cut off rod end at least 18 inches below surrounding ground surface elevation.

G. Secondary Units: Remove assembly and untie, resag, and retie secondary conductor or cables when existing item will be reused.

H. Service Units: Remove assembly and untie, resag, and retie secondary conductor or cables when existing service conductor or cable will be reused.

3.03 PROTECTION

A. Dust and Debris Control:
   1. Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
   2. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to vehicular traffic.

B. Traffic Control Signs: Where pedestrian and driver safety is endangered in the area of removal Work, use traffic barricades with flashing lights.

C. Existing Work:
   1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
   2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
   3. Provide temporary weather protection during interval between removal of existing exterior surfaces and installation of new to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
   4. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural
elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.

5. Do not overload pavements to remain.

D. Weather Protection: For portions of the building scheduled to remain, protect building interior and materials and equipment from weather at all times. Where removal of existing roofing is necessary to accomplish the Work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent loss.

E. Trees: Protect trees within the Site that might be damaged during demolition and are indicated to be left in place, by a 6-foot-high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the Work shall be replaced in kind, as approved by the Engineer.

F. Facilities:

1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring, and are determined by Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer.

3. Protect all facility elements not scheduled for demolition.

4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

G. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.

2. Provide temporary barricades and other forms of protection to protect Owner’s personnel and the general public from injury due to demolition Work.

3. Provide protective measures as required to provide free and safe passage of Owner’s personnel and the general public to occupied portions of the structure.
3.04 BURNING

A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.05 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Engineer. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Engineer.

3.06 BACKFILL

A. Do not use demolition debris as backfill material.

B. Fill excavations, open basements and other hazardous openings to existing ground level or foundation level of new construction in accordance with Section 31 23 23, Fill and Backfill.

3.07 TITLE TO MATERIALS

A. All salvaged equipment and materials will remain the property of Owner.

3.08 DISPOSITION OF MATERIAL

A. Do not remove equipment and materials without approval of Contractor’s Demolition/Renovation Plan by Engineer.

B. Salvage equipment and material to the maximum extent possible.

C. Remove materials and equipment that are to be removed by Contractor and deliver to a storage site as directed on the Site.

D. Remove salvaged items in a manner to prevent damage, and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents.

3.09 REUSE OF MATERIALS AND EQUIPMENT

A. Remove and store materials and equipment listed in Article Title To Materials to be reused or relocated to prevent damage, and reinstall as the Work progresses.

B. Properly store and maintain equipment and materials in same condition as when removed.
C. Store equipment and material designated to be reused in a location designated by Owner.

D. Equipment and material designated to be reused shall be cleaned, serviced and checked for proper operability before being put back into service.

E. Engineer will determine condition of equipment and materials prior to removal.

3.10 SPECIALIZED SALVAGE

A. Ozone Depleting Substances (ODS):
   1. Class I and Class II ODS are defined in Section 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling.
   2. Dispose of all Class I and Class II ODS refrigerants in accordance with the Clean Air Act Amendment of 1990.
   3. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g., residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

B. Fire Suppression Containers: Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment. Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.11 UNSALVAGEABLE MATERIAL

A. Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in accordance with the Contract.

B. Combustible material shall be disposed of in accordance with the Contract.

C. Universal Waste: Manage in accordance with the Contract.

D. Disposal shall be at the following locations in accordance with the Contract:
   1. DOE ORR Y-12 Sanitary Landfill.
   2. DOE ORR Environmental Management Waste Management Facility (EMWMF).
   3. Offsite commercial treatment and disposal facilities.
3.12 CLEANUP

A. Debris and rubbish shall be removed from basement and similar excavations. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas in accordance with the Contract.

END OF SECTION
Repair of Vertical and Overhead Concrete Surfaces

Revision History:

<table>
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<tr>
<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
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<tr>
<td>0</td>
<td>Issue for Construction</td>
<td>June 21, 2017</td>
<td>All</td>
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Document Review & Approval:

Originator:  
Harry W. Elliott PE / Lead Structural Engineer

Design Verification Complete:  
Alex Firth/Senior Structural Engineer

Approved:  
W. Laird Ellis, Jr. PE/Design Manager

Signature:  
Harry W. Elliott

Signature:  
Alex Firth

Signature:  
W. Laird Ellis, Jr.
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 301, Specifications for Structural Concrete.
   b. 506.2, Specification for Shotcrete.

2. ASTM International (ASTM):
   a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   c. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   d. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   e. C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   f. C78/C78M, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
   n. C882/C882M, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
   o. C1202, Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration.
1.02 DEFINITIONS

A. Abrasive Blasting: Surface preparation method that uses compressed air intermixed with an abrasive medium to clean surface of substrate concrete, exposed steel, and reinforcing steel. Compressed air and abrasive medium is projected at high speed through a nozzle directly at the surface. Method is used to remove corrosion by-products, laitance, or other materials that may inhibit bond of repair concrete.

B. Defective Area: Surface defect such as honeycomb, rock pockets, indentations and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch diameter, cracks in liquid containment structures and below-grade habitable spaces 0.005-inch wide and wider, cracks in other structures 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances which include but are not limited to fins, form pop-outs, and other projections, and at exposed concrete which includes texture irregularities, stains, and other color variations that cannot be removed by cleaning.

C. High-Pressure Water Blasting: Sometimes referred to as hydro-demolition. Uses water that may contain an abrasive medium, projected under high pressure and high velocity. Used for demolition, cutting, partial or full depth removal, cleaning, scarifying, or roughening of concrete surfaces, or removing existing coatings, for preparation of substrate concrete surfaces.

D. Low-Pressure Spray Mortar: Mortar suitable to be applied by low-pressure spraying, and in small areas may be applied by hand troweling.

E. New Concrete: Concrete less than 60 days old forming structures constructed as part of the Work.
F. Rebound: Shotcrete material, mostly aggregates, that bounce off a surface against which shotcrete was projected.

G. Shotcrete: Mortar pumped through hose and projected at high velocity.

1.03 SUBMITTALS

A. Action Submittals:
   1. Product data sheets for each material supplied.
   2. Drawings indicating results of sounding for hollow areas including location, size, and estimated quantity of hollow-sounding areas for each repair location.

B. Informational Submittals:
   1. Repair Mortar System: Manufacturer’s preparation and installation instructions.
   2. Mesh manufacturer’s installation instructions and allowable load criteria.
   3. Written description of equipment proposed for concrete removal and surface preparation.
   4. Certificates:
      a. Shotcrete Nozzleman: Current ACI Certification for each proposed nozzleman.
      b. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that proposed repair mortar systems:
         1) Meet or exceed specified performance criteria when tested in accordance with Article Field Quality Control.
         2) Are prepackaged, shrinkage compensated, specially designed for use on vertical and overhead surfaces that are exposed to potable water.
      c. Mortar Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.
      d. Confirmation material is certified to meet requirements of NSF 61.
   5. Statements of Qualification:
      a. Repair mortar system applicator.
      b. Repair mortar system manufacturer’s representative.
1.04 QUALITY ASSURANCE

A. Qualifications:

1. Repair Mortar System Applicator:
   a. Trained and experienced applicator recognized or certified by repair mortar system manufacturer.
   b. For Repair System B, in lieu of recognition or certification, demonstrate application of repair mortar manufacturer’s system and obtain Certification of Proper Installation, in accordance with Article Manufacturer’s Services.

2. Repair Mortar System Manufacturer’s Representative: As specified in Section 01 43 33, Manufacturers’ Field Services.

B. Independent Testing Laboratory: Meet criteria stated in ASTM E699.

C. Demonstration Mockup for Shotcrete Mortar or Low-Pressure Spray Mortar Repair System:

1. For each type of repair mortar system to be used, prepare one demonstration mockup in each orientation of at least 10 feet by 10 feet with average thickness, and containing reinforcement, representative of area being repaired on Project. Alternatively, a repair area in each orientation that is representative of area to be repaired in terms of size, thickness, and reinforcement, may be used for demonstration in lieu of mockups; subject to acceptance by Engineer.

2. Repair Mortar System Manufacturer’s Demonstration:
   a. Schedule time for manufacturer’s demonstration of repair system proposed for Project.
   b. Prepare mortar to specified consistency for testing and placement.
   c. Cure portions of each type of surface to be repaired using proposed curing procedure and materials, including overhead and vertical applications.
   d. Prepare surface area in advance of demonstration and obtain manufacturer’s acceptance of preparation for each type of application.
   e. Demonstrate the following:
      1) Mixing and application equipment capabilities and procedures, including flow of material from nozzle or sprayer.
      2) Nozzle operator and person in charge of low-pressure sprayer, capabilities and ability to follow prescribed application procedures and properly operate equipment and apply surface repair materials.
f. Compression Strength Test: Make compression test samples from wet mortar during demonstration placement and deliver to independent testing laboratory for testing at 7 days and 28 days.
g. Tensile Bond Test: Test in situ for tensile bond at 7 days as specified in Paragraph Direct Tension Bond Test.

D. Demonstration Mockup for Hand-Applied Repair Mortar:

1. For each type of repair mortar system to be used, prepare one demonstration mockup in each orientation of average size and thickness, and containing reinforcement, representative of area being repaired on Project. Alternatively, a repair area in each orientation that is representative of area to be repaired in terms of size, thickness, and reinforcement, may be used for demonstration in lieu of mockups; subject to acceptance by Engineer.

2. Repair Mortar System Manufacturer’s Demonstration:
   a. Schedule time for manufacturer’s demonstration of repair system proposed for Project.
   b. Prepare mortar to specified consistency, for testing and placement.
   c. Cure portions of each type of surface to be repaired using proposed curing procedure and materials, including overhead and vertical applications.
   d. Prepare surface area in advance of demonstration and obtain manufacturer’s acceptance of preparation for each type of application.
   e. Demonstrate mixing and application procedures.
   f. Compression Strength Test: Make compression test samples from wet mortar during demonstration placement and deliver to independent testing laboratory for testing at 7 days and 28 days.
   g. Tensile Bond Test: Test in situ for tensile bond at 7 days as specified in Paragraph Direct Tension Bond Test.

E. Pre-repair Conference:

1. Required Meeting Attendees:
   a. Contractor.
   b. Repair Subcontractor.
   c. Technical representative for repair material manufacturer.
   d. Engineer.

2. Schedule and conduct prior to conducting mockups and incorporation of respective products into Project. Notify Engineer of location and time.

3. Agenda shall include, but not limited to:
   a. Review of field conditions. Conduct field observations of Work to be performed.
b. Based on above observations, repair material manufacturer’s technical representative shall confirm material selection and make Project-specific repair method recommendations.

c. Technical representative for repair material manufacturer shall review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.

d. Other specified requirements requiring coordination.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package repair mortar system products in moisture-resistant bags, pails, or moisture-resistant bulk bags.

B. Deliver, store, and handle repair materials in accordance with manufacturer’s printed instructions.

PART 2 PRODUCTS

2.01 SYSTEM A—SHOTCRETE MORTAR

A. Mortar Materials:

1. Blend of selected portland cements, microsilica, and specially graded aggregates and fibers applicable for vertical and overhead surfaces.
2. Materials shall not contain asbestos, chlorides, nitrates, added gypsum, added lime, or high aluminum cements.
3. Noncombustible before and after cure.
4. Furnish in factory proportioned unit.
5. Workability from 1/4 inch in depth and greater.

B. Mixed Mortar Properties:

1. Working Time: 5 minutes to 10 minutes.
2. Finishing Time: 10 minutes to 20 minutes.
3. Color: Dark gray.

C. Cured Mortar Properties:

1. Compressive strength for 2-inch cubes in accordance with ASTM C109/C109M, or 3-inch cubes in accordance with manufacturer’s modification to ASTM C109/C109M:
   a. 7 Days: 6,000 psi minimum.
   b. 28 Days: 7,000 psi minimum.
2. Flexural Strength (Modulus of Rupture), ASTM C78/C78M or ASTM C348 (Modified) at 28 Days: 1,100 psi minimum.
5. Mortar shall not produce a vapor barrier.
6. Certified to meet requirements of NSF 61 for contact with potable water.

D. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MASTEREMACO S 211SP.
2. Sika Corp., Lyndhurst, NJ; SIKACEM 103F.
3. Euclid Chemical Co., Cleveland, OH; Eucoshot F.

2.02 SYSTEM B—LOW-PRESSURE SPRAY MORTAR

A. One-component, cement based, fiber reinforced, shrinkage compensated, gray in color, with a minimum 30-minute working time.

B. Cured materials mixed in accordance with manufacturer’s instructions shall conform to the following criteria:

2. Flexural Strength, ASTM C348 at 28 Days: 1,100 psi minimum.
3. Slant Shear Bond Strength, ASTM C882/C882M Test Method Modified with No Bonding Agent, at 28 Days: 3,000 psi minimum.
4. Direct Tensile Bond Strength, ASTM C496/C496M at 28 Days: 300 psi minimum.
5. Drying Shrinkage, ASTM C157/C157M Modified at 28 Days or ASTM C531: 0.1 percent maximum.
6. Chloride Ion Permeability Based on Charge Passed, ASTM C1202: 800 coulombs maximum.
7. System shall not produce a vapor barrier.
8. Certified to meet requirements of NSF 61 for contact with potable water.
9. Sprayable, extremely low permeability, sulfate resistant, easy to use and requiring only addition of water.
10. Free of chlorides and other chemicals causing corrosion.
C. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco S 488CI.
2. Sika Corp., Lyndhurst, NJ; SikaRepair 224.
3. Euclid Chemical Co., Cleveland, OH; Tamms Structural Mortar.

2.03 SYSTEM C—POLYMER-MODIFIED REPAIR MORTAR

A. Polymer-modified, one- or two-component, cementitious based, chloride resistant, flowable, gray in color, working time of 20 minutes minimum, surface renovation mortar.

B. Cured Mortar Properties:

2. Flexural Strength, ASTM C348 at 28 Days: 1,200 psi minimum.
3. Slant Shear Bond Strength, ASTM C882/C882M Test Method Modified with No Bonding Agent at 28 Days: 2,000 psi minimum.
5. Freeze Thaw Resistance, ASTM C666/C666M, at 300 Cycles: 90 percent RDM.
6. Chloride Ion Permeability Based on Charge Passed, ASTM C1202: 800 coulombs maximum.
7. Certified to meet requirements of NSF 61 for contact with potable water.

C. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco N 300 CI.
2. Sika Corp., Lyndhurst, NJ; SikaTop 123 PLUS.
3. Euclid Chemical Co., Cleveland, OH; DuralTop Gel.

2.04 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards, as specified in Section 03 30 00, Cast-in-Place Concrete.
2.05 REINFORCEMENT

A. Deformed Reinforcing Bars:
   1. ASTM A615/A615M, Grade 60.

B. Mesh Reinforcement: Welded wire fabric flat sheets with spacing of wires and wire size in accordance with ASTM A185/A185M, wire 75 ksi minimum tensile strength per ASTM A82/A82M.

C. Tie Wire: 16-gauge, galvanized.

D. Mesh Anchors:
   1. Manufacturers and Products:
      b. Hilti Fastener Systems, Tulsa, OK; Kwik Bolt HHDCA, 1/4-inch ceiling hanger.

2.06 CEMENTITIOUS BONDING AGENT AND REINFORCEMENT COATING

A. Cementitious adhesive, specifically formulated for bonding plastic portland cement concrete or mortar to hardened portland cement concrete.
   1. Mixed Bonding Agent Properties:
      a. Pot Life: 75 minutes to 105 minutes.
      b. Contact Time: 24 hours.
      c. Color: Concrete Gray.
   2. Cured Cementitious Adhesive Properties:
      a. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 500 psi minimum.
      b. Flexural Strength, ASTM C348: 1,000 psi minimum.
      c. Slant Shear Bond Strength, ASTM C882/C882M at 14 Days:
         1) 2-Hour Open Time: 2,500 psi minimum.
         2) 24-Hour Open Time: 2,000 psi minimum.
   3. Bonding agent shall not produce a vapor barrier.
   4. Compatible with repair system.

B. Manufacturers and Products:
   1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco P 124.
   2. Sika Corp., Lyndhurst, NJ; Sika Armatec 110 EpoCem.
   3. Euclid Chemical Co., Cleveland, OH; Dural Prep A.C.
2.07 EVAPORATION RETARDANT
   A. As specified in Section 03 39 00, Concrete Curing.

2.08 CURING COMPOUND
   A. As specified in Section 03 39 00, Concrete Curing.

PART 3 EXECUTION

3.01 GENERAL
   A. New Concrete Work: Repair deficiencies in new concrete structures constructed under this Contract with applicable repair system. Refer to Section 03 30 00, Cast-in-Place Concrete.

3.02 PREPARATION
   A. Identify unsound and deteriorated concrete by sounding techniques, or as directed by Engineer, and review proposed extent of repair with Engineer.

   B. Remove unsound, honeycombed, deteriorated, or otherwise defective areas of concrete from work areas.
      1. Use 8,000 psi minimum high-pressure water blasting machine as required for Site conditions.
      2. Remove concrete to abrade substrate concrete surfaces to a minimum amplitude roughness of 3/16 inch measured between high and low points with a 3-foot-long straightedge, in accordance with ASTM D4259.
      3. Where final surface is required to be flush with existing adjacent surface remove existing concrete depth as required for application of minimum thickness of repair mortar.

   C. Do not use power-driven jackhammers, chipping hammers, or scabblers unless water blasting is not permitted or practical due to Site conditions, or may cause other damage to equipment or facilities. In such cases where chipping hammers are required, limit size of chipping hammer to 16 pounds or lighter, or use small electric chipping hammer, to reduce formation of micro-fractures in substrate concrete surface.

   D. Following removal of unsound or deteriorated concrete, check substrate concrete surface by sounding techniques to identify unsound concrete remaining or resulting from use of chipping hammer.

   E. Remove unsound concrete to satisfaction of Engineer.
F. Square edges of patch areas by sawing or chipping to avoid tapered shoulders or featheredges. Avoid cutting embedded reinforcing steel. Roughen polished saw-cut edge by high-pressure water blasting.

G. Remove concrete adjacent to reinforcing bar to a minimum of 1-inch clearance around reinforcing bar for application and bonding of new repair mortar to circumference of exposed reinforcing bar if one or more of the following surface conditions exist:

1. 50 percent or more of circumference around reinforcing bar is exposed during concrete removal.
2. 25 percent or more of circumference around reinforcing bar is exposed during concrete removal and corrosion is present to extent that more than 25 percent loss of section has occurred.
3. Otherwise evident that bond between existing concrete and reinforcing bar has been destroyed or has deteriorated as determined by Engineer.

H. Clean exposed reinforcing steel bars of loose rust and concrete splatter per recommendations of repair material manufacturer and in accordance with ASTM D4258.

I. Keep areas from which concrete has been removed free of dirt, dust, and water blasting waste slurry. Remove laitance and other bond inhibiting contaminants from prepared areas.

J. Dampen repair areas at least 6 inches beyond area to receive repair mortar for at least 24 hours to provide saturated surface dry (SSD) condition without standing water at time of application of mortar as required by and in accordance with repair mortar manufacturer’s printed instructions.

K. Collect and dispose of spent water and concrete debris from removal operations offsite in manner and location acceptable to Owner.

3.03 REINFORCEMENT INSTALLATION

A. Provide reinforcement when existing reinforcement is not exposed, and when mortar application is more than 3 inches deep, unless otherwise shown on Drawings.

B. Replace deteriorated reinforcing with new reinforcing equivalent in cross-sectional area to original reinforcing.

C. Install mesh anchors in accordance with mesh manufacturer’s instructions.

D. Fasten reinforcing bars to mesh anchors with tie wire to prevent from moving during placement of repair mortar.
E. Lap reinforcement mesh a minimum of one mesh spacing and securely fasten mesh to mesh anchors, or to reinforcement fastened to mesh anchors, with tie wire at intervals no more than 12 inches to prevent movement during application of repair mortar.

F. Coat exposed new and existing reinforcing bars and reinforcement mesh with cementitious reinforcement coating at same time as substrate concrete is coated, as specified below, per repair mortar and cementitious reinforcement coating manufacturers’ printed instructions.

3.04 PROTECTION

A. If cementitious coating or bonding agent is used, protect adjacent surfaces from over application. Promptly remove bonding agent applied beyond repair area.

B. Protect adjacent surfaces, and equipment, from being damaged by overshooting, rebound, and dust, as applicable for repair mortar system used, from shotcrete mortar or low-pressure spray mortar.

3.05 SYSTEM A—SHOTCRETE MORTAR APPLICATION

A. Apply shotcrete mortar in accordance with manufacturer’s instructions.

B. Do not reuse rebound materials.

C. Apply mortar utilizing dry mix process, in accordance with ACI 506.2.

D. Shotcrete mortar shall emerge from nozzle in a steady, uninterrupted flow. If flow becomes intermittent, direct flow away from the Work until flow of mortar becomes constant.

E. Applied Shotcrete Mortar: Minimum thickness of 1-1/2 inches to 2 inches of cover over existing reinforcement, or to level of surrounding concrete surface, whichever results in thicker coat.

F. Nozzle Position: Hold nozzle approximately at right angles to and at a distance from surface in accordance with shotcrete repair mortar system manufacturer’s instructions for type of application, nozzle, and air pressure used.

G. Reinforcing Steel Encasement:

1. Modify procedure of shooting shotcrete mortar to better direct material around reinforcement bars.
2. Prevent shotcrete mortar from building up on reinforcement steel when shooting on, around, through, and behind steel to eliminate voids.

3. Provide dense void-free encasement of reinforcement steel.

H. Shotcreting More than One Layer: In accordance with shotcrete repair mortar system manufacturer’s printed instructions.

I. Slice off excess material with a wire screed approximately 5 minutes to 10 minutes after initial set.

J. Apply finish to exposed shotcrete mortar surface to match existing surface and in accordance with manufacturer’s instructions.

K. Rebound Removal: Continuously throughout shotcrete mortar application, remove rebound, sand, and miscellaneous debris, and dispose off Site at an approved disposal facility.

L. Cure as specified in Article Curing.

3.06 SYSTEM B—LOW-PRESSURE SPRAY MORTAR APPLICATION

A. Mix mortar in accordance with manufacturer’s printed instructions.

B. After priming prepared substrate concrete surface per manufacturer’s recommendations, apply mortar by low-pressure spraying equipment, unless noted otherwise.

C. Bonding Agent:

   1. Use bonding agent for hand applied areas, in accordance with repair mortar manufacturer’s instructions.
   2. Application of repair mortar over bonding agent shall be completed within time frame recommended by bonding agent manufacturer.
   3. Consult with manufacturer for optimum and minimum acceptable degrees of surface tackiness of coat.

D. Work mortar firmly and quickly into repair area.

E. Finish repair mortar to smooth even surface matching adjacent concrete surface.

F. Cure as specified in Article Curing.
3.07 SYSTEM C—POLYMER-MODIFIED REPAIR MORTAR APPLICATION

A. Mix mortar in accordance with manufacturer’s printed instructions.

B. Bond Coat: Apply to prepared substrate concrete surface before application of mortar in accordance with repair mortar manufacturer’s printed instructions. Do not apply more bond coat than can be covered with mortar before bond coat dries. Do not retemper bond coat.

C. Place mortar by hand or low-pressure spray and trowel to specified surface finish, in accordance with requirements of repair material’s printed instructions.

D. Finish repair mortar matching adjacent concrete surface with.

E. Cure as specified in Article Curing, and in accordance with manufacturer’s printed instructions.

3.08 CURING

A. Prior to curing, apply water fog to repair mortar system in accordance with repair mortar system manufacturer’s printed instructions.

B. Cure in accordance with repair mortar manufacturer’s printed instructions.

C. Where permitted by repair mortar manufacturer’s printed instructions, commence water curing after repair mortar system application and when curing will not cause erosion of mortar.

D. Continuously water cure repair mortar system for a period of 7 days.

E. Do not cure using curing compound or membrane, unless method is part of repair mortar system manufacturer’s printed instructions and approval is obtained from Engineer.

F. Cure intermediate layers of repair mortar in accordance with repair mortar manufacturer’s printed instructions.

G. Where curing compound is permitted by repair mortar system manufacturer, apply curing compound in accordance with Section 03 39 00, Concrete Curing.
FIELD QUALITY CONTROL

A. Sounding for Hollow Areas:
   1. Light hammer tap repaired areas listening for hollow sound to determine areas that have not properly bonded to substrate concrete.
   2. Mark hollow areas for removal and replacement.

B. Compression Strength Test:
   1. Test in accordance with ASTM C109/C109M, except modified by making samples using repair mortar.
   2. Obtain production samples of mixed wet mortar materials from nozzle, or mixer, during construction for compliance with Specifications for testing at 7 days, and 28 days.
   3. Provide a minimum of three samples for each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater, for testing.
   4. Record location where repair mortar is being applied at time production samples are obtained.

C. Direct Tension Bond Test:
   1. In Situ Bond Testing: Perform tension bond test in accordance with ASTM C1583/C1583M.
   2. Record locations on in situ bond tests on each type of applied repair mortar.

D. Testing laboratory retained by Owner will test the following:
   1. Compression Strength Test:
      a. Testing will follow a “modified” ASTM C109/C109M.
      b. A minimum of three production samples of mixed material will be obtained from each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater, for testing at 7 days, and 28 days.
      c. Record location where repair mortar is being applied at time production samples are obtained.
   2. Direct Tension Bond Test:
      a. Two core samples will be obtained and tested for each 2,000 square feet of repair work.
      b. Cores will be 2-1/2-inch or 3-inch diameter to a total depth equal to at least 2.5 times repair mortar thickness.
      c. Bond Strength of Repair Mortar to Substrate Concrete: 300 psi minimum in direct tension without failure or movement.
d. Record locations of Bond Tests on each type of applied repair mortar tested.

E. Retest mortar repairs that do not meet test requirements.

F. Repair and fill holes using same repair mortar where core samples have been removed.

3.10 MORTAR REPAIR FAILED TEST

A. Remove and replace unacceptable Work.

B. Hollow Sounding Areas: Saw cut hollow sounding areas to a new square edge. Remove unsound mortar repair. Prepare substrate surface and reapply repair mortar as specified herein above.

C. Failed Compression Strength Test: Remove affected areas of repair mortar represented by failed compression strength test results. Prepare substrate surface and reapply repair mortar as specified herein above.

D. Failed Bond Tests: Remove affected areas of repair mortar represented by failed bond test results. Prepare substrate surface and reapply repair mortar as specified herein above.

E. Retest areas where repair mortar was removed and replaced, in accordance with test requirements specified herein above.

3.11 MANUFACTURER’S SERVICES

A. Provide repair mortar system manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for review acceptability of surface preparation, mixing and installation assistance, training of repair mortar system applicators, inspection, and Certification of Proper Installation.

3.12 CLEANING

A. Remove overshot repair mortar and rebound materials as the Work proceeds. Remove waste materials, unsound material from concrete surfaces, material chipped from structure, and water used in preparation of or repair areas, finishing, and curing, and dispose offsite at an approved disposal site.

END OF SECTION
Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: Structural
Specification Division: 3 – Concrete
Date: 6/16/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Repair of Horizontal Concrete Surfaces

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Document Review & Approval:

Originator:
Harry W. Elliott PE / Lead Structural Engineer

Design Verification Complete:
Alex Firth/Senior Structural Engineer

Approved:
W. Laird Ellis, Jr. PE/Design Manager

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Digital signature by W. Laird Ellis, Jr.
Date: 2017.06.21 12:50:44 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): T277, Standard Method of Test for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration.

2. ASTM International (ASTM):
   a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   c. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   d. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   e. C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   f. C78/C78M, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
   n. C882/C882M, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
q. C1202, Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration.
r. C1583/C1583M, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).
u. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
v. D4259, Standard Practice for Abrading Concrete.

1.02 DEFINITIONS

A. Abrasive Blasting: Surface preparation method that uses compressed air intermixed with an abrasive medium to clean surface of substrate concrete, exposed steel, and reinforcing steel. Compressed air and abrasive medium is projected at high speed through a nozzle directly at the surface. Method is used to remove corrosion by-products, laitance, or other materials that may inhibit bond of repair concrete.

B. Defective Area: As defined in Section 03 30 00, Cast-in-Place Concrete.

C. High-Pressure Water Blasting: Sometimes referred to as hydro-demolition. Uses water that may contain an abrasive medium, projected under high pressure and high velocity. Used for demolition, cutting, partial or full depth removal, cleaning, scarifying, or roughening of concrete surfaces, or removing existing coatings, for preparation of substrate concrete surfaces.

D. New Concrete: As defined in Section 03 30 00, Cast-in-Place Concrete.

1.03 SUBMITTALS

A. Action Submittals:

1. Product data sheets for each material supplied.
2. Drawings indicating results of sounding for hollow areas including location, size, estimated quantity, of hollow-sounding areas for each repair location.
B. **Informational Submittals:**

1. **Repair Mortar System:** Manufacturer’s preparation and installation instructions.
2. **Written description of equipment proposed for concrete removal and surface preparation.**
3. **Certificates:**
   a. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that material meets requirements of ASTM C928/C928M.
   b. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that proposed repair mortar systems meet or exceed specified performance criteria when tested in accordance with Article Field Quality Control.
   c. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that repair mortar systems are prepackaged, shrinkage compensated, specially designed for use on horizontal surfaces that are exposed to.
   d. **Mortar Manufacturer’s Certificate of Proper Installation,** in accordance with Section 01 43 33, Manufacturers’ Field Services.
4. **Statements of Qualification:**
   a. Repair mortar system applicator.
5. **Field and laboratory test results.**

1.04 **QUALITY ASSURANCE**

A. **Qualifications:**

1. **Repair Mortar System Applicator:** Trained and experienced applicator endorsed by repair mortar system manufacturer.
2. **Repair Mortar System Manufacturer’s Representative:** As specified in Section 01 43 33, Manufacturers’ Field Services.

B. **Pre-repair Conference:**

1. **Required Meeting Attendees:**
   a. Contract.
   b. Repair Subcontractor.
   c. Technical representative for repair material manufacturer.
   d. Engineer.
2. **Schedule and conduct prior to incorporation of respective products into Project.** Notify Engineer of location and time.
3. **Agenda shall include, but not limited to:**
   a. Review of field conditions. Conduct field observations of the Work to be performed.
b. Based on above observations, repair material manufacturer’s technical representative shall confirm material selection and make Project specific repair method recommendations.

c. Technical representative for repair material manufacturer shall review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.

d. Other specified requirements requiring coordination.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package repair mortar system products in moisture-resistant bags, pails, or moisture-resistant bulk bags.

B. Deliver, store, and handle repair materials in accordance with manufacturer’s printed instructions.

PART 2 PRODUCTS

2.01 SYSTEM NO. 3—SHRINKAGE COMPENSATED REPAIR MORTAR

A. One-component cement-based, flowable, shrinkage compensated repair mortar system.

B. Compressive Strength, ASTM C109/C109M:
   1. 1 Day: 2,500 psi minimum.
   2. 7 Days: 6,000 psi minimum.
   3. 28 Days: 8,000 psi minimum.

C. Flexural Strength, ASTM C348 at 28 Days: 770 psi minimum.

D. Modulus of Elasticity, ASTM C469 at 28 Days: 5.9 by 10^6 psi minimum.

E. Slant Shear Bond Strength, ASTM C882/C882M Modified:
   1. 7 Days: 2,150 psi minimum.
   2. 28 Days: 3,000 psi minimum.

F. Freeze-thaw Resistance, ASTM C666/C666M, Procedure A, at 300 Cycles: 97.0 percent RDM.

G. Chloride Ion Permeability Based on Charge Passed, ASTM C1202 at 28 Days: 650 coulombs maximum.
H. Sulfate Resistance, ASTM C1012/C1012M after 6 Months: 0.01 percent length change maximum.

I. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco S 466 CI.
2. Euclid Chemical Co., Cleveland, OH; Eucocrete Supreme.

2.02 SYSTEM NO. 5—POLYMER MODIFIED REPAIR MORTAR

A. One or two-component, fast-setting, polymer modified cementitious based repair mortar system.

B. Compressive Strength, ASTM C109/C109M:

1. 1 Day: 2,500 psi minimum.
2. 7 Days: 5,000 psi minimum.
3. 28 Days: 7,000 psi minimum.

C. Flexural Strength, ASTM C348 at 28 Days: 1,500 psi minimum.

D. Slant Shear Bond Strength, ASTM C882/C882M at 28 Days: 2,000 psi minimum.

E. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 600 psi minimum.

F. Abrasion Resistance Depth of Wear, ASTM C779/C779M, Procedure A, at 60 Minutes: 0.033 inch maximum.

G. Drying Shrinkage, ASTM C157/C157M Modified, at 28 Days: 0.09 percent maximum.


I. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco T 310 CI.
2. Euclid Chemical Co., Cleveland, OH; Duraltop Flowable Mortar.
3. Sika Corp., Lyndhurst, NJ; SikaTop 122 PLUS.
2.03 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards, as specified in Section 03 30 00, Cast-in-Place Concrete.

2.04 REINFORCEMENT

A. Deformed Reinforcing Bars:
   1. Per Section 03 21 00, Reinforcing Steel.

B. Mesh Reinforcement: Welded wire fabric flat sheets with spacing of wires and wire size in accordance with ASTM A185/A185M, wire 75 ksi minimum tensile strength per ASTM A82/A82M.

C. Tie Wire: 16-gauge, galvanized.

D. Mesh Anchors:
   1. Manufacturers and Products:
      b. Hilti Fastener Systems, Tulsa, OK; Kwik Bolt HHDCA, 1/4-inch ceiling hanger.

2.05 CEMENTITIOUS BONDING AGENT AND REINFORCEMENT COATING

A. Cementitious adhesive, specifically formulated for bonding plastic portland cement concrete or mortar to hardened portland cement concrete.

   1. Mixed Bonding Agent Properties:
      a. Pot Life: 75 minutes to 105 minutes.
      b. Contact Time: 24 hours.
      c. Color: Concrete gray.

   2. Cured Cementitious Adhesive Properties:
      a. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 600 psi minimum.
      b. Flexural Strength, ASTM C348: 1,000 psi minimum.
      c. Slant Shear Bond Strength, ASTM C882/C882M:
         1) 2-Hour Open Time: 2,500 psi minimum.
         2) 24-Hour Open Time: 2,000 psi minimum.
      d. Bonding agent shall not produce a vapor barrier.
      e. Compatible with repair mortar system.
B. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco P 124.
2. Sika Corp., Lyndhurst, NJ; Sika Armatec 110 EpoCem.
3. Euclid Chemical Co., Cleveland, OH; Dural Prep AC.

2.06 EPOXY BONDING AGENT

A. Two-component, moisture insensitive, 100 percent solids epoxy resin.
B. Tensile Strength, ASTM D638, at 14 Days: 4,400 psi minimum.
C. Elongation at Break, ASTM D638: 1.49 percent minimum.
D. Compressive Strength, ASTM D695, at 28 Days for Application Temperature of 73 Degrees F to 77 Degrees F: 8,000 psi minimum.
E. Bond Strength, ASTM C882/C882M, at 14 Days: 1,800 psi minimum.
F. Pot Life, at 73 Degrees F to 77 Degrees F: 75 minutes minimum.

G. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco ADH 326 when ambient temperature is 73 degrees F or higher.
2. Sika Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod LPL.

2.07 EVAPORATION RETARDANT

A. As specified in Section 03 39 00, Concrete Curing.

2.08 CURING COMPOUND

A. As specified in Section 03 39 00, Concrete Curing.

PART 3 EXECUTION

3.01 GENERAL

A. New Concrete Work: Repair deficiencies in new concrete structures constructed under this Contract with applicable repair system.
3.02 PREPARATION

A. Identify unsound and deteriorated concrete by sounding techniques, or as directed by Engineer. Review proposed extent of repair with Engineer.

B. Remove unsound, deteriorated, or otherwise defective areas of concrete from work areas.
   1. Use 8,000 psi minimum psi high-pressure water blasting machine, as appropriate to suit Site conditions.
   2. Remove concrete to abrade substrate concrete surface to a minimum amplitude roughness of 3/16 inch measured between high and low points with a 3-foot-long straightedge, in accordance with ASTM D4259.
   3. Where final surface is required to be flush with existing adjacent surface, remove existing concrete depth as required for application of minimum thickness of repair mortar.

C. Do not use power-driven jackhammers, chipping hammers, scabblers, or scarifiers unless water blasting is not permitted or practical due to Site conditions, or may cause other damage to equipment or facilities. In such cases where chipping hammers are required, limit size of chipping hammer to 16 pounds or lighter, or use small electric chipping hammer, to reduce formation of micro-fractures in substrate concrete surface.

D. Following removal of unsound or deteriorated concrete, check substrate concrete surface by sounding techniques to identify unsound concrete remaining or resulting from use of chipping hammer.

E. Remove unsound concrete to satisfaction of Engineer.

F. Square edges of patch areas by sawing or chipping to avoid tapered shoulders or featheredges. Avoid cutting embedded reinforcing steel. Roughen polished saw-cut edge by high-pressure water blasting.

G. Remove concrete adjacent to reinforcing bar to a minimum of 1-inch clearance around reinforcing bar for application and bonding of new repair mortar to entire circumference of exposed reinforcing bar if one or more of the following surface conditions exist:
   1. 50 percent or more of circumference around reinforcing bar is exposed during concrete removal.
   2. 25 percent or more of circumference around reinforcing bar is exposed during concrete removal and corrosion is present to extent that more than 25 percent loss of section has occurred.
3. Otherwise evident that bond between existing concrete and reinforcing bar has been destroyed or has deteriorated as determined by Engineer.

H. Clean exposed reinforcing steel bars of loose rust and concrete splatter per recommendations of repair material manufacturer and in accordance with ASTM D4258.

I. Keep areas from which concrete has been removed free of dirt, dust, and water blasting waste slurry. Remove laitance and other bond inhibiting contaminates from prepared areas.

J. Substrate Concrete Surface in Areas to Receive Repair Mortar System Nos. 3, or 5: Dampen repair areas at least 6 inches beyond area to receive repair mortar for at least 24 hours to provide saturated surface dry (SSD) condition without standing water at time of application of mortar, as required by and in accordance with repair mortar manufacturer’s printed instructions.

K. Spalled Joints:
   1. Saw cut edge 1 inch deep and 6 inches back from old joint.
   2. Remove unsound concrete and concrete between saw cut and joint.
   3. Place wood or fiber spacer to thickness of joint at joint line.

L. Overlays:
   1. Square cut edges to a minimum of 1/4 inch deep.
   2. Do not feather edge area.
   3. Perform special preparation recommended by mortar manufacturer.

M. Collect and dispose of spent water and concrete debris from removal operations offsite in manner and location acceptable to Owner.

3.03 REINFORCEMENT INSTALLATION

A. Provide reinforcement when existing reinforcement is not exposed, and when mortar application is more than 4 inches deep, unless otherwise shown on Drawings.

B. Replace deteriorated reinforcing with new reinforcing equivalent in cross-sectional area to original reinforcing.

C. Install mesh anchors in accordance with mesh manufacturer’s instructions.

D. Fasten reinforcement to chairs with tie wire to prevent from moving during placement of repair mortar.
E. Lap reinforcement mesh a minimum of one mesh spacing and securely fasten mesh to mesh anchors, or to reinforcement fastened to mesh anchors, with tie wire at intervals no more than 12 inches to prevent movement during application of repair mortar.

F. Coat exposed new and existing reinforcing bars with cementitious reinforcement coating at the same time as substrate concrete is coated, as specified below, per repair mortar and cementitious reinforcement coating manufacturers’ printed instructions.

3.04 PROTECTION

A. If cementitious coating or bonding agent is used, protect adjacent surfaces from over application. Promptly remove bonding agent applied beyond repair area.

B. Protect adjacent surfaces, and equipment from spillage of repair mortar and dust, as applicable for repair mortar system used.

3.05 APPLICATION

A. General:

1. Repair Mortar System No. 3: Patches, joints, or overlays 1 inch thick or greater. Return to service in 7 days or more.
2. Repair Mortar System No. 5:
   a. Patches and Overlays: 1/4 inch to 3 inches thick.
   b. Return to service for foot traffic in 4 hours; wheel traffic in 7 days.
   c. Working Time: 30 minutes at 70 degrees F.
   d. Application Temperature Range: 45 degrees F to 90 degrees F.

B. Repair Mortar System Nos. 3, or 5:

1. Remove standing and free water from prepared area.
2. Apply bond scrub coat of mortar to prepared surface in accordance with manufacturer’s instructions. Do not apply more scrub coat of mortar than can be covered with repair mortar before scrub coat begins drying.
3. Immediately place mixed repair mortar into prepared area from one side to the other side.
4. Work material firmly into bottom and sides of patch to ensure a good continuous bond.
5. Level repair mortar and screed to elevation of existing concrete.
6. Finish to same texture as existing concrete around patch.
7. Repair Mortar System No. 5 screed or use self-leveling mixture to obtain a uniform and plane surface.
C. Joint Repair:
   1. Remove joint spacer when repair mortar is hard enough that a pointed trowel will penetrate surface less than 1/2 inch.
   2. When repair mortar is cured and ready for use, fill joint in accordance with repair mortar system manufacturer’s instructions.

3.06 FINISHING
   A. Spray full strength evaporation retardant on fresh concrete to prevent rapid drying during hot and windy weather.

3.07 CURING
   A. Repair Mortar System Nos. 3, or 5: Apply curing compound in accordance with Section 03 39 00, Concrete Curing.

3.08 FIELD QUALITY CONTROL
   A. Sounding for Hollow Areas:
      1. Chain drag or light hammer tap repaired areas listening for hollow sound to determine areas that have not properly bonded to substrate concrete.
      2. Mark hollow areas for removal and replacement.
   B. Compression Strength Test:
      1. Test in accordance with ASTM C109/C109M, except modified by making samples using repair mortar.
      2. Obtain production samples of mixed materials from mixer during construction for compliance with Specifications.
      3. Provide minimum of three samples for each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater for testing.
      4. Record location where repair mortar is being applied at time production samples are obtained.
   C. Direct Tension Bond Test:
      1. In Situ Bond Testing: Perform tension bond test in accordance with ASTM C1583/C1583M.
      2. Record locations on in situ bond tests on each type of applied repair mortar.
D. Testing laboratory retained by Owner will test the following:

1. Compression Strength Test:
   a. Testing will follow a “modified” ASTM C109/C109M.
   b. A minimum of three production samples of mixed material will be obtained from each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater, for testing at 7 days, and 28 days.
   c. Record location where repair mortar is being applied at time production samples are obtained.

2. Direct Tension Bond Test:
   a. Two core samples will be obtained and tested for each 2,000 square feet of repair work.
   b. Cores will be 2-1/2-inch or 3-inch diameter to a total depth equal to at least 2.5 times repair mortar thickness.
   c. Bond Strength of Repair Mortar to Substrate Concrete: 300 psi minimum in direct tension without failure or movement.
   d. Record locations of bond tests on each type of applied repair mortar tested.

E. Retest mortar repairs that do not meet test requirements.

F. Repair and fill holes using same repair mortar where core samples have been removed.

3.09 MORTAR REPAIR FAILED TEST

A. Remove and replace unacceptable Work.

B. Hollow Sounding Areas: Saw cut hollow sounding areas to a new square edge, remove unsound mortar repair. Prepare substrate surface and reapply repair mortar as specified herein above.

C. Failed Compression Strength Test: Remove affected areas of repair mortar represented by failed compression strength test results. Prepare substrate surface and reapply repair mortar as specified herein above.

D. Failed Bond Tests: Remove affected areas of repair mortar represented by failed bond test results. Prepare substrate surface and reapply repair mortar as specified herein above.

E. Retest areas where repair mortar was removed and replaced, in accordance with test requirements specified herein above.
3.10 MANUFACTURERS’ SERVICES

A. Provide mortar manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for advice on product selection, review acceptability of surface preparation, mixing and installation assistance, inspection, and Certification of Proper Installation.

3.11 CLEANING

A. Remove excess repair mortar materials as the Work proceeds. Remove waste materials, unsound material from concrete surfaces, material chipped from structure, and water used in preparation of repair areas, finishing, and curing, and dispose offsite at approved disposal site.

END OF SECTION
**Specification Document Control No.:** 03 10 00  
**Revision No.:** 0  
**Project:** Outfall 200 Mercury Treatment Facility  
**Engineering Discipline:** Structural  
**Specification Division:** 3 – Concrete  
**Date:** 6/23/2017  

**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)  
Concrete Forming and Accessories

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**Document Review & Approval:**

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Harry W. Elliott / Lead Structural Engineer  
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**Design Verification Complete:**  
Alex Firth/Senior Structural Engineer  
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Date: 2017.06.23 15:22:44 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. 318, Building Code Requirements for Structural Concrete and Commentary.

1.02 DEFINITIONS

A. Architectural Concrete: See definition in Section 03 30 00, Cast-in-Place Concrete.

B. Defective Areas: See definition in Section 03 30 00, Cast-in-Place Concrete.

C. Exposed Concrete: See definition in Section 03 30 00, Cast-in-Place Concrete.

1.03 DESIGN REQUIREMENTS

A. Design formwork in accordance with ACI 301 and ACI 318 to provide concrete finishes specified in Section 03 30 00, Cast-in-Place Concrete.

B. When high range water reducer (superplasticizer) is used in concrete mix, form design shall account for increased hydrostatic pressures.

C. Joints in forms shall be watertight.

D. Limit panel deflection to 1/360th of each component span to achieve tolerances specified.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Layout of panel joints and tie hole pattern.
2. Product Data:
   a. Form release agent.
   b. Form ties.
   c. Products to be used for sealing tie holes.

B. Informational Submittals:

1. Statement of qualifications for formwork designer.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Formwork Designer: Formwork, falsework, and shoring design shall be by an engineer licensed in the state of Project.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in “new and undamaged” condition, of sufficient strength and surface smoothness to produce specified finish.

2. Where steel forms are used, treat steel surfaces to prevent rusting using products approved for use on steel forms.

3. Circular Structure: Wall forms shall conform to circular shape of structure.

B. Column Forms:

1. Rectangular Columns: As specified for walls.

2. Circular Columns: Fabricated steel or fiber-reinforced plastic with bolted sections or spirally wound laminated fiber form. Internally treat with release agent for full height of column.

C. Sandblasted Surface Forms: Medium density overlay plywood for flat concrete surfaces to be sandblasted.

D. Painted Surface Forms: High-density overlay plywood for flat concrete surfaces to be painted.

E. All Other Forms: Materials as specified for wall forms.
2.02 ACCESSORIES

A. Form Release Agent:

1. Material:
   a. Shall not bond with, stain, or adversely affect concrete surfaces.
   b. Shall not impair subsequent treatments of concrete surfaces when applied to forms.
   c. Ready-to-use water based material formulated to reduce or eliminate surface imperfections.
   d. Contain no mineral oil or organic solvents.

2. Manufacturers and Products: Not for surfaces exposed to potable water.
   a. BASF, Shakopee, MN; MBT MasterFinish RL 211.
   b. Cresset Chemical Company; Crete-Lease 20-VOC-Xtra.

B. Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

C. Form Snap-Ties:

2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 1.5-inch depth and sufficient dimensions to permit patching of tie hole.

D. Form Snap-Ties with Water Stop: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:

1. Integral steel waterstop 0.103-inch thick and 0.625-inch diameter tightly and continuously welded to tie.
2. Neoprene waterstop 3/16-inch thick and 15/16-inch diameter whose center hole is one half diameter of tie, or molded plastic water stop of comparable size.
3. Orient waterstop perpendicular to tie and symmetrical about center of tie.
4. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.
E. Through-Bolts:

1. At Contractor’s option, may be used as alternate to form snap-tie or form snap-tie with waterstop.
2. Tapered minimum 1-inch diameter at smallest end.
3. Elastic Vinyl Plug For Through-Bolt Tie Holes:
   a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal; forms watertight seal.
   b. Manufacturers and Products:
      1) Dayton Superior, Miamisburg, OH; A58 Sure Plug.
      2) Greenstreak Group, Inc., St Louis, MO; X-Plug.

PART 3 EXECUTION

3.01 FORM SURFACE PREPARATION

A. Prior to coating surface, thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants.

B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by manufacturer.

C. Steel Forms: Apply form release agent as soon as they are cleaned to prevent discoloration of concrete from rust.

3.02 ERECTION

A. General: In accordance with ACI 301, unless otherwise specified.

B. Beveled Edges (Chamfer):

1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
2. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain Engineer’s approval of size prior to placement of beveled edge.

C. Wall Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to ensure conformance with specified tolerances.
D. Curb, Sidewalk, and Driveway Forms:

1. Provide standard steel or wood forms.
2. Set forms to true lines and grades, and securely stake in position.

E. Form Tolerances: Provide forms in accordance with ACI 117 and ACI 318, and the following tolerances for finishes specified:

1. See the Schedule of Concrete Finishes in Section 03 30 00, Cast-in-Place Concrete, for beam, column, and wall types related to required form tolerances.
2. Wall Tolerances:
   a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
   b. Wall Type W-A:
      1) Plumb within 1/4 inch in 10 feet or within 1 inch from top to bottom for walls over 40 feet high.
      2) Depressions in Wall Surface: Maximum 5/16 inch when 10-foot straightedge is placed on high points in all directions.
   c. Wall Type W-B:
      1) Plumb within 1/8 inch in 10 feet or within 1/2 inch from top to bottom for walls over 40 feet high.
      2) Depressions in Wall Surface: Maximum 1/8 inch when 10-foot straightedge is placed on high points in all directions.
   d. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
   e. Form Offset: Between adjacent pieces of formwork, facing material shall not exceed 1/4 inch.
3. Beams and Columns Tolerances:
   a. Exposed Straight Horizontal and Vertical Surfaces: Flat planes within tolerances specified.
   b. Lateral Alignment:
      1) Centerlines shall be within plus or minus 1/2 inch from dimensions shown.
      2) At intersections, centerlines shall intersect within plus or minus 1/2 inch of dimensions shown.
   c. Beam Type B-A:
      1) Physical Dimensions: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
      2) Elevations: Within plus or minus 1/2 inch, except where tops of beams become part of finished slab. In this case refer to slab tolerances.
3.03 FORM REMOVAL

A. Nonsupporting forms, sides of beams, walls, columns, and similar parts of Work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:

1. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
2. Curing and protection operations are maintained.

B. Elevated Structural Slabs or Beams: In accordance with ACI 318, Chapter 6, and at such time as concrete has reached compressive strength equal to 80 percent of specified 28-day compressive strength as determined by test cylinders.

C. Form Ties: Remove conical inserts or through bolts and plug holes as specified in Section 03 30 00, Cast-in-Place Concrete.

3.04 FIELD QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

END OF SECTION
Concrete Joints and Accessories

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Document Review & Approval:

**Originator:**
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**Design Verification Complete:**
Alex Firth/Senior Structural Engineer

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager
SECTION 03 15 00
CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   b. A615/A615M, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   f. D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   g. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
   i. D1751, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

2. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Waterstop: Details of splices, method of securing and supporting waterstop in forms to maintain proper orientation and location during concrete placement.
   b. Construction and Control Joints: Layout and location for each type.

2. Samples: PVC waterstop splice, joint, and fabricated cross of each size, shape, and fitting of waterstop.
B. Informational Submittals:

1. Manufacturer’s written instructions for product shipment, storage, handling, installation/application, and repair for:
   a. Waterstop.
   b. Joint filler and primer.
   c. Preformed control joint.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Verify delivered materials are in accordance with Specifications and manufacturer’s product data sheets prior to unloading and storing onsite.

B. Storage: Store materials under tarps to protect from oil, dirt, and sunlight.

PART 2 PRODUCTS

2.01 PLASTIC WATERSTOP

A. Extruded from elastomeric plastic compound of which basic resin shall be prime virgin polyvinyl chloride (PVC). Compound shall not contain scrapped material, reclaimed material, or pigment.

B. Specific Gravity: Approximately 1.37.

C. Shore Durometer Type A Hardness: Approximately 80.


E. Type: Center bulb with parallel ribs or protrusions on each side of strip center.

F. Corrugated or tapered type waterstops are not acceptable.

G. Thickness: Constant from bulb edge to outside stop edge.

H. Minimum Weight per Foot of Waterstop:
   1. 1.60 pounds for 3/8 inch by 6 inches.
   2. 2.30 pounds for 3/8 inch by 9 inches.

I. Factory Fabrications: Use only factory fabrications for intersections, transitions, and changes of direction.
J. Manufacturers and Products:

1. Vinylex Corp., Knoxville, TN; Catalog No. 03250/VIN: No. RB6-38H (6 inches by 3/8 inch) and No. RB9-38H (9 inches by 3/8 inch).
2. Greenstreak Plastic Products, St. Louis, MO; Catalog No. 03150/GRD: Style 732 (6 inches by 3/8 inch) and Style 735 (9 inches by 3/8 inch).
3. Four Seasons Industries Durajoint, Garrettsville, OH; Catalog No. CSP-162: Type 9 (6 inches by 3/8 inch), and Type 10 (9 inches by 3/8 inch).

K. Waterstop for Chemical Containment Areas: Vinylex Corp., Knoxville, TN; Catalog No. 03250/VIN: No. VRB6316 (6 inches by 3/16 inch) and No. VRB9316 (9 inches by 3/16 inch).

2.02 WIRE LOOLED PLASTIC WATERSTOP

A. Furnish as alternative to plastic waterstops.
B. Same material and geometry as plastic waterstops.
C. Furnish with continuous galvanized wire looping at edge, for convenience in positioning and securing stop in place in forms.
D. Manufacturer and Product: Paul Murphy Plastics, Roseville, MI; “Wire Stop Waterstop”; geometry numbers ACR 6380, ACR 9380, as shown on Paul Murphy Plastics Co. Drawing No. CCP-120-12M.

2.03 HYDROPHILIC WATERSTOP

A. For use at construction joints only, where new concrete is placed against existing concrete and as shown on Drawings.
B. Material shall be a nonbentonite hydrophilic rubber compound.
C. Manufacturers and Products:

1. Greenstreak Plastic Products, St. Louis, MO; Hydrotite CJ-1020-2K with Leakmaster LV-1 adhesive and sealant.

2.04 BOND BREAKER

A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape, same width as joint that will adhere to premolded joint material or concrete surface.
B. Use either bond breaker tape or bond prevention material as specified in Section 03 30 00, Cast-in-Place Concrete, except where tape is specifically called for.

2.05 PREMOLDED JOINT FILLER

A. Bituminous Type: ASTM D994 or ASTM D1751.

B. Sponge Rubber:
   1. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum. Use in joints for potable and nonpotable water containment structures.

2.06 PREFORMED CONTROL JOINT

A. One-Piece, Flexible, Polyvinyl Chloride Joint Former:

B. One-Piece Steel Strip with Preformed Groove:

C. Furnish in full-length, unspliced pieces.

2.07 POURABLE JOINT FILLERS

A. Filler for Nonpotable Water Containment Structures:
   1. Pourable, two-component, cold-applied compound meeting ASTM C920, Type M, Grade P, Class 25, Use T.
   2. Color: Black.

2.08 STEEL EXPANSION JOINT DOWELS

A. Dowels: ASTM A36/A36M round smooth steel bars.

B. Bar Coating: As specified in Section 09 90 00, Painting and Coating, with factory-applied lubricating coating.
2.09 ACCESSORIES

A. Joint Sealant: Polyurethane as specified in Section 07 92 00, Joint Sealants.
B. Nonshrink Grout: As specified in Section 03 62 00, Nonshrink Grouting.
C. Roofing Felt: ASTM D226, Type II, 30-pound asphalt-saturated or equal weight of ASTM D227 coal-tar saturated felt.
D. Reinforcing Steel: As specified in Section 03 21 00, Reinforcing Steel.
E. Nails: Galvanized, as required for securing premolded joint filler.
F. Masking Tape: As required to temporarily adhere to concrete at each side of joint to receive filler.
G. Ties for PVC Waterstop: “Hog Rings” or grommets for each edge at 12-inch maximum spacing.

PART 3 EXECUTION

3.01 GENERAL

A. Commence concrete placement after joint preparation is complete.
B. Time Between Concrete Pours: As specified in Section 03 30 00, Cast-in-Place Concrete.

3.02 SURFACE PREPARATION

A. Construction Joints: Prior to placement of abutting concrete, clean contact surface:
   1. Remove laitance and spillage from reinforcing steel and dowels.
   2. Roughen surface to minimum of 1/4-inch amplitude:
      a. Sandblast after concrete has fully cured.
      b. Water blast after concrete has partially cured.
      c. Green cut fresh concrete with high pressure water and hand tools.
   3. Perform cleaning so as not to damage waterstop, if one is present.

B. Expansion Joint:
   1. Use wire brush or other motorized device to mechanically roughen and thoroughly clean concrete surfaces on each side of joint from plastic waterstop to top of joint.
   2. Use dry high pressure air to remove dust and foreign material, and dry joint.
3. Prime surfaces as required before placing joint filler.
4. Avoid damage to waterstop.

C. Contraction Joint and Control Joint:
1. Coat concrete surfaces above and below plastic waterstop with bond breaker.
2. Do not damage or coat waterstop.

D. Construction Joint with Hydrophilic Waterstop:
1. Follow hydrophilic waterstop manufacturer’s written instructions.
2. Clean debris, dirt, dust, and foreign material from concrete surface. Concrete surface must be smooth, clean, and dry. Grind concrete as required.

3.03 INSTALLATION OF WATERSTOPS

A. General:
1. Continuous waterstop (as specified) shall be installed in all construction joints in walls and slabs of water holding basins and channels and in walls of belowgrade structures, unless specifically noted otherwise.
2. Join waterstop at intersections to provide continuous seal.
3. Center waterstop on joint.
5. Repair or replace damaged waterstop.
6. Place concrete and vibrate to obtain impervious concrete in vicinity of joints.
7. Joints in Footings and Slabs:
   a. Ensure that space beneath plastic waterstop is completely filled with concrete.
   b. During concrete placement, make visual inspection of waterstop area.
   c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.
B. Plastic Waterstop:
   1. Install in accordance with manufacturer’s written instructions.
   2. Splice in accordance with waterstop manufacturer’s written instructions using Teflon-coated thermostatically controlled heating iron at approximately 380 degrees F.
      a. Allow at least 10 minutes before new splice is pulled or strained in any way.
      b. Finished splices shall provide cross section that is dense and free of porosity with tensile strength of not less than 80 percent of unspliced materials.
      c. Use only factory made waterstop fabrications for all intersections, changes of directions and transitions.
      d. Field splice permitted only for straight butt welds.
   3. Wire looped plastic waterstop may be substituted for plastic waterstop.

C. Hydrophilic Waterstop:
   1. Install in accordance with manufacturer’s written instructions.
   2. Provide minimum of 2-1/2 inches of concrete cover over waterstop. When structure has two layers of reinforcing steel, locate centered between layers of steel or as shown.
   3. Apply adhesive to concrete surface and allow to dry for specified time before applying waterstop strip.
   4. Butt ends of waterstop strip together at splices and corners and join with sealant.
   5. Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.

3.04 EXPANSION JOINT INSTALLATION

A. Premolded Joint Filler:
   1. Sufficient in width to completely fill joint space where shown.
   2. If waterstop is in joint, cut premolded joint filler to butt tightly against waterstop and concrete face.
   3. Precut premolded joint filler to required depth at locations where joint filler or sealant is to be applied.
   4. Form cavities for joint filler with either precut, premolded joint filler, or smooth removable accurately shaped material. Entire joint above waterstop, in slabs, shall be formed and removed so that entire space down to waterstop can be filled with the pourable joint filler.
   5. Vibrate concrete thoroughly along joint form to produce dense, smooth surface.
B.  Bituminous Type Premolded Joint Filler:
   1.  Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
   2.  Secure premolded joint filler in forms before concrete is placed.
   3.  Install in walkways, at changes in direction, at intersections, at each side of driveway entrances, and at 45-foot intervals, maximum.

C.  Pourable Joint Filler:
   1.  General: Install in accordance with the manufacturer’s written instructions, except as specified below:
       a.  Apply primer prior to pouring joint filler.
       b.  Fill entire joint above the waterstop with joint filler as shown.
       c.  Use masking tape on top of slabs at sides of joints; clean spillage. Remove masking tape afterwards.

D.  Steel Expansion Joint Dowels:
   1.  Install coated and lubricated bars parallel to wall or slab surface and in true horizontal position perpendicular to joint in both plan and section view, so as to permit joint to expand or contract without bending dowels.
   2.  Secure dowels tightly in forms with rigid ties.
   3.  Install reinforcing steel in concrete as shown.

3.05  CONTRACTION JOINT INSTALLATION
   A.  Place bond breaker above and below stop.
   B.  Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface.

3.06  CONTROL JOINT INSTALLATION
   A.  Locate reinforcing steel as shown.
   B.  Install PVC waterstop.
   C.  Concrete surfaces shall be dense and smooth.
   D.  Install bond breaker to concrete surfaces above and below waterstop.
3.07 PREFORMED CONTROL JOINTS

A. Use only where specifically shown; do not use in water-holding basins.
B. Locate slightly below top of slab.
C. Install in accordance with manufacturer’s written instructions in straight, full-length pieces.
D. Steel Strip Type with Preformed Groove: Brace to withstand pressure of concrete during and after placement.

END OF SECTION
Reinforcing Steel
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete and Commentary.

2. ASTM International (ASTM):
   a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   d. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

3. Concrete Reinforcing Steel Institute (CRSI):
   a. Placing Reinforcing Bars.


1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66:
   a. Bending lists.
   b. Placing drawings.

2. Welded, metallic sleeve splice, and mechanical threaded connection.

B. Informational Submittals:

1. Lab test reports for reinforcing steel showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
   a. Current ICC Evaluation Services Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
   b. Verification device threads have been tested and meet requirements for thread quality, in accordance with manufacturer’s published methods.
   c. Manufacturer’s instructions.
3. Test results of field testing.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Unload, store, and handle bars in accordance with CRSI publication “Placing Reinforcing Bars.”

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars:
   1. Includes stirrups, ties, and spirals.
   2. ASTM A615/A615M, Grade 60.

B. Mechanical Splices and Connections:
   1. Metal Sleeve Splice:
      a. Furnish with cast filler metal, capable of developing, in tension or compression, 125 percent of minimum tensile strength of bar.
      b. Manufacturer and Product: Pentair Solon, OH; Lenton Cadweld T-Series.
   2. Mechanical Threaded Connections:
      a. Furnish metal coupling sleeve with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
      b. Manufacturers and Products:
         1) Pentair, Solon, OH; Lenton Reinforcing Steel Couplers.

C. Welded Wire Fabric:
   1. ASTM A185 or ASTM A497 and ACI 318, using ASTM A82 wire of 75 ksi minimum tensile strength.
   2. Furnish flat sheets only, rolled sheets not permitted.
2.02 ACCESSORIES

A. Tie Wire:
   1. Black, soft-annealed 16-gauge wire.
   2. Nylon-, epoxy-, or plastic-coated wire.

B. Bar Supports and Spacers:
   1. Use precast concrete bar supports or all-plastic bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
   2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
   3. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.
   4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to reinforcing steel.
   5. In Beams, Columns, Walls, and Slabs Exposed to View after Form Removal: Use small precast concrete blocks made of same color as concrete in which they are embedded. All-plastic bar supports and side form spacers may be used, except where surface is exposed as described above.
   6. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
   8. Precast Concrete Supports: Total bond precast high performance concrete bar supports as supplied by Con Sys Inc., Pinawa, MB, Canada.

2.03 FABRICATION


B. Bend bars cold.
PART 3  EXECUTION

3.01  PREPARATION

A. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.

B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.

C. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.

3.02  INSTALLATION

A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.

B. Spacing and Positioning: Conform to ACI 318.

C. Location Tolerances: In accordance with CRSI publication, “Placing Reinforcing Bars”.

D. Splicing:
   1. Follow ACI 318.
   2. Use lap splices, unless otherwise shown or permitted in writing by Engineer.
   3. Welding of reinforcement is not permitted.
   4. Stagger splices in adjacent bars where indicated.

E. Mechanical Splices and Connections:
   1. Use only in areas specifically approved in writing by Engineer.
   2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Services Report or equivalent code agency report.
   3. For metal sleeve splice, follow manufacturer’s installation recommendations.
   4. Maintain minimum edge distance and concrete cover.

F. Tying Reinforcing Bars:
   1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
   2. Bend tie wire away from concrete surface to provide clearance of 1 inch from surface of concrete to tie wire.
G. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end.

H. Straightening and Rebending: Field bending of reinforcing steel bars is not permitted.

I. Unless permitted by Engineer, do not cut reinforcing bars in field.

3.03 WELDED WIRE FABRIC INSTALLATION
A. Use only where specifically shown.
B. Extend fabric to within 2 inches of edges of slab, and lap splices at least 1-1/2 courses of fabric or minimum 8 inches.
C. Tie laps and splices securely at ends and at least every 24 inches with tie wire.
D. Place welded wire fabric on concrete blocks and rigidly support equal to that provided for reinforced bars. Do not use broken concrete, brick, or stone.
E. Follow ACI 318 and WRI WWR-500.
F. Do not use fabric that has been rolled. Install flat sheets only.

3.04 TESTS AND INSPECTION
A. An independent testing agency shall be retained by Contractor and approved by Engineer to inspect each mechanical splice and verify each component is installed in accordance with manufacturer’s instructions and ICC Evaluation Services Report or equivalent code agency report.
B. Special inspection will be provided by Owner as indicated on Drawings.

END OF SECTION
**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Cast-in-Place Concrete

### Revision History:

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### Document Review & Approval:

**Originator:**

Harry W. Elliott PE / Lead Structural Engineer

**Design Verification Complete:**

Alex Firth/Senior Structural Engineer

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.

Date: 2017.06.21 13:01:10 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. 305.1, Specification for Hot Weather Concreting.
   e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.
   f. CP-1, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1.

2. ASTM International (ASTM):
   j. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   n. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
3. National Ready Mixed Concrete Association (NRMCA).

1.02 DEFINITIONS

A. Basin Train: Series of interconnected basins that operate as a unit with same water level.

B. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.

C. Contractor’s Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.
D. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

E. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.

F. Hot Weather: As defined in ACI 305.1.

G. Hydraulic Structure: Liquid containment structure.

H. New Concrete: Less than 60 days old.

1.03 SUBMITTALS

A. Action Submittals:

1. Mix Designs:
   a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
   b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
   c. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
      1) Portland cement.
      2) Fly ash.
      3) Aggregates, including specified class designation for coarse aggregate.
      4) Admixtures.
      5) Concrete producer has verified compatibility of constituent materials in design mix.
   d. Test Reports:
      1) Chemical analysis report.
      2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
      3) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with
ASTM C1218/C1218M at an age between 28 days and 42 days.

4) Shrinkage Test Results: In accordance with ASTM C157/C157M as modified herein.

e. Aggregates:
   1) Coarse Aggregate Gradation: List gradings and percent passing through each sieve.
   2) Fine Aggregate Gradation: List gradings and percent passing through each sieve.
   3) Percent of fine aggregate weight to total aggregate weight.
   4) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
   5) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
   6) Test Reports:
      a) Alkali Aggregate Reactivity: Aggregate shall be classified as nonpotentially reactive in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.

f. Admixtures: Manufacturer’s catalog cut sheets and product data sheets for each admixture used in proposed mix designs.


3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
   a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
   b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
   c. Methods for temperature protection during placement.
   d. Types of covering, insulation, housing, or heating to be provided.
   e. Curing methods to be used during and following protection period.
   f. Use of strength accelerating admixtures.
   g. Methods for verification of in-place strength.
   h. Procedures for measuring and recording concrete temperatures.
   i. Procedures for preventing drying during dry, windy conditions.

4. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
   a. Procedures for measuring, and recording temperatures of reinforcement and other embedded items prior to concrete placement.
   b. Use of retarding admixture.
c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
d. Types of shading and wind protection to be provided.
e. Curing methods, including use of evaporation retardant.
f. Procedures for measuring and recording concrete temperatures.
g. Procedures for preventing drying during dry, windy conditions.
5. Thermal Control Plan: For concrete sections with a minimum specified dimension that is greater than 2 feet 6 inches.

B. Informational Submittals:
1. Preinstallation Conference minutes.
2. Manufacturer’s application instructions for bonding agent and bond breaker.
3. Manufacturer’s Certificate of Compliance to specified standards:
   a. Bonding agent.
   b. Bond breaker.
   c. Repair materials.
4. Statement of Qualification:
   a. Batch Plant: Certification as specified herein.
   b. Mix designer.
   c. Installer.
   d. Testing agency.
5. Field test reports.
6. Recorded temperature data from concrete placement where specified.
7. Tightness test results.
8. Concrete Delivery Tickets:
   a. For each batch of concrete before unloading at Site.
   b. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
   c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.04 QUALITY ASSURANCE

A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.

B. Qualifications:
1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor’s Licensed Design Engineer.
3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher.

4. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
   a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
   b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Thermal Control Plan: When required, shall include the following minimum requirements:

1. Calculated or measured adiabatic temperature rise of concrete.
2. Upper limit for concrete temperature at time of placement.
3. Description of specific measures and equipment that will be used to ensure maximum temperature in placement will not exceed specified maximum temperature limit.
4. Calculated maximum temperature in placement based on expected conditions at time of placement and use of proposed measures to control temperatures.
5. Description of specific measures and equipment that will be used to ensure temperature difference will not exceed specified temperature difference limit.
6. Calculated maximum temperature difference in placement based on expected conditions at time of placement and use of proposed measures to control temperature differences.
7. Description of equipment and procedures that will be used to monitor and log temperatures and temperature differences.
8. Drawing showing locations for temperature sensors in placement.
9. Description of format and frequency of providing temperature data to Engineer.
10. Description of measures to address and reduce excessive temperatures and temperature differences, if they occur.
11. Description of curing procedures, including materials and methods, and curing duration.
12. Description of formwork removal procedures to ensure temperature difference at temporarily exposed surface will not exceed temperature difference limit, and how curing will be maintained.
13. Alternate temperature limits when permitted by Engineer.
   a. Determination of alternate temperature limits shall be based on
detailed thermal and crack analyses.
   b. Analyses shall be stamped by Contractor’s Licensed Design
Engineer.
14. If concrete design mixture is changed, thermal control plan must be
updated.

D. Preinstallation Conference:

1. Required Meeting Attendees:
   a. Contractor, including pumping, placing and finishing, and curing
      subcontractors.
   b. Ready-mix producer.
   c. Admixture representative.
   d. Testing and sampling personnel.
   e. Engineer who authored Statement of Special Inspection Plan or
      Engineer’s designee.
2. Schedule and conduct prior to incorporation of respective products into
Project. Notify Engineer of location and time.
3. Agenda shall include:
   a. Admixture types, dosage, performance, and redosing at Site.
   b. Mix designs, test of mixes, and Submittals.
   c. Placement methods, techniques, equipment, consolidation, and
      form pressures.
   d. Slump and placement time to maintain slump.
   e. Finish, curing, and water retention.
   f. Thermal control plan.
   g. Protection procedures for weather conditions.
   h. Other specified requirements requiring coordination.
4. Conference minutes.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cementitious Materials:

1. Cement:
   a. Portland Cement: Unless otherwise specified, conform to
      requirements of ASTM C150/C150M.
   b. Blended Hydraulic Cement:
      1) Unless otherwise specified, conform to requirements of
         ASTM C595/C595M.
      2) Portland cement used in blended hydraulic cement, conform
         to requirements of ASTM C150/C150M.
   c. Furnish from one source.
2. Supplementary Cementitious Materials (SCM):
   a. Fly Ash (Pozzolan): Class F fly ash in accordance with
      ASTM C618, except as modified herein:
      1) Shall not be produced from process that has utilized
         hazardous materials.
      2) ASTM C618, Table 1, Loss on Ignition: Unless permitted
         otherwise, maximum 3 percent.

B. Aggregates: Furnish from one source for each aggregate type used in a mix
   design.

1. Normal-Weight Aggregates:
   a. In accordance with ASTM C33/C33M, except as modified herein.
      1) Class Designation: 4S unless otherwise specified.
   b. Free of materials and aggregate types causing popouts,
      discoloration, staining, or other defects on surface of concrete.
   c. Alkali Silica Reactivity: See Article Concrete Mix Design.

2. Fine Aggregates:
   a. Clean, sharp, natural sand.
   b. ASTM C33/C33M.
   c. Limit deleterious substances in accordance with
      ASTM C33/C33M, Table 2 and as follows:
      1) Limit material finer than 75-μm (No. 200) sieve to 5 percent
         mass of total sample.
      2) Limit coal and lignite to 0.5 percent.

3. Coarse Aggregate:
   a. Natural gravels, combination of gravels and crushed gravels,
      crushed stone, or combination of these materials containing no
      more than 15 percent flat or elongated particles (long dimension
      more than five times the short dimension).
   b. Limit deleterious substances in accordance with
      ASTM C33/C33M, Table 4 for specified class designation.

C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.

1. Characteristics:
   a. Compatible with other constituents in mix.
   b. Contain at most, only trace amount chlorides in solution.
   c. Furnish type of admixture as recommended by manufacturer for
      anticipated temperature ranges.


3. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
   a. Manufacturers and Products:
      1) BASF Admixtures Inc., Shakopee, MN; MasterPozzolith
         Series or MasterPolyHeed Series.
      2) Euclid Chemical Co., Cleveland, OH; Eucon Series.
3) GCP Applied Technologies, Cambridge, MA; Daracem Series or Mira Series.

4. Retarding Admixture: ASTM C 494/C 494M, Type B.

5. Accelerating Admixture: ASTM C 494/C 494M, Type C.

6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
   a. Manufacturers and Products:
      1) BASF Admixtures Inc., Shakopee, MN; MasterGlenium Series, or MasterRheobuild 1000.
      2) Euclid Chemical Co., Cleveland, OH; Eucon Series or Plastol Series.
      3) GCP Applied Technologies, Cambridge, MA; ADVA Series, Daracem Series, or EXP 950.

7. Plasticizing Admixture: ASTM C1017/C1017M, Type I or Type II.

8. Corrosion Inhibiting Admixtures: ASTM C1582/C1582M.

9. Shrinkage Reducing Admixture:
   a. Manufacturers and Products:
      1) BASF Admixtures Inc., Shakopee, MN; Masterlife SRA 20.
      2) Euclid Chemical Co., Cleveland, OH; Eucon SRA Series.
      3) GCP Applied Technologies, Cambridge, MA; Eclipse Series.

10. Do not use calcium chloride as an admixture.

D. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.

1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
   a. Chloride Content: 500 ppm.
   b. Sulfate Content as SO₄: 3,000 ppm.
   c. Alkalis as (Na₂O + 0.658 K₂O): 600 ppm.
   d. Total Solids by Mass: Less than 50,000 ppm.

2.02 ANCILLARY MATERIALS

A. Bonding Agent: Unless otherwise specified, in accordance with the following:

1. ASTM C881/C881M, Type V.

2. Two-component, moisture insensitive, 100 percent solids epoxy.

3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.

4. Manufacturers and Products:
   a. BASF Building Systems Inc., Shakopee, MN; MasterEmaco ADH 326.
   b. Euclid Chemical Co., Cleveland, OH; Euco No. 452 Epoxy System LV.
c. Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
d. Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

B. Bond Breaker:

1. Nonstaining type, providing positive bond prevention.
2. Manufacturers and Products:
   a. Dayton Superior Corporation, Kansas City, KS; Sure Lift J6WB.
   b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.

C. Repair Material:

1. In accordance with requirements of Section 03 01 32, Repair of Vertical and Overhead Concrete Surfaces.
2. In accordance with requirements of Section 03 01 33, Repair of Horizontal Concrete Surfaces.

D. Crack Repair: In accordance with requirements of Section 03 64 23, Crack Repair Epoxy Injection Grouting.

2.03 CONCRETE MIX DESIGN

A. General:

1. See Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
2. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.
3. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
4. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture in pumped concrete, in concrete with a water-cementitious materials ratio below 0.50, and in concrete that is part of a liquid-containment structure.
5. Unless otherwise permitted, use water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture in columns, piers, pilasters, and walls.
6. Use water-reducing admixture or high-range, water-reducing admixture, or plasticizing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
7. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
8. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.

9. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials and aggregate packing.

B. Potential Alkali-Aggregate Reactivity of Concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).

2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260 or ASTM C1567.
   a. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C227 or ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less than 0.04 percent expansion at 2 years for combinations with pozzolan.
   b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.
   c. Use low-alkali cement or incorporate pozzolans into concrete mixture as necessary to satisfy testing for potential alkali reactivity.

C. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.

2. Where fly ash is included in mix, minimum fly ash content shall be 15 percent of weight of total cementitious materials.

D. Concrete Shrinkage Limits: Where shrinkage limits are specified, design mix for following shrinkage limits and test in accordance with ASTM C157/C157M, with the following modifications:

1. Prisms shall be moist cured for 7 days prior to 28-day drying period.

2. Comparator reading at end of 7-day moist cure shall be used as initial length in length change calculation.

3. Reported results shall be average of three prisms.

4. If shrinkage of a specimen departs from average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
5. Unless otherwise specified, results at end of 28-day drying period shall not exceed 0.040 percent if 3-inch prisms are used, or exceed 0.038 percent if 4-inch prisms are used. Aggregate will be rejected if test values exceed these limits.

E. Slump Range at Site:

1. Prior to submitting mix design, consult with concrete producer and select a target slump value at point of delivery, for each application of each design mix. Unless otherwise permitted, target slump value will then be enforced for duration of Project.

2. Design mixes that include a high-range, water-reducing or a plasticizing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.

3. Slump tolerance shall meet requirements of ACI 117.

F. Combined Aggregate Gradation:

1. Combined Gradation Limits: Fine aggregate shall be in range of 36 percent to 40 percent of total aggregate weight.

2. Combined Gradation Limits: Limits shown are for coarse aggregates and fine aggregates mixed together (combined). Select one of the gradations shown in the following table:

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<tr>
<th>Sieve Sizes</th>
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2.04 **CONCRETE MIXING**

A. **General**: In accordance with ACI 301, except as modified herein.

B. **Truck Mixers**:
   1. For every truck, test slump of samples taken per ASTM C94/C94M, paragraph 12.5.1.
   2. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.05 **TEMPERATURE LIMITS**

A. For concrete sections with a minimum specified dimension that is greater than 2 feet 6 inches, and unless otherwise permitted:
   1. Provide documentation that maximum concrete temperature in structure will not exceed 158 degrees F, and maximum temperature differential between center of section and external surfaces of concrete will not exceed 35 degrees F.

2.06 **SOURCE QUALITY CONTROL**

A. **Source Quality Control Inspection**: Engineer shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this section.

### PART 3 EXECUTION

3.01 **PLACING CONCRETE**

A. **Preparation**: Meet requirements ACI 301, except as modified herein.

B. **Inspection**: Notify Engineer and Special Inspector at least 1 full working day in advance before starting to place concrete.
C. Placement into Formwork:

1. Reinforcement: Secure in position before placing concrete.
2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
4. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
5. Vertical Free Fall Drop to Final Placement:
   a. Forms 8 Inches or Less Wide: 5 feet.
   b. Forms Wider than 8 Inches: 8 feet, except as specified.
6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
   a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
7. Do not use aluminum conveying devices.
8. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
9. Joints in Footings and Slabs:
   a. Ensure space beneath plastic waterstop completely fills with concrete.
   b. During concrete placement, make visual inspection of entire waterstop area.
   c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
   d. Apply procedure to full length of waterstop.
10. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
11. Cure concrete as specified in Section 03 39 00, Concrete Curing.

D. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
4. Conveyor Belts:
   a. Approved by Engineer.
   b. Wipe clean with device that does not allow mortar to adhere to belt.
   c. Cover conveyor belts and chutes.

E. Retempering: Not permitted for concrete where cement has partially hydrated.

F. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

G. Concrete sections with a minimum specified dimension that is greater than 2 feet 6 inches:

1. Cure and protect concrete in accordance with accepted thermal control plan and as follow:
   a. Minimum curing period shall be 14 days.
   b. Unless otherwise permitted, preserve moisture by maintaining forms in place.
2. Strength measurement shall be representative of in-place concrete within 2 inches of concrete surface.
3. Concrete strength shall be verified through correlation of concrete temperature and compressive strengths established by cylinder compressive tests and in accordance with ASTM C1074.
4. Unless otherwise specified, control concrete temperatures to within specified limits from time concrete is placed until time internal temperature has cooled from its maximum, such that difference between average daily ambient and maximum internal concrete temperature at time of protection removal, is less than specified temperature difference limit.
5. Unless otherwise specified, place one temperature sensor at center of mass of placement and one temperature sensor at a depth 2 inches from center of nearest exterior surface. Place additional sensor at each location to serve as a backup in event that other temperature sensor fails. In addition, provide temperature sensor in shaded location for monitoring ambient onsite temperature.
   a. Unless otherwise specified, monitor temperatures hourly using electronic sensors capable of measuring temperature from 32 degrees F to 212 degrees F to an accuracy of 2 degrees F.
b. Ensure temperature sensors are operational before placing concrete.
c. Unless otherwise specified, provide data from sensors to Engineer on a daily basis, until requirements are met.
d. Compare temperatures and temperature differences with maximum limits specified in Article Temperature Limits every 12 hours, unless otherwise permitted. If either exceeds specified limits, take immediate action as described in accepted thermal control plan to remedy situation. Do not place additional mass concrete until cause of excessive temperature or temperature difference has been identified and corrections are accepted.

H. Maximum Size of Concrete Placements:

1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
2. Locate expansion, control, and contraction joints where shown on Drawings.
3. Construction Joints: Unless otherwise shown or permitted, locate construction joints as follows:
   a. Locate construction joints as shown on Drawings or where approved in joint location submittal required in Section 03 15 00, Concrete Joints and Accessories.
   b. Provide vertical construction joints in walls and slabs at maximum spacing of 40 feet, unless shown or approved otherwise.
   c. When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
   d. Uniformly space vertical construction joints within straight sections of walls and slabs, avoiding penetrations.
4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
5. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.

I. Minimum Time between Adjacent Placements:

1. Construction or Control Joints: 14 days (7 days wet cure and 7 days dry cure) unless otherwise specified.
2. Construction joint between top of footing or slab, and column or wall: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
3. Expansion or Contraction Joints: 1 day.
4. For columns and walls with a height in excess of 10 feet, wait at least 2 hours before depositing concrete in beams, girders, or slabs supported thereon.
5. For columns and walls 10 feet in height or less, wait at least 1 hour prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

J. Consolidation and Visual Observation:

1. Consolidation Equipment and Methods: ACI 301.
2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.
3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
4. Vibrate concrete in vicinity of joints to obtain impervious concrete.

K. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
   a. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
   b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.

2. Concrete Curing: As specified in Section 03 39 00, Concrete Curing.

L. Cold Weather Placement:

1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
   a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
   b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Engineer.
   c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
   d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
   e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
   f. Cure concrete as specified in Section 03 39 00, Concrete Curing.
1) Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.

2. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.

3. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.

4. Maintain curing conditions as specified in Section 03 39 00, Concrete Curing.

3.02 CONCRETE BONDING

A. Construction Joints in New Concrete Members:

1. Prepare surface of construction joint as specified in Section 03 15 00, Concrete Joints and Accessories.

2. Horizontal Construction Joints Containing Waterstop in New Concrete Walls:
   a. Unless otherwise permitted, place slurry mixture 4-inch maximum thickness, 2-inch minimum thickness in horizontal construction joints containing waterstops.
   b. Use positive measuring device such as bucket or other device that will contain only enough slurry mixture for depositing in visually measurable area of wall to ensure that portion of form receives appropriate amount of slurry mixture to satisfy placement thickness requirements.
   c. Do not deposit slurry mixture from pump hoses or large concrete buckets, unless specified placement thickness can be maintained and verified through inspection windows close to joint, or by other means.
   d. Limit concrete placed immediately on top of slurry mixture to 12 inches thick. Thoroughly vibrate to mix concrete and slurry mixture together.

B. Construction Joints at Existing Concrete:

1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 1/4 inch.

2. Saturate surface with water for 24 hours prior to placing new concrete.
3.03 REPAIRING CONCRETE

A. General:

1. Inject cracks that leak with crack repair epoxy as specified in Section 03 64 23, Crack Repair Epoxy Injection Grouting.
2. Repair defective areas of concrete.
3. Repair horizontal concrete surfaces in accordance with Section 03 01 33, Repair of Horizontal Concrete Surfaces.
4. Repair vertical and overhead concrete surfaces in accordance with Section 03 01 32, Repair of Vertical and Overhead Concrete Surfaces.
5. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Engineer.
6. Obtain quantities of repair material and manufacturer’s detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
7. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Engineer.

B. Tie Holes:

1. Unless otherwise specified, fill with specified repair material.
   a. Prepare substrate and mix, place, and cure repair material per manufacturer’s written recommendations.

C. Alternate Form Ties, Through-Bolts:

1. Mechanically roughen entire interior surface of through hole.
2. Apply bonding agent to roughened surface and drive elastic vinyl plug to half depth.
3. Dry pack entire hole from both sides of plug with nonshrink grout, as specified in Section 03 62 00, Nonshrink Grouting.
4. Use only enough water to dry pack grout.
5. Dry pack while bonding agent is still tacky.
6. If bonding agent has dried, remove bonding agent by mechanical means and reapply new coat of bonding agent.
7. Compact grout using steel hammer and steel tool to drive grout to high density.
8. Cure grout with water.
D. Exposed Metal Objects:

1. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
2. Repair area of chipped-out concrete as specified for defective areas.

E. Blockouts at Pipes or Other Penetrations: Where shown install in accordance with requirements of Drawings.

3.04 CONCRETE WALL FINISHES

A. Type W-1 (Ordinary Wall Finish):

1. Patch tie holes.
2. Knock off projections.
3. Repair defective areas.
4. Inject cracks in accordance with requirements of Section 03 64 23, Crack Repair Epoxy Injection Grouting.

B. Type W-2 (Smooth Wall Finish):

1. Patch tie holes.
2. Grind off fins and other projections.
3. Repair defective areas to provide smooth uniform appearance.
4. Inject cracks in accordance with requirements of Section 03 64 23, Crack Repair Epoxy Injection Grouting.

C. Type W-5 (Finish for Painting):

1. In accordance with requirements for Type W-2 except as follows:
   a. Leave surface ready for painting as specified in Section 09 90 00, Painting and Coating.

3.05 CONCRETE SLAB FINISHES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Finish slab in accordance with specified slab finish.
4. Do not dust surfaces with dry materials nor add water to surfaces.
5. Cure concrete as specified in Section 03 39 00, Concrete Curing.
B. Type S-1 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.
2. Wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand steel trowel concrete to produce smooth, smooth dense surface, free from trowel marks.
5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.
6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
7. Power Finishing:
   a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.
   b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
   c. Do first steel troweling for slab S-1 finish by hand.

C. Type S-2 (Wood Float Finish):

1. Finish slab to receive fill and mortar setting bed by screeding with straightedges to bring surface to required finish plane.
2. Wood float finish to compact and seal surface.
3. Remove laitance and leave surface clean.
4. Coordinate with other finish procedures.

D. Type S-3 (Underside Elevated Slab Finish): When forming is removed, grind off projections on underside of slab and repair defective areas, including small shallow air pockets where schedule of concrete finishes requires:

E. Type S-5 (Broomed Finish):

1. Finish as specified for Type S-1 floor finish, except use only a light-steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.

F. Type S-6 (Sidewalk Finish):

1. Slope walks down 1/4 inch per foot away from structures, unless otherwise shown.
2. Strike off surface by means of strike board and float with wood or cork float to true plane, then flat steel trowel before brooming.
3. Broom surface at right angles to direction of traffic or as shown.
4. Lay out sidewalk surfaces in blocks, as shown or as directed by Engineer, with grooving tool.

G. Concrete Curbs:
1. Float top surface of curb smooth, and finish all discontinuous edges with steel edger.
2. After concrete has taken its initial set, remove front form and give exposed vertical surface an ordinary wall finish, Type W-1.

3.06 CONCRETE SLAB TOLERANCES
A. Slab Tolerances:
1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Slab Type S-A: Steel gauge block 5/16 inch thick.
4. Slab Type S-B: Steel gauge block 1/8 inch thick.
5. Slab Type S-A and S-B: Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
6. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.

B. Slab Elevation and Thickness:
1. Finish Slab Elevation: Slope slabs to floor drains and gutter. Slabs shall adequately drain regardless of tolerances.
2. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.

3.07 BEAM AND COLUMN FINISHES
A. Type B-1: Match wall Type W-1.
B. Type B-2: Match wall Type W-2.
C. Type B-3:
   1. Repair rock pockets.
   2. Fill air voids.
   3. Match wall Type W-5.

D. Type C-1: Match wall Type W-1.

E. Type C-2: Match wall Type W-2.

F. Type C-3:
   1. Fill air pockets.
   2. Match wall Type W-5.

3.08 BACKFILL AGAINST STRUCTURES

A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.

B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.

C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.09 FIELD QUALITY CONTROL

A. General:
   1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
   2. Unless otherwise specified, sample concrete for testing and for making test specimens, from point of delivery.
   3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
      a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours.
   4. Evaluation will be in accordance with ACI 301 and Specifications.
   5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
   6. Frequency of testing may be changed at discretion of Engineer.

8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.

2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified in Section 03 39 00, Concrete Curing, by 7 additional days.

3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. Shrinkage Tests:

1. When required to conform to shrinkage limits, collect actual concrete materials being batched and before liquids have been added to mix.

2. Mix sampled material in a laboratory at proportions matching batched concrete.

3. Test shrinkage characteristics every 5,000 cubic yards of concrete used on job and every 3 months during construction when compression test cylinders are made.

4. Concrete Shrinkage Limits: Test in accordance with ASTM C157/C157M, with the following modifications:
   a. Prisms shall be moist cured for 7 days prior to 28-day drying period.
   b. Comparator reading at end of 7-day moist cure shall be used as initial length in length change calculation.
   c. Reported results shall be average of three prisms.
   d. If drying shrinkage of a specimen departs from average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
   e. Results at end of 28-day drying period shall not exceed 0.040 percent if 3-inch prisms are used, or exceed 0.038 percent if 4-inch prisms are used.
f. If 7-day or 14-day shrinkage tests results exceed shrinkage limits established by design mix testing, furnish additional 14 days of water curing beyond original curing period, for concrete surfaces of hydraulic structures represented by prisms. Modify concrete mix design to reduce shrinkage prior to casting additional concrete on Project.

D. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on Project.

1. Segregation Test Objective: Concrete with 4-inch to 8-inch slump shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

E. Cold Weather Placement Tests:

1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
   a. Six extra test cylinders from last 100 cubic yards of concrete.
   b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
6. Use test results to determine specified strength gain prior to falsework removal or for prestressing.

F. Tolerances:

1. Walls: Measure and inspect walls for compliance with tolerances specified in Section 03 10 00, Concrete Forming and Accessories.
2. Slab Finish Tolerances and Slope Tolerances:
   a. Make floor flatness measurements day after floor is finished and before shoring is removed to eliminate effects of shrinkage, curing, and deflection.
   b. Support 10-foot long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
c. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

G. Liquid Tightness Tests:

1. Purpose: To determine integrity and liquid-tightness of finished exterior and interior concrete surfaces of liquid containment structures.

2. Test the following structures for liquid-tightness:
   a. Base Flow Wet Well
   b. Storm Flow Wet Well
   c. Base Flow Grit Separator
   d. Storm Flow Grit Separator

3. Water for initial tightness test will be provided by Owner. See UCOR-4931, Outfall 200 Mercury Treatment Facility Startup Test Plan.

4. After testing has been completed, dispose of test water in a manner approved by Owner.

5. Liquid-Tightness Test Requirement:
   a. Perform tightness tests in accordance with ACI 350.1 and as specified herein.
   b. Do not place backfill or install brick facing, grout topping slab, coatings, or other work that will cover concrete surfaces until tightness testing has been completed and approved.
   c. Measure evaporation, precipitation, and temperature as specified.

6. Measure water surface at two points 180 degrees apart when possible where attachments, such as ladders exist, at 24-hour intervals.

7. Acceptance Criteria:
   a. Volume loss shall not exceed 0.050 percent of contained liquid volume per 24-hour period, adjusted for evaporation, precipitation, and temperature.
   b. Acceptance that structure has passed tightness test shall be based on total volume loss at end of specified test period.

8. Repairs When Test Fails:
   a. Dewater structure; fill leaking cracks with crack repair epoxy as specified in Section 03 64 23, Crack Repair Epoxy Injection Grouting.
   b. Patch areas of damp spots previously recorded, and repeat water leakage test in its entirety until structure successfully passes test.

3.10 MANUFACTURER’S SERVICES

A. Provide representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.
1. Concrete Producer Representative:
   a. Observe how concrete mixes are performing.
   b. Be present during first placement of each type of concrete mix.
   c. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
   d. Establish control limits on concrete mix designs.
   e. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump and air content if needed.

2. Admixture Manufacturer’s Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3. Bonding Agent Manufacturer’s Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.11 PROTECTION OF INSTALLED WORK

A. After curing as specified in Section 03 39 00, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.

B. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.12 SCHEDULE OF CONCRETE FINISHES

A. Form Tolerances: As specified in Section 03 10 00, Concrete Forming and Accessories.

B. Special Floor Finishes: As specified in Section 03 35 00, Concrete Finishing.

C. Provide concrete finishes as scheduled:

<table>
<thead>
<tr>
<th>Area</th>
<th>Type of Finish</th>
<th>Required Form Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Wall Surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abovegrade/exposed (above point 6&quot; below finish grade)</td>
<td>W-2</td>
<td>W-B</td>
</tr>
<tr>
<td>Abovegrade/covered with brick veneer or other finish material</td>
<td>W-1</td>
<td>W-A</td>
</tr>
<tr>
<td>Area</td>
<td>Type of Finish</td>
<td>Required Form Tolerances</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Backfilled/waterproofed (below point 6” below finish grade)</td>
<td>W-1</td>
<td>W-A</td>
</tr>
<tr>
<td>Backfilled/not waterproofed (below point 6” below final grade)</td>
<td>W-1</td>
<td>W-A</td>
</tr>
<tr>
<td><strong>Interior Wall Surfaces</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open top water-holding tanks and basins/not painted or coated</td>
<td>W-2</td>
<td>W-A</td>
</tr>
<tr>
<td>Covered water-holding tanks and basins/not painted or coated</td>
<td>W-1</td>
<td>W-A</td>
</tr>
<tr>
<td>Water-holding tanks, channels, and basins/painted or coated</td>
<td>W-5</td>
<td>W-A</td>
</tr>
<tr>
<td>Buildings, pipe galleries, and other dry areas/not painted or coated</td>
<td>W-2</td>
<td>W-A</td>
</tr>
<tr>
<td>Buildings, pipe galleries, and other dry areas/painted or coated</td>
<td>W-5</td>
<td>W-A</td>
</tr>
<tr>
<td><strong>Exterior Slabs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof slab/exposed</td>
<td>S-5</td>
<td>S-B</td>
</tr>
<tr>
<td>Roof slab/covered with roofing material</td>
<td>S-1</td>
<td>S-A</td>
</tr>
<tr>
<td>Water-holding tanks and basins/top of wall</td>
<td>S-5</td>
<td>S-B</td>
</tr>
<tr>
<td>Top of footing</td>
<td>S-2</td>
<td>S-A</td>
</tr>
<tr>
<td>Other water-holding tanks and basins</td>
<td>S-1</td>
<td>S-A</td>
</tr>
<tr>
<td>Stairs and landings</td>
<td>S-5</td>
<td>S-B</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>S-6</td>
<td>S-B</td>
</tr>
<tr>
<td>Other exterior slabs</td>
<td>S-5</td>
<td>S-A</td>
</tr>
<tr>
<td><strong>Interior Slabs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings, pipe galleries, and other dry areas</td>
<td>S-1</td>
<td>S-B</td>
</tr>
<tr>
<td>Slabs to receive mortar setting bed for tile</td>
<td>S-2</td>
<td>S-A</td>
</tr>
<tr>
<td>Slabs to receive resilient flooring or carpet</td>
<td>S-1</td>
<td>S-A</td>
</tr>
<tr>
<td>Hydraulic channels</td>
<td>S-1</td>
<td>S-A</td>
</tr>
<tr>
<td>Underside of elevated slabs</td>
<td>S-3</td>
<td>S-A</td>
</tr>
</tbody>
</table>
### Area | Type of Finish | Required Form Tolerances
--- | --- | ---
**Beams and Columns**
Beams/coated | B-3 | B-A
Beams/not coated | B-2 | B-A
Columns/coated | C-3 | C-A
Columns/not coated | C-2 | C-A

3.13 **SUPPLEMENTS**

A. Requirements of concrete mix designs following “End of Section,” are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:

1. Concrete Mix Design, Class 4500F2S1P1C1.
2. Concrete Mix Design, Class 4000F1S1P0C1.
3. Concrete Mix Design, Class 4000F3S1P1C2.

**END OF SECTION**
CONCRETE MIX DESIGN, CLASS 4500F2S1P1C1


B. Exposure Categories and Classifications: F2S1P1C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
2. Minimum concrete compressive strength (f’c) shall be 4,500 psi at 28 days.
   a. Designed to conform to shrinkage limits.
   b. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
      1) Slabs to receive a hard-troweled finish.
      2) Slabs to receive a topping placed monolithically as a two-course floor on top of plastic concrete.
   c. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

<table>
<thead>
<tr>
<th>Nominal Maximum Aggregate Size (in.)</th>
<th>Air Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>7.5</td>
</tr>
<tr>
<td>1/2</td>
<td>7.0</td>
</tr>
<tr>
<td>3/4</td>
<td>6.0</td>
</tr>
<tr>
<td>1</td>
<td>6.0</td>
</tr>
<tr>
<td>1-1/2</td>
<td>5.5</td>
</tr>
<tr>
<td>2§</td>
<td>5.0</td>
</tr>
<tr>
<td>3§</td>
<td>4.5</td>
</tr>
<tr>
<td>Nominal Maximum Aggregate Size in. ‡</td>
<td>Air Content (%)*</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.</td>
<td>*Tolerance of air content is +1-1/2 percent.</td>
</tr>
<tr>
<td>§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on sieved fraction passing 1-1/2-inch sieve in accordance with ASTM C231/C231M.</td>
<td></td>
</tr>
</tbody>
</table>

3. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
      3) ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).

4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.
CONCRETE MIX DESIGN, CLASS 4000F1S1P0C1

A. Mix Locations:
   1. Electrical duct banks.
   2. Pipe encasements that are not cast monolithically with concrete base mats or slabs.

B. Exposure Categories and Classifications: F1S1P0C1.

C. Mix Properties:
   1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
   2. Minimum concrete compressive strength (f’c) shall be 4,000 psi at 28 days.
   3. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

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‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is +1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on the sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.
4. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
      3) ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
         a) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.

5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.
CONCRETE MIX DESIGN, CLASS 4000F3S1P1C2

A. Mix Locations: Concrete curbs and sidewalks.

B. Exposure Categories and Classifications: F3S1P1C2.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.42.

2. Minimum concrete compressive strength (f’c) shall be 4,000 psi at 28 days.

3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
   a. Slabs to receive hard-troweled finish.
   b. Slabs to receive dry shake floor hardener.
   c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.

4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

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‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is +1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on the sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.
5. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in a mix design, as follows:
   a. Fly Ash and other Pozzolans: 25 percent.
      1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
      2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.

6. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
   c. ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
      1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.
Specimen Document Control No.: 03 35 00  
Revision No.: 0

Project: Outfall 200 Mercury Treatment Facility

Engineering Discipline: Structural

Specification Division: 3 – Concrete

Date: 6/16/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Concrete Finishing

<table>
<thead>
<tr>
<th>Revision No.</th>
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<td>0</td>
<td>Issue for Construction</td>
<td>June 21, 2017</td>
<td>All</td>
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</table>

Document Review & Approval:

Originator: Harry W. Elliott PE / Lead Structural Engineer

Design Verification Complete: Alex Firth/Senior Structural Engineer

Approved: W. Laird Ellis, Jr. PE/Design Manager

Digital signature by W. Laird Ellis, Jr.

Date: 2017.06.21 13:03:51 -06'00'
PART 1    GENERAL

1.01    REFERENCES

A. The following is a list of standards which may be referenced in this section:


1.02    SUBMITTALS

A. Action Submittals: Manufacturer’s product data sheet(s).

B. Informational Submittals:

1. Agenda: Conference prior to slab placement.
2. Manufacturer’s written procedures for slab preparation, product application, protection of finished surface, and post-application cleanup.
3. Product manufacturer representatives’ names and phone numbers.
4. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for products to be furnished.
5. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.
6. Statement of Qualifications:
   a. Manufacturer’s Product Service Record.
   b. Application personnel.
   c. Manufacturer’s representative.
7. Manufacturer’s installation instructions.
8. Manufacturer’s written instructions for maintenance and repair of floor finishes installed.

1.03    QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer’s Product Service Record: Five previous projects at least 5 years old where product was used at representative coverage per square foot.
2. Floor Product Manufacturer: Manufacture components of floor material, except the epoxy, in own plant and under control of trained quality control manager.
3. Application Personnel: Four previous projects of successful installation of specified materials or manufacturer’s training.

B. Preinstallation Training: Manufacturer-approved training of application personnel and quality control inspectors for these floor finishes.

C. Conference Prior to Slab Placement:
   1. Conducted by Contractor.
   2. Agenda:
      a. Concrete mix design.
      b. Placing techniques.
      c. Finishing techniques.
      d. Floor hardener application procedures.
      e. Equipment required for these procedures.
   3. Attendees:
      a. Contractor’s superintendent.
      b. Subcontractor’s representative involved in slab installation and finishing.
      c. Engineer.

D. Mockups: Install one 10-foot by 20-foot area for each type of finish floor to demonstrate that the material and methods produce a finished product acceptable to the Engineer.
   1. Mockup will establish the standard of quality for floor finishes.
   2. Use specified materials at a location designated by Engineer or Owner.
   3. Notify Engineer 5 days in advance of commencement of mockup floor slab application and training.
   4. Do not purchase floor materials until mockup slab installation has been accepted by the Engineer or Owner.

E. Color Samples: Minimum 2-inch by 2-inch Sample applications of floor finishes available.

PART 2 PRODUCTS

2.01 CLEAR LIQUID SEALER DUST PROOFER

A. Colorless, aqueous solution of zinc and magnesium fluorosilicate.

B. Each gallon of solution shall contain a minimum of 2 pounds of fluorosilicate compound.
C. Manufacturers:

1. Master Builders Co., Cleveland, OH.
2. Sonneborn, Minneapolis, MN.
3. Euclid Chemical Co., Cleveland, OH.

PART 3 EXECUTION

3.01 CLEAR LIQUID SEALER DUST PROOFER APPLICATION

A. Before application, thoroughly cure floors to receive treatment for minimum 28 days, keep clean, unpainted, free from membrane curing compounds, and perfectly dry with all Work above them completed.

B. Apply hardener evenly to surface, using three coats, allowing 24 hours between coats.

1. First coat 1/3 strength, second coat 1/2 strength, and third coat 2/3 strength, mix with water.
2. Apply each coat so as to remain wet on surfaces for 15 minutes.
3. Apply approved treatment in accordance with manufacturer’s instructions.
4. After final coat is completed and dry, remove surplus hardener from surface by scrubbing and mopping with water.

3.02 TESTS AND INSPECTION

A. Vapor Transmission Test: Conduct test on new and existing concrete to show that no surface moisture exists prior to application of specified special floor treatment, as follows:

1. Place polyethylene plastic sheet, minimum 4 feet by 4 feet and sealed along four sides with duct tape to prevent moisture transmission by evaporation, over concrete floor area for 24 hours.
2. Indication of moisture transmission will be apparent by accumulation of moisture on enclosed surface of polyethylene plastic sheet.
3. Do not apply concrete bonding agent until test results indicate moisture is not being transmitted from concrete surface.

B. Strength Tests: Test metallic aggregate topping for compressive strength by making 2-inch by 2-inch cubes in accordance with ASTM C109.

C. Epoxy Joint Filler:

1. Allow 90 days after slab placement before filling joints.
2. Mix and install in accordance with manufacturer’s instructions.
3. Fill contraction or construction joints in areas receiving armored joint treatment.
3.03 MANUFACTURER’S SERVICES

A. Provide manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for installation assistance, inspection and certification of proper installation, and training of application personnel.

1. Technical assistance with design and adjustment of concrete mixes to receive floor finishes and toppings.
2. Technical assistance to assure and certify application and installation of system being used.
3. Consultation, direction, and certification of mockup, for full-scale application of floor finishes, and at other times as needed.
4. Attendance at the conference prior to slab placement to finalize proper methods and procedures.

END OF SECTION
Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: Structural
Specification Division: 3 – Concrete
Date: 6/16/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Concrete Curing

Revision History:

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Document Review & Approval:

Originator: Harry W. Elliott PE / Lead Structural Engineer

Design Verification Complete: Alex Firth/Senior Structural Engineer

Approved: W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr. Date: 2017.06.21 13:06:51 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturers’ data indicating compliance with the requirements specified herein for the following products:
   a. Exposed aggregate finish retardant on formed surface.
   b. Evaporation retardant.
   c. Curing compound.

2. Curing methods proposed for each type of element such as slab, walls, beams, and columns in each facility.

B. Informational Submittals:

1. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
   a. Curing compound showing moisture retention requirements.
   b. Retardants for exposed aggregate finish.

PART 2 PRODUCTS

2.01 MATERIALS

A. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C309 Type I, Class A.
2. Manufacturers and Products:
   a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
   b. Dayton Superior; Safe Cure and Seal 309 EF.
   c. Euclid Chemical Co., Cleveland, OH; EucoCure VOX.
   d. Euclid Chemical Co., Cleveland, OH; Kurez DR VOX.

B. Evaporation Retardant:
   1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
   2. Manufacturers and Products:
      a. BASF Construction Chemicals, Shakopee, MN; MasterKure ER 50.
      b. Euclid Chemical Co., Cleveland, OH; Eucobar.

C. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3 EXECUTION

3.01 CONCRETE CURING

A. General:
   1. Where surfaces are to receive coatings, painting, cementitious material, or other similar finishes, use only water curing procedures. Refer to Interior Finish Schedule for surfaces to receive coatings.
   2. Use only water curing on potable water structures.
   3. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by Engineer prior to placing concrete.
   4. As required in Section 03 30 00, Cast-in-Place Concrete, if result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified below, by 7 additional days.

B. Use one of the following methods as approved by Engineer:
   1. Walls:
      a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for 7 days.
      b. Method 2: Continuously sprinkle with water 100 percent of exposed surfaces for 7 days starting immediately after removal of forms.
      c. Method 3: Apply curing compound, where allowed, immediately after removal of forms.
2. Slabs and Curbs:
   a. Method 1: Protect surface by water ponding for 7 days.
   b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 7 days.
   c. Method 3: Cover with 1-inch layer of wet sand, earth, or sawdust, and keep continuously wet for 7 days.
   d. Method 4: Continuously sprinkle exposed surface for 7 days.
   e. Method 5: Apply curing compound, where allowed, immediately after final finishing when surface will no longer be damaged by traffic.

3.02 EVAPORATION RETARDANT APPLICATION

A. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface.

B. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.

C. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

3.03 MANUFACTURER’S SERVICES

A. Provide manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for installation assistance, inspection, and certification of proper installation for products specified.

B. Provide clear sealer manufacturer’s representative to demonstrate proper application of product.

C. Provide curing compound manufacturer’s representative to demonstrate proper application of curing compound to show coverage in one coat.

END OF SECTION
**Nonshrink Grouting**

### Revision History:

<table>
<thead>
<tr>
<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
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<td>0</td>
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### Document Review & Approval:

**Originator:**

Harry W. Elliott PE / Lead Structural Engineer  

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**Design Verification Complete:**

Alex Firth/Senior Structural Engineer  

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**Approved:**

W. Laird Ellis, Jr. PE/Design Manager  

---
SECTION 03 62 00
NONSHRINK GROUTING

PART 1   GENERAL

1.01   REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   d. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

1.02   SUBMITTALS

A. Action Submittals:

1. Product data of grouts.
2. Proposed method for keeping existing concrete surfaces wet prior to placing grout.

B. Informational Submittals:

1. Manufacturer’s Written Instructions:
   a. Adding fiber reinforcing to batching.
   b. Cement-water ratio of grout topping.
   c. Mixing of grout.
2. Manufacturer’s proposed training schedule for grout work.
3. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements:
a. Grout free from chlorides and other corrosion-causing chemicals.
b. Nonshrink grout properties of Category II, verifying expansion at 3 days or 14 days will not exceed the 28-day expansion and nonshrink properties are not based on gas or gypsum expansion.

4. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.

5. Statements of Qualification: Nonshrink grout manufacturer’s representative.

6. Test Reports:
   a. Test report for 24-hour evaluation of nonshrink grout.
   b. Test results and service report from demonstration and training session.
   c. Field test reports and laboratory test results for field-drawn Samples.

1.03 QUALIFICATIONS

A. Nonshrink Grout Manufacturer’s Representative: Authorized and trained representative of grout manufacturer. Minimum of 1-year experience that has resulted in successful installation of grouts similar to those for this Project.

B. Epoxy Grout Manufacturer’s Representative: Authorized and trained representative of grout manufacturer. Minimum of 1-year experience that has resulted in successful installation of grouts similar to those for this project.

C. For grout suppliers not listed herein, provide completed 24-hour Evaluation of Nonshrink Grout Test Form, attached at the end of this section. Independent testing laboratory to certify that testing was conducted within last 18 months.

1.04 GUARANTEE

A. Manufacturer’s guarantee shall not contain disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished.

B. Manufacturer guarantees participation with Contractor in replacing or repairing grout found defective as a result of faulty materials, as determined by industry standard test methods.

PART 2 PRODUCTS

2.01 NONSHRINK GROUT SCHEDULE

A. Furnish nonshrink grout for applications in grout category in the following schedule:
### Application

<table>
<thead>
<tr>
<th>Application</th>
<th>Temperature Range</th>
<th>Max. Placing Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filling tie holes</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Blockouts for gate guides</td>
<td>I or II</td>
<td>II</td>
</tr>
<tr>
<td>Column baseplates single-story</td>
<td>I or II</td>
<td>II</td>
</tr>
<tr>
<td>Machine bases 25 hp or less</td>
<td>II</td>
<td>II</td>
</tr>
<tr>
<td>Baseplates for columns over one story</td>
<td>II</td>
<td>II</td>
</tr>
<tr>
<td>Through-bolt openings</td>
<td>II</td>
<td>II</td>
</tr>
<tr>
<td>Machine bases 26 hp and up</td>
<td>Epoxy Grout</td>
<td>Epoxy Grout</td>
</tr>
<tr>
<td>Baseplates and/or soleplates with vibration, thermal movement, etc.</td>
<td>Epoxy Grout</td>
<td>Epoxy Grout</td>
</tr>
</tbody>
</table>

#### 2.02 NONSHRINK GROUT

**A. Category I:**

1. Nonmetallic and nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Test in accordance with ASTM C1107/C1107M:
   - Grout shall have flowable consistency.
   - Flowable for 15 minutes.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
   - BASF Building Systems, Inc., Shakopee, MN; Masterflow 100.
   - Euclid Chemical Co., Cleveland, OH; NS Grout.
   - Dayton Superior Corp., Kansas City, KS; 1107 Advantage Grout.
B. Category II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
   a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
   b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
8. Manufacturers and Products:
   b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
   c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
   d. Dayton Superior Corp., Kansas City, KS; Sure Grip High Performance Grout.

C. Epoxy Grout:

1. High strength, high temperature epoxy grouting material developed for the support of heavy equipment with vibratory loads.
2. Three-component mixture of a two-component epoxy resin system (100 percent solids) with a graded, precision aggregate blend.
3. Premeasured, prepackaged system.
4. Flowable.
5. Minimum compressive strength in accordance with ASTM C579, Method B, 11,000 psi at 75 degrees F; 6,000 psi at 170 degrees F at 7 days.
6. Maximum creep resistance in accordance with ASTM C1181 at 600 psi, 140 degrees F; 6.0 x 10^{-3} in/in.
7. Minimum bond strength in accordance with ASTM C882, 2,000 psi.
8. Minimum tensile strength in accordance with ASTM C307, 2,000 psi.
9. Maximum coefficient of thermal expansion in accordance with ASTM C531 at 73 to 210 degrees F; 24.0 x 10^{-6} in/in degrees F.
10. Working Time: Minimum 2 hours at 50 degrees F; 1.5 hours at 70 degrees F; 50 minutes at 90 degrees F.
11. Good chemical resistance.
12. Good effective bearing area.
15. Modify resin and aggregate content where recommended by epoxy grout manufacturer to provide desired epoxy grout flow properties.
16. Manufacturers and Products:
   a. BASF Building System, Inc., Shakopee, MN; Masterflow 648.

PART 3 EXECUTION

3.01 NONSHRINK AND EPOXY GROUT

A. General: Mix, place, and cure nonshrink and epoxy grout in accordance with grout manufacturer’s representative’s training instructions.

B. Form Tie or Through-Bolt Holes: Provide nonshrink grout, Category I and Category II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes; coordinate dry pack dense grout application with vinyl plug in Section 03 10 00, Concrete Forming and Accessories, and bonding agent in Section 03 30 00, Cast-in-Place Concrete.

C. Grouting Machinery Foundations:
   1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material.
   2. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts.
   3. Form with watertight forms at least 2 inches higher than bottom of plate.
   4. Fill space between bottom of machinery base and original concrete in accordance with manufacturer’s representative’s training instructions.

3.02 FIELD QUALITY CONTROL

A. Evaluation and Acceptance of Nonshrink Grout:
   1. Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer’s representative.
   2. Perform flow cone and bleed tests, and make three 2-inch by 2-inch cubes for each 25 cubic feet of each type of nonshrink grout used. Use restraining caps for cube molds in accordance with ASTM C1107/C1107M.
   3. For large grout applications make three additional cubes and one more flow cone test. Include bleed test for each additional 25 cubic feet of nonshrink grout placed.
4. Consistency: As specified in Article Nonshrink Grout. Grout with consistencies outside range requirements shall be rejected.
5. Segregation: As specified in Article Nonshrink Grout. Grout when aggregate separates shall be rejected.
6. Nonshrink grout cubes shall test equal to or greater than minimum strength specified.
7. Strength Test Failures: Nonshrink grout work failing strength tests shall be removed and replaced.
8. Perform bleeding test to demonstrate grout will not bleed.
9. Store cubes at 70 degrees F.
10. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C1107/C1107M.

B. Evaluation and Acceptance of Epoxy Grout:

1. Performed by epoxy grout manufacturer’s technical representative.
2. Perform the following quality control inspections on the first installation of each size and type of equipment that is mounted using epoxy grout.
3. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer’s requirements.
4. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria, including but not limited to substrate profile, degree of cleanliness, and moisture.
5. Inspect the surface preparation of metallic substrates onto which the epoxy primer is to be applied.
6. Inspect the epoxy primed metallic substrate for coverage and adhesion.
7. Inspect preparation and application of epoxy grout form work for conformance to the Specifications.
8. Inspect and record that the “pot life” of epoxy grout materials is not exceeded during installation.
10. Inspect and record that localized repairs made to grout voids are in conformance with the Specification requirements.
11. Conduct a final review of completed epoxy grout installation for conformance to these Specifications.
12. Independent testing laboratory shall prepare, store, cure and test cubes in accordance with ASTM C579.

3.03 MANUFACTURER’S SERVICES

A. General: Provide training for installation, curing, and testing of nonshrink and epoxy grout by the manufacturer’s qualified representative.
B. Training: Provide assistance from manufacturer’s qualified representative as needed for proper installation, testing, and inspection of all nonshrink and epoxy grout products specified.

3.04 SUPPLEMENTS

A. The supplement listed below, following “End of Section,” is part of this Specification.

1. 24-hour Evaluation of Nonshrink Grout Test Form and Grout Testing Procedures.

END OF SECTION
24-HOUR EVALUATION OF NONSHRINK GROUT TEST FORM

OBJECTIVE: Define standard set of test procedures for an independent testing laboratory to perform and complete within a 24-hour period.

SCOPE: Utilize test procedures providing 24-hour results to duplicate field grouting demands. Intent of evaluation is to establish grout manufacturer’s qualifications.

PRIOR TO TEST: Obtain five bags of each type of grout.

1. From intended grout supplier for Project.
2. Five bags of grout shall be of same lot number.

ANSWER THE FOLLOWING QUESTIONS FOR GROUT BEING TESTED FROM LITERATURE, DATA, AND PRINTING ON BAG:

A. Product data and warranty information contained in company literature and data? Yes____ No____

B. Literature and bag information meet specified requirements? Yes____ No____

C. Manufacturer guarantees grout as specified in Article Guarantee? Yes____ No____

D. Guarantee extends beyond grout replacement value and allows participation with Contractor in replacing and repairing defective areas? Yes____ No____

E. Water demands and limits printed on bag? Yes____ No____

F. Mixing information printed on the bag? Yes____ No____

G. Temperature restrictions printed on bag? Yes____ No____

*Rejection of a grout will occur if one or more answers are noted NO.
GROUT TESTING PROCEDURES

A. Bagged Material:
   1. List lot numbers.  
   2. List expiration date.  
   3. Weigh bags and record weight.  

Owner’s Representative will disqualify grout if bag weights have misstated measure plus or minus 2 pounds by more than one out of five bags. (Accuracy of weights is required to regulate amount of water used in mixing since this will affect properties.)

B. Mixing and Consistency Determination:
   1. Mix full bag of grout in 10 gallon pail.  
   2. Use electric drill with a paddle device to mix grout (jiffy or jiffler type paddle).  
   3. Use maximum water allowed per water requirements listed in bag instructions.  
   4. Mix grout to maximum time listed on bag instructions.  
   5. In accordance with ASTM C939 (flow cone) determine time of mixed grout through the flow cone. __________ seconds  
   6. Add water to attain 20 to 30 second flow in accordance with ASTM C939.  
   7. Record time of grout through cone at new water demand. _______ seconds  
   8. Record total water needed to attain 20 to 30 second flow. _______ pounds  
   9. Record percent of water. _________ percent

C. When fluid grout is specified and additional water is required beyond grout manufacturer’s listed maximum water, ASTM C1107/C1107M will be run at new water per grout ratio to determine whether grout passes using actual water requirements to be fluid. Use new water per grout ratio on remaining tests.

D. Bleed Test:
   1. Fill two gallon cans half full of freshly mixed grout at ambient temperatures for each category and at required consistency for each.  
   2. Place one can of grout in tub of ice water and leave one can at ambient temperature.  
   3. Cover top of both cans with glass or plastic plate preventing evaporation.  
   4. Maintain 38 degrees F to 42 degrees F temperature with grout placed in ice and maintain ambient temperature for second container for 1 hour.
5. Visually check for bleeding of water at 15-minute intervals for 2 hours.

6. Perform final observation at 24 hours.

If grout bleeds a small amount at temperatures specified, grout will be rejected.

E. Extended Flow Time and Segregation Test (for Category II):

1. Divide the remaining grout into two 3 gallon cans. Place the cans into the 40-degree F and 100-degree F containers and leave for 20, 40, and 60 minutes. Every 20 minutes remove and check for segregation or settlement of aggregate. Use a gloved hand to reach to the bottom of the can, if more than 1/4-inch of aggregate has settled to the bottom or aggregate has segregated into clumps reject the grout.

2. Right after the settlement test mix the grout with the drill mixer for 10 seconds. Take a ASTM C939 flow cone test of grout and record flow time. Maintain this process for 1 hour at ambient temperatures of 40 degrees F and 100 degrees F.
   a. 20 min _____, sec. @ 40 degrees F.
   b. 40 min _____, sec. @ 40 degrees F.
   c. 60 min _____, sec. @ 40 degrees F.
   d. 20 min _____, sec. @ 100 degrees F.
   e. 40 min _____, sec. @ 100 degrees F.
   f. 60 min _____, sec. @ 100 degrees F.

All Category II and Category III grout that will not go through the flow cone with continuous flow after 60 minutes will be disqualified.

____________________  ____________
Qualified   Disqualified

F. 24-hour Strength Test:

1. Using grout left in mixing cans in accordance with ASTM C1107/C1107M for mixing and consistency determination test and for extended time flow test, make minimum of nine cube samples.

2. Store cubes at 70 degrees F for 24 hours.

3. Record average compressive strength of nine cubes at 24 hours.

Grout will be disqualified if 24-hour compressive strengths are less than 2,500 psi for grouts claiming fluid placement capabilities.

Grouts that have not been disqualified after these tests are qualified for use on the Project for the application indicated in Nonshrink Grout Schedule.

____________________  __________________
Signature of Independent Testing Laboratory   Date Test Conducted
### Specification Document Control

**Specification Document Control No.:** 03 64 23  
**Revision No.:** 0

**Project:** Outfall 200 Mercury Treatment Facility  
**Engineering Discipline:** Structural  
**Specification Division:** 3 – Concrete  
**Date:** 6/23/2017

### Specification Title & Description

(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Crack Repair Epoxy Injection Grouting

### Revision History

<table>
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<td>0</td>
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<td>June 23, 2017</td>
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### Document Review & Approval

#### Originator:

Harry W. Elliott / Lead Structural Engineer  

#### Design Verification Complete:

Alex Firth/Senior Structural Engineer

#### Approved:

W. Laird Ellis, Jr. PE/Design Manager  

**Digitally signed by W. Laird Ellis Jr.  
Date: 2017.06.23 15:27:06 -06'00'**
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

3. ASTM International (ASTM):

1.02 DEFINITIONS

A. Crack: Complete or incomplete separation of concrete into two or more parts produced by breaking or fracturing.

B. Crack Injection: Method of sealing or repairing cracks by injecting a polymer.

C. Large Cracks: Wider than 0.015 inch.

D. Small Cracks: Width equal to 0.015 inch or less.

1.03 SUBMITTALS

A. Action Submittals:

1. Physical and chemical properties for epoxy adhesives.
2. Technical data for metering, mixing, and injection equipment.
B. Informational Submittals:

1. Manufacturer’s recommended surface preparation procedures and application instructions for epoxy adhesives.
2. Installation instructions for repairing core holes with epoxy grout.
3. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements: Certified test results for each batch of epoxy grout.
4. Statements of Qualification for Epoxy Adhesive:
   a. Manufacturer’s Site representative.
   b. Injection applicator.
   c. Injection pump operating technician.
5. Epoxy adhesive two component ratio and injection pressure test records for concrete crack repair work.

1.04 QUALITY ASSURANCE

A. Qualifications for Epoxy Injection Staff:

1. Manufacturer’s Site Representative:
   a. Capable of instructing successful methods for restoring concrete structures utilizing epoxy injection process.
   b. Understands and is capable of explaining technical aspects of correct material selection and use.
   c. Experienced in the operation, maintenance, and troubleshooting of application equipment.
2. Injection crew and job foreman shall provide written and verifiable evidence showing compliance with the following requirements:
   a. Licensed and certified by epoxy manufacturer.
   b. Minimum 3 years’ experience in successful epoxy injection for at least 10,000 linear feet of successful crack injection including 2,000 linear feet of wet crack injection to stop water leakage.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Package adhesive material in new sealed containers and label with following information:

1. Manufacturer’s name.
2. Product name and lot number.
3. ANSI Hazard Classification.
4. ANSI recommended precautions for handling.
5. Mix ratio by volume.

B. Storage and Protection: Store adhesive containers at ambient temperatures below 110 degrees F and above 45 degrees F.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. BASF Building Systems, Shakopee, MN; Masterinject Series.
2. Sika Corp., Lyndhurst, NJ; Sikadur Series.
3. Euclid Chemical Co., Cleveland, OH; Euco Series.

2.02 EPOXY ADHESIVE

A. Two-component A and B structural epoxy adhesive for injection into cracks or other voids in concrete structures for bonding or grouting.

B. Adhesive Properties:

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D638</td>
<td>7-day, Tensile Strength, psi</td>
</tr>
<tr>
<td></td>
<td>ASTM D638</td>
</tr>
<tr>
<td>ASTM D695a</td>
<td>Compressive Yield Strength, 7 days @ 73°F, psi</td>
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<tr>
<td>ASTM D695a</td>
<td>Compressive Modulus, psi</td>
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<tr>
<td>ASTM D648a</td>
<td>Heat Deflection Temperature, °F</td>
</tr>
<tr>
<td>ASTM D570</td>
<td>Water absorption @ 24 hours, Maximum %</td>
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<tr>
<td>ASTM C882</td>
<td>Bond Strength @ 2 days psi</td>
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<tr>
<td>ASTM C882</td>
<td>Bond Strength @ 14 days psi</td>
</tr>
<tr>
<td>AASHTO T237b</td>
<td>Slant Shear Strength: (5,000 psi Compressive Strength Conc.) Where test results are available psi.</td>
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<tr>
<td></td>
<td>Cured 3 days @ 40 deg F—Wet Concrete</td>
</tr>
<tr>
<td></td>
<td>Cured 1 day @ 77 deg F—Dry Concrete</td>
</tr>
<tr>
<td></td>
<td>Cured 3 days @ 77 deg ± 3 deg F</td>
</tr>
</tbody>
</table>

psi.
<table>
<thead>
<tr>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>aCure test specimens so that peak exothermic temperature of adhesive does not exceed 100°F.</td>
</tr>
<tr>
<td>bSee referenced specifications for preparation method of test specimens.</td>
</tr>
</tbody>
</table>

**2.03 SURFACE SEAL**

A. Sufficient strength and adhesion for holding injection fittings firmly in place, and to resist pressures preventing leakage during injection.

B. Capable of removal after injection adhesive has cured.

**2.04 SOURCE QUALITY CONTROL**

A. Test Requirements: Perform tests for each batch of adhesive.

B. Pot Life Test:

1. Condition Components A and B to required temperature.
2. Measure components in ratio of Component B as stated on manufacturer’s label into an 8-fluid ounce paper cup.
3. Start stopwatch immediately and mix components for 60 seconds using wooden tongue depressor, take care to scrape sides and bottom of cup periodically.
4. Probe mixture once with tongue depressor every 30 seconds, starting 2 minutes prior to minimum specified pot life.
5. Pot Life Definition: Time at which a soft stringy mass forms in center of cup.

C. Fabrication of Slant Shear Specimens for Testing Bond of Injectable Adhesives to Wet Concrete at 40 Degrees F:

1. Scope: Test method for preparation of diagonal concrete mortar blocks used in determining slant shear strength of low viscosity injectable adhesives in accordance with AASHTO T237 when concrete is wet.
2. Materials:
   a. Diagonal concrete mortar blocks prepared in accordance with AASHTO Test Method T237 and cured to produce a mortar with compressive strength of 5,000 psi or greater.
   b. Paraffin wax.
   d. Suitable 20-mil-thick shim stock.
3. Preparation:
   a. Place a 20-mil shim between diagonal faces of two blocks and align so ends and sides are square.
   b. Bind block with masking tape covering gap between blocks.
   c. Leave a gap between blocks on one face uncovered for removal of shim and application of adhesive.
   d. Paint melted paraffin wax over masking tape.
   e. Shallow dam may be built up around opening using paraffin wax or modeling clay to help retain adhesive.
   f. Apply suitable capping compound to each end of specimen producing smooth surfaces perpendicular to longitudinal axis of block.
   g. Remove shim stock from gap opening.
   h. Soak specimen in water at 40 degrees F, plus or minus 3 degrees F for at least 24 hours.
   i. After soaking, remove specimen, shake free water from surface and gap opening.
   j. Prepare liquid adhesive.
   k. Within 5 minutes after removing specimen from water, start flowing adhesive into crack without entrap air bubbles.
   l. Place specimen in 40 degrees F, plus or minus 3 degrees F ambient for curing within 15 minutes after removing specimen from water for bonding. Do not expose specimen to temperatures beyond 77 degrees F during the 15-minute period.
   m. Cure specimen for 72 hours, plus or minus 4 hours at 40 degrees F, plus or minus 3 degrees F.

PART 3 EXECUTION

3.01 GENERAL
   A. Cracks:
      1. Repair by injection of epoxy adhesive.
      2. Repair cracks where specified or as shown.

3.02 PREPARATION
   A. Free cracks from loose matter, dirt, laitance, oil, grease, salt, and other contaminants.
   B. Clean cracks in accordance with epoxy adhesive manufacturer’s instructions.
   C. Clean surfaces adjacent to cracks from dirt, dust, grease, oil, efflorescence, and other foreign matter detrimental to bond of surface seal system.
D. Do not use acids and corrosives for cleaning, unless neutralized prior to injecting epoxy.

3.03 APPLICATION

A. Sealing: Apply surface seal in accordance with manufacturer’s instructions to designated crack face prior to injection. Seal surface of crack to prevent escape of injection epoxy.

B. Entry Ports:
   1. Establish openings for epoxy entry in surface seal along crack.
   2. Determine space between entry ports equal to thickness of concrete member to allow epoxy to penetrate to the full thickness of the wall.
   3. Provide a means to prevent concrete dusts and fines from contaminating the crack or ports when drilling.
   4. Space entry ports closer together to allow adjustment of injection pressure to obtain minimum loss of epoxy to soil at locations where:
      a. Cracks extend entirely through wall.
      b. Backfill of walls on one side.
      c. Difficult to excavate behind wall to seal both crack surfaces.

C. Epoxy Injection:
   1. Store epoxy at minimum of 70 degrees F.
   2. Start injection into each crack at lowest elevation entry port.
   3. Continue injection at first port until adhesive begins to flow out of port at next highest elevation.
   4. Plug first port and start injection at second port until adhesive flows from next port.
   5. Inject entire crack with same sequence.

D. Finishing:
   1. Cure epoxy adhesive after cracks have been completely filled to allow surface seal removal without draining or runback of epoxy material from cracks.
   2. Remove surface seal from cured injection adhesive.
   3. Finish crack face flush with adjacent concrete.
   4. Indentations or protrusions caused by placement of entry ports are not acceptable.
   5. Remove surface seal material and injection adhesive runs and spills from concrete surfaces.
3.04 EQUIPMENT

A. Portable, positive displacement type pumps with in-line metering to meter and mix two adhesive components, and inject mixture into crack.

B. Pumps:
   1. Electric or air powered with interlocks providing positive ratio control of proportions for the two components at nozzle.
   2. Primary injection pumps for each material of different mix ratio, including a standby backup pump of similar ratio.
   3. Capable of immediate compensation for changes in resins.
   4. Do not use batch mix pumps.
   
C. Discharge Pressure: Automatic pressure controls capable of discharging mixed adhesive at pressures up to 200 psi, plus or minus 5 percent, and able to maintain pressure.

D. Automatic Shutoff Control: Provide sensors on both Component A and B reservoirs for stopping machine automatically when only one component is being pumped to mixing head.

E. Proportioning Ratio Tolerance: Maintain epoxy adhesive manufacturer’s prescribed mix ratio within a tolerance of plus or minus 5 percent by volume at discharge pressure up to 160 psi.

F. Ratio/Pressure Check Device:
   1. Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing valve to restrict material flow.
   2. Pressure gauge capable of sensing pressure behind each valve.

3.05 FIELD QUALITY CONTROL

A. Epoxy Adhesive Two Component Ratio Tests:
   1. Disconnect mixing head and pump two adhesive components simultaneously through ratio check device.
   2. Adjust discharge pressure to 160 psi for both adhesive components.
   3. Simultaneously discharge both adhesive components into separate calibrated containers.
   4. Compare amounts simultaneously discharged into calibrated containers during same time period to determine mix ratio.
   5. Complete test at 160 psi discharge pressure and repeat procedure for 0 psi discharge pressure.
6. Run ratio test for each injection unit at beginning and end of each injection work day, and when injection work has stopped for more than 1 hour.

7. Document and maintain complete accurate records of, ratios and pressure checks.

B. Injection Pressure Test:

1. Disconnect mixing head of injection equipment and connect two adhesive component delivery lines to pressure check device.

2. Pressure Check Device:
   a. Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing of valve.
   b. Pressure gauge capable of sensing pressure buildup behind each valve.

3. Close valves on pressure check device and operate equipment until gauge pressure on each line reads 160 psi.

4. Stop pumps and observe pressure; do not allow pressure gauge to drop below 150 psi within 3 minutes.

5. Run pressure test for each injection equipment unit:
   a. Beginning and end of each injection work day.
   b. When injection work as stop for more than 45 minutes.

6. Check tolerance to verify equipment capable of meeting specified ratio tolerance.

END OF SECTION
Specification Document Control No.: 05 05 23  
Revision No.: 0

Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: Structural
Specification Division: 5 – Metals
Date: 6/16/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Welding

<table>
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<tr>
<th>Revision No.</th>
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Document Review & Approval:

Originator: Harry W. Elliott PE / Lead Structural Engineer

Design Verification Complete: Alex Firth/Senior Structural Engineer

Approved: W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.  Date: 2017.06.21 13:16:35 -06'00'
PART 1  GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. BPVC SEC V, Nondestructive Examination.
   b. BPVC SEC IX, Welding and Brazing Qualifications.
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0, Standard Welding Terms and Definitions.
   e. D1.3/1.3M, Structural Welding Code - Sheet Steel.
   g. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
   h. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.
B. CWI: Certified Welding Inspector.
C. MT: Magnetic Particle Testing.
D. NDE: Nondestructive Examination.
E. NDT: Nondestructive Testing.
F. PJP: Partial Joint Penetration.
G. PQR: Procedure Qualification Record.
H. PT: Liquid Penetrant Testing.
I. RT: Radiographic Testing.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Shop and field WPSs and PQRs.
   2. NDT procedure specifications prepared in accordance with ASME
      BPVC SEC V.
   3. Welding Data (Shop and Field): Submit welding data together with
      Shop Drawings as a complete package.
      a. Show on Shop Drawings or a weld map complete information
         regarding base metal specification designation, location, type,
         size, and extent of welds with reference called out for WPS and
         NDE numbers in tails of combined welding and NDE symbols as
         indicated in AWS A2.4.
      b. Distinguish between shop and field welds.
      c. Indicate, by welding symbols or sketches, details of welded joints
         and preparation of base metal. Provide complete joint welding
         details showing bevels, groove angles, and root openings for
         welds.
      d. For pipe fittings, provide a joint weld beveling diagram. Refer to
         AWS D1.1/D1.1M, Annex P Local Dihedral Angle that can be
         used to calculate bevels for weld joint details of intersecting pipes.
      e. Welding and NDE symbols shall be in accordance with
         AWS A2.4.
      f. Welding terms and definitions shall be in accordance with
         AWS A3.0.

B. Informational Submittals:
   1. WPQs.
   2. CWI credentials.
   3. Testing agency personnel credentials.
   4. CWI reports.
   5. Welding Documentation: Submit on forms in referenced welding codes.

1.04 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1/D1.1M (Annex N Forms) for shop or
   field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for
   shop welding only.
B. WPOs: In accordance with AWS D1.1/D1.1M (Annex N Forms); or ASME BPVC SEC IX (Form QW-484).

C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Engineer.

D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. CWI shall be present whenever shop welding is performed. CWI shall perform inspection, as necessary, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verifying conformance of specified job material and proper storage.
2. Monitoring conformance with approved WPS.
3. Monitoring conformance of WPQ.
4. Inspecting weld joint fit-up and performing in-process inspection.
5. Providing 100 percent visual inspection of welds.
6. Supervising nondestructive testing personnel and evaluating test results.
7. Maintaining records and preparing report confirming results of inspection and testing comply with the Work.

PART 3 EXECUTION

3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Weld Inspection Criteria:

1. Selection of welds to be tested, unless 100 percent NDT is specified herein, shall be as agreed upon between Engineer and Contractor.
2. Unless otherwise specified, perform NDT of welds at a frequency as shown below and in the attached Table in accordance with referenced welding codes as follows. Perform UT on CJP groove welds that cannot
be readily radiographed. In case there is a conflict, higher frequency level of NDT shall apply.

a. CJP Groove, Butt Joint Welds: 10 percent random RT.
b. All other CJP Groove Welds: 10 percent random UT.
c. Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
d. All Welds: 100 percent VT.

3. Weld Acceptance:
   a. VT:
      2) All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
   d. PT or MT:
      1) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.10.
      2) Acceptance shall be in accordance with VT standards specified above.

3.03 FIELD QUALITY CONTROL

A. CWI shall be present whenever field welding is performed. CWI shall perform inspection, as necessary, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verify conformance of specified job material and proper storage.
2. Monitor conformance with approved WPS.
3. Monitor conformance of WPQ.
4. Inspect weld joint fit-up and perform in-process inspection.
5. Provide 100 percent visual inspection of all welds.
6. Supervise nondestructive testing personnel and evaluating test results.
7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.
3.05 SUPPLEMENTS

A. The supplement listed below, following “End of Section,” is a part of this Specification.

1. Welding and Nondestructive Testing Table.

END OF SECTION
<table>
<thead>
<tr>
<th>Specification Section</th>
<th>Governing Welding Codes or Standards</th>
<th>Submit WPS</th>
<th>Submit WPQ</th>
<th>Onsite CWI Req’d</th>
<th>Submit Written NDT Procedure Specifications</th>
<th>NDT Requirements</th>
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<tr>
<td>05 12 00 Structural Steel Framing</td>
<td>AWS D1.1/D1.1M, Structural Welding Code - Steel</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>10% UT or RT of all groove-and-butt joint welds; 10% MT of all fillet welds; also see Section 05 12 00</td>
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<td>05 31 00 Steel Decking</td>
<td>AWS D1.1/D1.1M, Structural Welding Code - Steel or AWS D1.3/D1.3M, Structural Welding Code - Sheet Steel</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>100% VT; also see Section 05 31 00</td>
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<td>05 41 00 Structural Metal Stud Framing</td>
<td>AWS D1.1/D1.1M, Structural Welding Code - Steel or AWS D1.3/1.3M, Structural Welding Code - Sheet Steel</td>
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<td>No</td>
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<td>05 50 00 Metal Fabrications</td>
<td>AWS D1.1/D1.1M, Structural Welding Code - Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum or AWS D1.6/D1.6M, Structural Welding Code - Stainless Steel</td>
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<td>Yes</td>
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<td>05 52 19, Steel Railings</td>
<td>AWS D1.1/D1.1M, Structural Welding Code - Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum</td>
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<td>No</td>
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<td>No</td>
<td>100% VT; also see Section 05 52 19, Steel Railings</td>
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<td>05 53 00 Metal Gratings</td>
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<td>No</td>
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<td>33 16 13.13 Welded Steel Tank</td>
<td>ASME BPV Code, Section IX or AWS D1.1/D1.1M, Structural Welding Code - Steel</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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**Document Review & Approval:**

**Originator:**
Harry W. Elliott PE / Lead Structural Engineer

**Design Verification Complete:**
Alex Firth/Senior Structural Engineer

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. American Institute of Steel Construction (AISC):
   b. 325, Steel Construction Manual.
   c. 341, Seismic Provisions for Structural Steel Buildings.
   d. 360, Specification for Structural Steel Buildings.
   e. AISC Quality Certification Program.
   f. AISC Erector Certification Program.
4. ASTM International (ASTM):
   h. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
   i. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   k. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
m. A572/A572M, Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel.


r. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.


5. Occupational Safety and Health Administration (OSHA).


1.02 SUBMITTALS

A. Action Submittals:

1. Provide Shop Drawing details showing:
   a. Erection plans.
   b. Members, including piece numbers, sizes, grades, dimensions, cambers, and connection details.
   c. Anchor bolt layouts.
   d. Hardened washer details.
   e. Joint details for complete penetration welds.

2. Product specifications, including primer and other coatings.

B. Informational Submittals:

1. Schedule for submittal of shop and erection drawings.
2. Name and address of manufacturer(s).
3. Mill Certificates of tests made in accordance with ASTM A6/A6M.
4. Manufacturers’ testing procedures and standards.
5. Preparation and installation or application instructions, as appropriate.
6. Proposed method to resolve misalignment between anchor bolts and bolt holes in steel members.
7. High-Strength Bolts (Plain Noncoated and Hot-Dip Galvanized):
   a. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that products meet specified chemical and mechanical requirements.
   b. Manufacturer’s inspection test report results for production lot(s) furnished, to include:
1) Tensile strength.
2) Yield strength.
3) Reduction of area.
4) Elongation and hardness.

c. Certified Mill Test Reports for Bolts and Nuts:
   1) Name and address of manufacturer.
   2) Bolts correctly marked.
   3) Marked bolts and nuts used in required mill tests and manufacturer’s inspection tests.

8. Direct Tension Indicators (DTIs): Manufacturer’s test report meeting requirements of ASTM F959.
9. Tension Control (TC) Bolts: Manufacturer’s test report meeting requirements of ASTM A325 and ASTM F1852.
10. Welding Procedures, Qualifications, and Inspection Reports: As specified in Section 05 05 23, Welding.
11. AISC Quality Certification: AISC certificate showing name and address of certified firm, effective date, and category of certification; or, for erectors, documentation of similar project experience to include project name, location, date of completion, and name and phone number of owner’s contact person.
12. Charpy V-notch test results.

1.03 QUALITY ASSURANCE

A. Qualifications: Welding qualifications as specified in Section 05 05 23, Welding.

B. Certifications:

   1. Mill identification marks, heat number, size of section, and length in accordance with ASTM A6/A6M.
   2. AISC Quality Certification for Fabricator: Standard for Steel Building Structures (STD).
   3. AISC Quality Certification as Certified Steel Erector (CSE), or documented experience in erection of at least five similar structural steel facilities over past 10 years in lieu of AISC certification.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Load structural members in such a manner that they will be transported and unloaded without damage to coatings and without being excessively stressed, deformed, or otherwise damaged.
B. Storage:
   1. Protect structural steel members and packaged materials from corrosion and deterioration.
   2. Store in dry area and not in direct contact with ground.
   3. Protect fasteners from dirt and moisture. Do not remove lubricant from bolts and nuts.

C. Handle materials to avoid distortion or damage to members or supporting structures.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rolled Plates, Shapes except W-Shapes and Bars: ASTM A36/A36M or A572/A572M, Grade 50, unless indicated otherwise.

B. W-Shapes: ASTM A992/A992M, unless indicated otherwise on Drawings.

C. Steel Pipe: ASTM A53/A53M, Grade B.

D. Round Hollow Structural Sections (HSS): ASTM A500/A500M, Grade B (Fy equals 42 ksi).

E. Square and Rectangular Hollow Structural Sections (HSS): ASTM A500/A500M, Grade B (Fy equals 46 ksi).

F. Castellated Steel Beams:
   1. Manufacturers:
      a. Smartbeam – Metals USA, Ambridge, PA.
      b. New Millennium Building Systems; Ft. Wayne, Indiana.

2.02 FASTENERS

A. Anchor Bolts: As specified in Section 05 50 00, Metal Fabrications.

B. High-Strength Bolts:
   1. ASTM A325 or ASTM A490, bolt Type 1, plain uncoated.
   2. Bolt Length and Thread Length: As required for connection type shown, with hardened washers as required.
C. Direct Tension Indicators (DTIs) or Load Indicator Washers:
   1. ASTM F959, coating type to match bolt finish.
   2. Type A325 or A490, to match bolt type.
   3. Manufacturers and Products:
      a. TurnaSure LLC, Langhorne, PA; DTIs.
      b. Applied Bolting Technology Products, Ludlow, VT; DTIs, regular or Squirter type.

D. Tension Control (TC) Bolts:
   1. High-strength, ASTM A325 and ASTM F1852.
   2. Manufacturers:
      a. LeJeune Bolt Company, Burnsville, MN.
      b. Nucor Fastener, Saint Joe, IN.
      c. Haydon Bolts, Philadelphia, PA.
      d. Vermont Fasteners Manufacturing, Swanton, VT.

E. Nuts: ASTM A563, type to match bolt type and finish.

F. Hardened Steel Flat and Beveled Washers: ASTM F436, type to match bolt finish.

G. Welded Shear Studs: As specified in Section 05 50 00, Metal Fabrications.

2.03 ANCILLARY MATERIALS

A. Surface Preparation and Primer: As specified in Section 09 90 00, Painting and Coating.

B. Grout: As specified in Section 03 62 00, Nonshrink Grouting.

2.04 FABRICATION

A. General:
   1. Fabricate as shown and in accordance with AISC 360 and AISC 303.
   2. Columns shall be full length members without splices, unless shown otherwise or approved by Engineer.
   3. Mark and match mark materials for field assembly.
   4. Complete assembly, including bolting and welding of units, before start of finishing operations.
   5. Fabricate to agree with field measurements.
   6. Provide camber as indicated on Drawings.
   7. Sheared and flame-cut edges shall be free from rough corners and projections.
B. Connections:

1. **Shop Connections:** Weld or bolt as shown on Drawings.
2. Meet requirements of AISC 325 for bolted double-angle shear connections, unless indicated otherwise.
3. Meet OSHA requirements for one independent bolt at beams framing into column web connections.
4. Provide oversized holes for anchor bolts in column baseplate in accordance with AISC 325, unless indicated otherwise.

C. Welded Construction:

1. As specified in Section 05 05 23, Welding.
2. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

D. Interface with Other Work:

1. Holes:
   a. As necessary or as indicated for securing other Work to structural steel framing, and for passage of other Work through steel framing members shall be approved by Engineer.
   b. No flame-cut holes are permitted without prior approval of Engineer.
2. Weld threaded nuts to framing members, and other specialty items to receive other Work.

2.05 FINISHES

A. Shop Paint Primer:

1. Surface Preparation and painting as specified in Section 09 90 00, Painting and Coating.
2. Do not shop prime the following surfaces, unless indicated otherwise:
   a. Faying surfaces of slip critical bolted connections.
   b. Within 2 inches of field-welded connections.
   c. Steel members to be completely encased in reinforced concrete or coated with cementitious fireproofing.
3. Apply shop primer to top flange surfaces of composite steel beams, unless indicated otherwise.
4. Shop primer for steel members to be coated with intumescent fireproofing shall be compatible with specified fireproofing.
B. Slip Critical Bolted Connections: Mask faying surfaces of slip critical (SC) bolted connections to be shop painted as specified in Section 09 90 00, Painting and Coating.

C. Fully Tensioned Bolted Connections:
   1. Provide Class A faying surface. Mask faying surfaces of fully tensioned (FT) bolted connections to be shop painted as specified in Section 09 90 00, Painting and Coating.
   2. Exclude threads from shear plane, unless approved by Engineer.

2.06 SOURCE QUALITY CONTROL

A. Heavy Shapes and Plates: Thermally cut surfaces of beam copes and weld access holes shall be inspected and tested by an independent testing agency, retained by Contractor and approved by Engineer, in accordance with AISC 360, Paragraph J1.6.

B. Welding:
   1. Visually inspect fabrication welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
   2. An independent testing agency will be retained by Owner to perform the following inspection and testing of fabrication welds as specified in Section 05 05 23, Welding.
      a. Groove welds:
         1) Radiographic (RT) or ultrasonic (UT) testing for 10 percent of randomly selected welds, unless otherwise indicated.
         2) Use RT only for butt joint groove welds.
      b. Fillet Welds Larger than 5/16-inch: Liquid penetrant (PT) or magnetic particle (MT) for 10 percent of randomly selected welds, unless otherwise indicated.
      c. All Welds: 100 percent visually inspected (VT).
   3. Repair and retest defective welds as specified in Section 05 05 23, Welding.

C. Special inspection of fabrication process and shop welding will be provided by Owner as indicated on Drawings.
PART 3 EXECUTION

3.01 ERECTION

A. General:
1. Meet requirements of AISC 360 and AISC 303, with exceptions as specified.
2. Install Contractor-designed temporary construction bracing to provide necessary support until components are in place and construction is complete.
3. Provide additional field connection material as required by AISC 303.
4. Splice members only where indicated and accepted on Shop Drawings.

B. Field Assembly:
1. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly.
2. Set structural frames accurately to lines and elevations shown.
3. Align and adjust various members forming a part of a complete frame or structure before permanently fastening.
4. Level and plumb individual members of structure within tolerances shown in AISC 303.
5. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be completed and in service.
6. Perform necessary adjustments to compensate for minor discrepancies in elevations and alignment.

C. Setting Baseplates and Bearing Plates:
1. Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces.
2. Clean bottom surface of baseplates and bearing plates.
3. Set loose and attached baseplates and bearing plates for structural members on wedges, shims, leveling nuts, or other adjustable devices. Use leveling plates where indicated.
4. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to placing grout. Weld plate washer to baseplate where indicated.
5. Grout Under Baseplate: As specified in Section 03 62 00, Nonshrink Grouting, prior to placing loads on structure.
D. Anchor Bolts:

1. Coordinate installation of anchor bolts and other connectors required for securing structural steel to in-place work.
2. Provide templates and other devices for presetting bolts and other anchors to accurate locations.
3. Projection of anchor bolts beyond face of concrete and threaded length shall be adequate to allow for full engagement of threads of hold-down nuts, adjustment of leveling nuts, washer thicknesses, and construction tolerances, unless indicated otherwise.
4. Placement Tolerances:
   a. As required by AISC 303, unless indicated otherwise.
   b. Embedded anchor bolts shall not vary from dimensions shown on Drawings by more than the following:
      1) Center to Center of Any Two Bolts Within an Anchor Group: 1/8 inch.
      2) Center to Center of Adjacent Anchor Bolt Groups: 1/4 inch.
      3) Variation From Perpendicular to Theoretical Bearing Surface: 1:50.

E. Connections:

1. High-Strength Bolted:
   a. Tighten in accordance with RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
   b. Hardened Washers:
      1) Provide at locations required by Washer Requirements section of RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts, to include slip critical connections using slotted or oversized holes or ASTM A490 bolts.
      2) Use beveled style and extra thickness where required by RCSC Specification.
      3) Use square or rectangular beveled washers at inner flange surfaces of American Standard beams and channels.
      4) Do not substitute DTIs for hardened flat washers required at slotted and oversize holes.
   c. For bearing-type connections not fully tensioned (N, X), tighten to snug tight condition. Use hardened washer over slotted or oversize holes in outer plies.
2. Fully Tensioned Bolted:
   a. Use DTIs or TC bolts at slip critical (SC) and fully tensioned (FT) bearing-type connections.
b. DTIs:
1) Position within bolted assembly in accordance with ASTM F959.
2) Install bolts, with DTIs plus hardened washers as required, in holes of assembly and tighten until plies are in firm contact and fasteners are uniformly snug tight.

c. Final tightening bolts begin at most rigid part of bolted connection and progress toward free edges until final twist off of TC bolts or until DTIs have been compressed to an average gap equal to or less than shown in ASTM F959, Table 2.

3. Welded:
   a. As specified in Section 05 05 23, Welding.
   b. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

3.02 MISFITS

A. At Bolted Connections:
   1. Immediately notify Engineer for approval of one of the following methods of correction:
      a. Ream holes that must be enlarged to admit bolts and use oversized bolts.
      b. Plug weld misaligned holes and redrill holes to admit standard size bolts.
      c. Drill additional holes in connection, conforming to AISC for bolt spacing and end and edge distances, and add additional bolts.
      d. Reject member containing misfit, incorrect sized, or misaligned holes and fabricate new member to ensure proper fit.
   2. Do not enlarge incorrectly sized or misaligned holes in members by burning or by use of drift pins.

B. At Anchor Bolts:
   1. Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved Shop Drawing.
   2. Do not flame cut to enlarge holes without prior approval of Engineer.

C. Gas Cutting:
   1. Do not use gas cutting torches in field for correcting fabrication errors in structural framing.
   2. Secondary members not under stress and concealed in finished structure may be corrected by gas cutting torches, if approved by Engineer.
   3. Finish flame-cut sections equivalent to sheared and punched appearance.
3.03 REPAIR AND CLEANING

A. Clean shop primer from field welds, bolted connections, and abraded areas immediately after erection.

B. Remove and grind smooth tack welds, fit-up-lugs, and weld runoff tabs.

C. Remove weld back-up bars and grind smooth where indicated on Drawings.

D. Apply touchup paint primer by brush or spray of same thickness and material as that used in shop application and as specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY CONTROL

A. High-Strength Bolted Connections:

1. An independent testing agency will be retained by Owner to perform the following inspection and testing in accordance with the RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts:
   a. Marking identification and conformance to ASTM standards.
   b. Alignment of bolt holes.
   c. Placement, type, and thickness of hardened washers.
   d. Tightening of bolts.

2. Bearing-Type Connections Not Fully Tensioned (N, X): Snug tight condition with plies of joint in firm contact.

3. Fully Tensioned (FT) Bearing and Slip Critical (SC) Connections:
   a. Conduct preinstallation test.
   b. Monitor installation and tightening of DTIs or TC bolts.
   c. Monitor condition of faying surfaces for slip critical connections.

4. Preinstallation Test:
   a. Conduct test in accordance with Specification for Structural Joints Using ASTM A325 or ASTM A490 bolts prior to using bolt tension measuring device.
   b. Select representative sample of not less than three bolts of each diameter, length, and grade.
   c. Include DTIs and flat hardened washers as required to match actual connection assembly.


6. Defective Connections: Correct and reinspect defective and improperly tightened high-strength bolted connections. Retest fully tensioned bolts as necessary to demonstrate compliance of completed work.
B. Welded Connections:

1. Visually inspect field welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

2. An independent testing agency will be retained by Owner to perform the following inspection and testing of field welds as specified in Section 05 05 23, Welding.
   a. Groove Welds:
      1) Radiographic (RT) or ultrasonic (UT) testing for 10 percent of randomly selected welds, unless otherwise indicated.
      2) Use RT only for butt joint groove welds.
   b. Fillet Welds Larger Than 5/16 Inch: Liquid penetrant (PT) or magnetic particle (MT) for 10 percent of randomly selected welds, unless otherwise indicated.
   c. All Welds: 100 percent visually inspected (VT).

3. Repair and retest defective welds as specified in Section 05 05 23, Welding.

C. Special inspection will be provided by Owner as indicated on Drawings.

D. Welded Shear Studs: Inspect and test welded shear studs as specified in Section 05 50 00, Metal Fabrications.

END OF SECTION
**Specification Document Control No.:** 05 31 00  
**Revision No.:** 0

**Project:** Outfall 200 Mercury Treatment Facility

**Engineering Discipline:** Structural

**Specification Division:** 5 – Metals  
**Date:** 6/16/2017

**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Steel Decking

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**Revision History:**

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**Document Review & Approval:**

**Orinigator:**

Harry W. Elliott PE / Lead Structural Engineer

**Signature**

**Design Verification Complete:**

Alex Firth / Senior Structural Engineer

**Signature**

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

**Signature**
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

3. ASTM International (ASTM):
   a. A611, Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled.
   b. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. Steel Deck Institute (SDI):
   a. Design Manual for Composite Decks, Form Decks and Roof Decks.
5. Factory Mutual (FM):
   a. Factory Mutual Approval Guide.
   b. FM Research Corporation (FMRC): Approval Requirements for Steel Roof Deck Construction.

1.02 SUBMITTALS

A. Action Submittals:

1. Plan view layout of decking showing type and section properties of deck panels, reinforcing channels, pans, special jointing, and accessories.
2. Location of openings, deck laps, and deck attachment details.
3. Location of temporary shoring for placement of concrete topping.
B. Informational Submittals:

1. Decking manufacturer’s installation requirements.
2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.
3. Operation manuals for mechanical fastener installation tools.
4. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.03 QUALITY ASSURANCE

A. General: For metal decking section properties, meet requirements of AISI Specifications for Design of Cold-Formed Steel Structural Members.

B. FM Requirements:

1. Steel Roof Deck: Listed in Factory Mutual “Approval Guide” for Class 1 fire rating and Class 1-90 wind uplift rating.
2. Mechanical Fasteners: Packing containers shall show name of manufacturer and product and FMRC approval mark.

C. Qualifications for Field Welding: As specified in Section 05 05 23, Welding.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store deck bundles on platforms or pallets, with one end elevated to provide drainage.

C. Protect bundles against condensation with a ventilated waterproof covering.

D. Stack bundles so there is no danger of tipping, sliding, rolling, shifting or material damage.

E. Architecturally exposed deck shall be appropriately packaged and protected to prevent damage during shipment.

PART 2 PRODUCTS

2.01 METAL DECKING

A. Provide metal deck as shown in the following schedule:
### Steel Deck Schedule

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Roof Deck</td>
<td>3</td>
<td>32</td>
<td>0.0470</td>
<td>38</td>
<td>0.699</td>
<td>1.273</td>
<td>398</td>
<td>Galv, G-60, Shop Primed</td>
</tr>
<tr>
<td>Composite Floor Deck</td>
<td>1-1/2</td>
<td>36</td>
<td>0.0470</td>
<td>38</td>
<td>0.321</td>
<td>0.302</td>
<td>400</td>
<td>Galv, G-60, Shop Primed</td>
</tr>
</tbody>
</table>

B. Materials and Finishes:

1. Galvanized Deck:
   a. Sheet steel for galvanized deck and accessories shall conform to ASTM A653 Structural Quality Grade 38 or higher, as shown in Steel Deck Schedule.
   b. Galvanizing shall conform to ASTM A924 with coating class of G60 as defined in ASTM A653 and as shown in Steel Deck Schedule.

C. Manufacturers:

1. Vulcraft Division of Nucor Co., Brigham City, UT.
2. BHP Steel Building Products, USA, Inc., West Sacramento, CA.
3. Verco Manufacturing, Inc., Phoenix, AZ.
4. United Steel Deck, Inc., Summit, NJ.

### 2.02 ACCESSORIES

A. Provide pour stops, column closures, end closures, cover plates, girder fillers, ridge and valley plates, finish strips, reinforcing channels, and other accessories as required for complete installation.

B. Accessories shall be minimum 20-gauge, except edge forms shall be sized as required by the deck manufacturer, unless shown otherwise on the Drawings.

### 2.03 MECHANICAL FASTENERS

A. Self-Drilling Screws:

1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.
2. Manufacturers and Products:
   a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.

**PART 3 EXECUTION**

3.01 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.02 INSTALLATION

A. Locate deck bundles to prevent overloading of support framing members.

B. Install at right angles to supporting members in a three span minimum lay-up, unless shown otherwise, and in accordance with Specification and manufacturer’s installation recommendation.

C. Bearing: 1-1/2 inches, minimum.

D. Endlaps: Minimum of 2 inches and located over supports.

E. Do not stretch sidelaps.

F. Closure Plates:

   1. Install closure and cover plate accessories as recommended by the metal deck manufacturer, unless shown otherwise on the Drawings.
   2. Floor Deck and Form Deck Closures:

      a. Fasten column closures, cell closures, and zee closures to deck to provide tight fitting closures at open ends of ribs and sides of decking.
      b. Fasten cell closures at changes of direction of deck units, unless otherwise indicated.

G. Holes and Openings:

   1. Cut and fit around roof openings and other work projecting through or adjacent to decking.
   2. Locate holes and openings as shown to clear structural framing and bracing members.
   3. Reinforcement Around Openings:

      a. Roof Deck: For hole sizes of at least 6 inches across, but not more than 12 inches across in roof deck, reinforce with 0.0474-inch
design thickness steel plate, galvanized to match deck coating. Extend plate at least 12 inches beyond opening in all directions and attach to top of roof deck with No. 10 self-drilling screws at 6-inch spacing and at all corners. For openings larger than 12 inches across, reinforce roof deck with framing as shown on Drawings.

b. Composite Floor Deck and Form Deck: Reinforce openings as indicated on Drawings.

H. Protect deck areas from heavy concentrated loads or wheel traffic with planking or other approved means.

I. Install temporary shoring, if required, to meet strength and deflection limitations, before placing any concrete topping on deck panels.

J. Completed Deck: Free from buckles and irregularities, and in accordance with FM and UL requirements.

3.03 DECK ATTACHMENT

A. Fasten panels as shown in the following schedule:

<table>
<thead>
<tr>
<th>STEEL DECK ATTACHMENT SCHEDULE</th>
</tr>
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<tbody>
<tr>
<td>At Perpendicular Supports</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Roof Deck</td>
</tr>
<tr>
<td>Composite Floor Deck</td>
</tr>
</tbody>
</table>

B. Welded Connections: AWS D1.3 and as specified in Section 05 05 23, Welding.

C. Mechanical Fasteners:

1. Self-Drilling Screws:
   a. Install screws in accordance with manufacturer’s written instructions and with special installation tool. Do not over-torque.
   b. Remove and redrive screws at sidelaps where upper sheet is not drawn tightly against lower sheet.
3.04 TOUCHUP PAINTING

A. Immediately following erection, remove unused deck edge trimmings, screws, fasteners, welding washers, butt ends of welding rods, and debris from completed installation.

B. Clean field welds, bolted connections, rust spots, and abraded areas.

C. Repair damaged painted surfaces as specified in Section 09 90 00, Painting and Coating.

D. Repair damaged galvanized surfaces with zinc-rich spray paint in accordance with ASTM A780; color to match galvanized deck.

E. Use magnetic gauge to determine that thickness of repair is equal to or greater than base painted or galvanized coating.

3.05 FIELD QUALITY CONTROL

A. Special inspection will be provided by Owner as indicated on Engineer’s Statement of Special Inspection in the Drawings.

END OF SECTION
UCOR-FM-001, REV. 0 - SPECIFICATION COVER SHEET

Specification Document Control No.: 05 41 00  Revision No.: 0
Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: Architectural
Specification Division: 5 – Metals  Date: 6/23/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Structural Metal Stud Framing

Revision History:

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Document Review & Approval:

Originator:
Harry W. Elliott / Lead Structural Engineer
NAME/POSITION

Design Verification Complete:
Alex Firth/Senior Structural Engineer
NAME/POSITION

Approved:
W. Laird Ellis, Jr. PE/Design Manager
NAME/POSITION

Signature: [Signature]
Date: [Date]

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 15:22:41 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Iron and Steel Institute (AISI):
   a. Specification for the Design of Cold-Formed Steel Structural Members.
   b. Cold-Formed Steel Design Manual.
   c. Design Guide for Cold-Formed Steel Trusses.
   d. Fasteners for Residential Steel Framing.


3. ASTM International (ASTM):
   b. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Structural Tubing in Rounds and Shapes.
   c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   e. C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
   f. C955, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.


5. International Code Council (ICC): Evaluation Reports for Cold-Formed Steel Framing and Fasteners.
1.02 SUBMITTALS

A. Action Submittals:

1. Plan and elevation views of all metal framing systems, including location and framing of all openings.
2. Material specifications, member sizes, and properties.
3. Details of track, web stiffeners, stud bracing, blocking, bridging, and other members as required to provide a complete installation.
4. Details of connections including welding, mechanical fasteners, and accessory items.
5. Installation and erection instructions, including sequence of operations and requirements for temporary bracing and bridging.

B. Informational Submittals:

1. Manufacturer’s installation requirements.
2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.
3. Operation manuals for mechanical fastener installation tools.

1.03 QUALITY ASSURANCE

A. General: For member section properties, meet requirements of AISI, Specification for the Design of Cold-Formed Steel Structural Members.

B. Qualifications for Welding: As specified in Section 05 05 23, Welding.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver to Site in bundles marked with name of manufacturer, section type, thickness, grade of material, and length.

B. Store bundles on wood blocking, flat and off ground, to keep clean and to prevent any damage or permanent distortion.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide size and type of members as indicated on Drawings.

B. Sheet Steel: ASTM A653/A653M, with G-60 galvanized coating.

C. Cold-Formed Members and Accessories: ASTM C955.

D. Dimensions and Properties: Calculate section properties in accordance with AISI Cold-Formed Steel Design Manual.
2.02 STUDS AND JOISTS

A. Material:

1. ASTM A653/A653M, Structural Steel (SS) Grade 33, or High-Strength Low-Alloy Steel (HSLAS), Type A or B, Grade 50.
2. Section: Type, size, and thickness as indicated on Drawings.
3. Flanges: Stiffened with return lip.
4. Webs:
   a. Studs: Punched.
   b. Joists: Unpunched, unless indicated otherwise on Drawings.

B. Accessories:

1. Track: Size as required to fit over studs, same thickness as stud material, unpunched.
2. Blocking, Bridging, and Fire Stops: Same depth as studs or joists, 0.0566-inch minimum design thickness, unpunched.
4. Mounting Plates: 0.0566-inch minimum design thickness by 8 inches by 18 inches.
5. Accessories shall be from same manufacturer as studs and joists.

C. Manufacturers and Products:

1. AMS, Los Angeles, CA; Angeles Metal Systems.
2. Clark Steel, Middleton, OH; Steel Framing Systems.
3. Dale Industries; Dearborn, MI; Dale/Incor Steel Framing.
4. Dietrich Industries, Pittsburgh, PA; Lightgauge Metal Framing Products.
5. Knorr Steel Framing Systems, Salem, OR; Light Gauge Steel Framing.
6. Marino/Ware, South Plainfield, NJ; Stud-Rite Lightweight Steel Framing Systems.
7. Unimast Incorporated, Schiller Park, IL; Steel Framing Systems.

2.03 MECHANICAL FASTENERS

A. Self-Drilling Screws:

1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.
2. Manufacturers and Products:
   a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.
B. Powder-Driven Fasteners:

1. Knurled shank, minimum 1/2-inch diameter steel washer, corrosion-resistant coating.
2. Pin diameter and length to suit deck type and flange thickness of steel support member.
3. Manufacturers and Products:
   a. ITW Buildex, Itasca, IL; Buildex BX14 pins with yellow dichromate galvanizing and BX900 Installation Tool.
   b. Hilti, Inc., Tulsa, OK; ENP-series fasteners with electroplated zinc coating and DX-750 Installation Tool.

2.04 CONCRETE ANCHORS

A. Drilled anchors, size and type as shown on Drawings and as specified in Section 05 50 00, Metal Fabrications.

2.05 PREFABRICATION

A. Structural wall framing panels may be prefabricated prior to erection.

B. Prefabricated assemblies shall be not more than 1/8 inch out of square within length of assembly and shall be braced against racking. Use jig templates for layout and fabrication.

C. Protect prefabricated panels from damage during handling.

2.06 SOURCE QUALITY CONTROL

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect all prefabricated assemblies and repair any damage.

B. Examine bearing support surfaces for compliance with requirements for installation tolerances and other conditions affecting performance of metal framing systems.

C. Provide smooth level bearing surfaces for bottom track of load-bearing walls.

D. Clean all member and bearing surfaces that will be in contact after assembly.
3.02 INSTALLATION

A. General:

1. Install framing systems as indicated on Drawings, complete and in accordance with manufacturer’s recommendations.
2. Provide temporary bracing for support of all construction loads until framing system is installed complete with sheathing or decking.
3. Install framing in true line, plumb, level, and in proper alignment.
4. Cut ends of framing members with saw or shear to bear uniformly against abutting members. Flame cutting is not permitted.
5. All structural framing members shall be full-length without splices, unless indicated otherwise.
6. Fasten members together in accordance with AISI, Cold-Formed Steel Design Manual, Part IV, Connections. Wire tying is not permitted.

B. Stud Bearing Walls:

1. Secure bottom track to floor slab with concrete anchors as indicated on Drawings.
2. Seat studs squarely and firmly within track before securing with fasteners. Gap between end of stud and track shall be less than 1/16 inch.
3. Install studs with spacing as shown and not more than 2 inches from abutting walls.
4. Provide double studs at jambs of openings wider than stud spacing.
5. Provide triple studs at corners and at jambs of openings wider than 48 inches, unless indicated otherwise.
6. Track shall be continuous. Center splices between studs and splice with stud section full length between studs.
7. Frame wall penetrations for pipes and ducts larger than stud spacing to avoid cutting structural members.
8. Fire stop stud walls and partitions with unpunched blocking full width of stud at midpoint or where required for nailers, in conformance with applicable building code.
9. Provide blocking for support of mechanical items.
10. Do not remove the web knockouts within 10 inches of either end of load-bearing studs.
11. Provide bracing straps with gusset plates and anchor holddown assemblies where indicated on Drawings.
12. Tolerances:
   b. Stud Spacing: Plus or minus 1/8 inch.

C. Joists:

1. Position joists directly over bearing studs and attach to track.
2. Joists shall be one-piece within a single span. For multiple spans, lap joists and splice as shown on Drawings.
3. Immediately install bridging and solid blocking to support joists. Maximum spacing of bridging shall be 5 feet.
4. Install web stiffeners where indicated
5. Web Penetrations:
   a. Drilled holes for other trades shall be limited to the middle 1/3 of the joist depth within the middle 1/3 of the span, unless indicated otherwise. Minimum spacing between drilled holes shall be 1-1/2 times the joist depth. Notching of joist flanges and flame cutting of holes are not permitted.
6. Tolerances:
   a. Joist Spacing: Plus or minus 1/8 inch.
   b. Joist Levelness: Plus or minus 1/8 inch in 10 feet.

3.03 FASTENERS

A. Self-Drilling Screws:

1. Install in accordance with manufacturer’s written instructions and with special installation tool.
2. Screw type, diameter, and length shall be in accordance with AISI, Fasteners for Residential Steel Framing, minimum two screws per connection unless indicated otherwise.
3. Use clamp to hold members together. Drive screw from lighter to heavier gauge, to allow plies to be pulled together without stripping metal. Do not over torque. A minimum of three exposed threads shall extend through steel.
4. Minimum screw spacing, end distance, and edge distance shall be 3 diameters.

B. Powder-Driven Fasteners:

1. Use only for connecting cold-formed steel to structural steel members, unless indicated otherwise.
2. Install in accordance with manufacturer’s written instructions and with special installation tool.
C. Welded Connections:
   1. Welding shall not be used for material thinner than 0.0451 inch.
   2. Weld framing members and accessories in accordance with AWS D1.3.
   3. Resistance welding for prefabricated framing shall be in accordance with AWS C1.1 and AWS C1.3.
   4. Repair galvanized surfaces damaged by welding with zinc-rich spray paint in accordance with ASTM A780.

D. Concrete Anchors: Install in accordance with Section 05 50 00, Metal Fabrications.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will be retained by Owner to perform following inspections.
   1. Welded Connections: Visually inspect in accordance with AWS D1.3, Section 7, and as specified in Section 05 05 23, Welding.
   2. Mechanical Fasteners: Visually inspect, in accordance with manufacturer’s instructions, for each type of fastener.

B. Repair or replace defective welds and fasteners.

C. Special inspection will be provided by Owner as indicated in the Engineer’s Statement of Special Inspections on the Drawings.

END OF SECTION
## Specification Title & Description

(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Metal Fabrications

## Revision History

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## Document Review & Approval

### Originator

Harry W. Elliott PE / Lead Structural Engineer

NAME/POSITION

![Signature](signature.png)

W. Laird Ellis, Jr.

### Design Verification Complete

Alex Firth/Senior Structural Engineer

NAME/POSITION

![Signature](signature.png)

June 16, 2017

### Approved

W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

Digitally signed by W. Laird Ellis, Jr.

Date: 2017.06.21 13:23:31 -06'00'
SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. American Galvanizers Association (AGA):
   a. Inspection of Hot-Dip Galvanized Steel Products.
6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
7. American Welding Society (AWS):
   c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. ASTM International (ASTM):
   h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
ll. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
mm. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

a. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
b. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
c. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
d. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
e. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.


11. Occupational Safety and Health Administration (OSHA):
b. 29 CFR 1926.105, Safety Nets.
c. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.

12. Specialty Steel Industry of North America (SSINA):
a. Specifications for Stainless Steel.
b. Design Guidelines for the Selection and Use of Stainless Steel.
c. Stainless Steel Fabrication.
d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.

B. Concrete Anchor: Post-installed concrete anchors listed in this specification.

C. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

D. Exterior Area: Location not protected from weather by building or other enclosed structure.

E. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.
F. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

G. Masonry Anchor: Post-installed masonry anchors listed in this specification.

H. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Metal fabrications, including welding and fastener information.
   b. Specific instructions for concrete anchor installation, including drilled hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

2. Samples: Color samples of abrasive stair nosings.

B. Informational Submittals:

1. Concrete and Masonry Post-Installed Anchors:
   a. Manufacturer’s product description and printed installation instructions.
   b. Current ICC-ES Report for each type of post-installed anchor to be used.
   c. Adhesive Anchor Installer Certification.

2. U-Channel Concrete Inserts:
   a. Manufacturer’s product description.
   b. Allowable load tables.


5. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Adhesive Anchor Installer: Trained to install adhesive anchors in accordance with manufacturer’s printed installation instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Insofar as practical, factory assemble specified items. Assemblies, because of necessity, have to be shipped unassembled shall be packaged and tagged in manner that will protect materials from damage and will facilitate identification and field assembly.

B. Package stainless steel items in a manner to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.

D. Store fabricated items in dry area, not in direct contact with ground.

E. Store adhesives anchors at service temperature ranges recommended by manufacturer.

1.06 SPECIAL GUARANTEE

A. Manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of floor hatches found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

1.07 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following extra materials:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoprene Gasket</td>
<td>Two for each location requiring neoprene gaskets.</td>
</tr>
<tr>
<td>Neoprene Gasket Adhesive</td>
<td>One (manufacturer’s recommended) for each location requiring neoprene gaskets.</td>
</tr>
</tbody>
</table>

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.
PART 2  PRODUCTS

2.01  GENERAL

A.  For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

B.  Unless otherwise indicated, meet the following requirements:

<table>
<thead>
<tr>
<th>Item</th>
<th>ASTM Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Wide Flange Shapes</td>
<td>A992/992M</td>
</tr>
<tr>
<td>Other Steel Shapes and Plates</td>
<td>A36/A36M</td>
</tr>
<tr>
<td>Steel Pipe</td>
<td>A501 or A53/A53M, Type E or S, Grade B</td>
</tr>
<tr>
<td>Hollow Structural Sections (HSS)</td>
<td>A500/A500M, Grade B</td>
</tr>
<tr>
<td>Stainless Steel:</td>
<td></td>
</tr>
<tr>
<td>Bars and Angles</td>
<td>A276, AISI Type 316 (316L for welded connections)</td>
</tr>
<tr>
<td>Shapes</td>
<td>A276, AISI Type 304 (304L for welded connections)</td>
</tr>
<tr>
<td>Steel Plate, Sheet, and Strip</td>
<td>A240/A240M, AISI Type 316 (316L for welded connections)</td>
</tr>
<tr>
<td>Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs</td>
<td>F593, AISI Type 316, Condition CW</td>
</tr>
<tr>
<td>Nuts</td>
<td>F594, AISI Type 316, Condition CW</td>
</tr>
<tr>
<td>Steel Bolts and Nuts:</td>
<td></td>
</tr>
<tr>
<td>Carbon Steel</td>
<td>A307 bolts, with A563 nuts</td>
</tr>
<tr>
<td>High-Strength</td>
<td>A325, Type 1 bolts, with A563 nuts</td>
</tr>
<tr>
<td>Anchor Bolts and Rods</td>
<td>F1554, Grade 55, with weldability supplement S1.</td>
</tr>
<tr>
<td>Eyebolts</td>
<td>A489</td>
</tr>
<tr>
<td>Threaded Rods</td>
<td>A36/A36M</td>
</tr>
<tr>
<td>Flat Washers (Unhardened)</td>
<td>F844</td>
</tr>
<tr>
<td>Item</td>
<td>ASTM Reference</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Flat and Beveled Washers (Hardened)</td>
<td>F436</td>
</tr>
<tr>
<td>Thrust Ties for Steel Pipe:</td>
<td></td>
</tr>
<tr>
<td>Threaded Rods</td>
<td>A193/A193M, Grade B7</td>
</tr>
<tr>
<td>Nuts</td>
<td>A194/A194M, Grade 2H</td>
</tr>
<tr>
<td>Plate</td>
<td>A283/A283M, Grade D</td>
</tr>
<tr>
<td>Welded Anchor Studs</td>
<td>A108, Grades C-1010 through C-1020</td>
</tr>
<tr>
<td>Aluminum Plates and Structural Shapes</td>
<td>B209 and B308/B308M, Alloy 6061-T6</td>
</tr>
<tr>
<td>Aluminum Bolts and Nuts</td>
<td>F468, Alloy 2024-T4</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>A48/A48M, Class 35</td>
</tr>
</tbody>
</table>

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:
   1. Headed type, unless otherwise shown on Drawings.
   2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:
   1. Plastic:
      a. Single unit construction with corrugated sleeve.
      b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
      c. Material: High-density polyethylene.
   2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE ANCHORS

A. General:
   1. AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Fastener Schedule at end of this section.
3. Anchors shall be suitable for long-term loads, as well as for wind and seismic loads.
4. Acceptable for use in potable water structures by EPA and local health agencies or NSF 61.
5. Torque-Controlled Expansion Anchors (Wedge Anchors):
   a. Wedge anchors used in sustained tension applications (such as overhead or cantilevered applications) shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC193 for cracked concrete.
   b. Manufacturers and Products:
      1) ITW Ramset/Red Head, Addison, IL; Trubolt+ Wedge Anchor (ESR-2427).
      2) Hilti, Inc., Tulsa, OK; Kwik-Bolt–TZ (KB-TZ) Anchors (ESR-1917).
      3) Powers Fasteners, Brewster, NY; Power-Stud +SD2 or +SD1 Anchors (ESR-2502 and ESR-2818).
6. Displacement-Controlled Expansion Anchors (Drop-in Anchors):
   a. Self-drilling anchors, snap-off or flush type, zinc-plated.
   b. Nondrilling Anchors: Flush type for use with zinc-plated or stainless steel bolt, or stud type with projecting threaded stud.
   c. Manufacturers and Products:
      1) ITW Ramset/Red Head, Addison, IL; Multi-Set II Drop-In Anchor.
      2) Hilti, Inc., Tulsa, OK; Hilti HDI+ Drop-In Anchor.
      3) Powers Fasteners, Brewster, NY; Steel Drop-In Anchor.
      4) Simpson Strong-Tie Co., Inc., Pleasanton, CA; Drop-In Anchor.
7. Undercut Anchors:
   a. When used in sustained tension applications (such as overhead or cantilevered applications) shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC193 for cracked concrete.
   b. Manufacturers and Products:
      1) Hilti, Inc., Tulsa, OK; HDA Undercut Anchor (ESR-1546).
      2) Powers Fasteners, Brewster, NY; Atomic+ Undercut (ESR-3067).
8. Self-Tapping Concrete Screw Anchors:
   a. When used in sustained tension applications (such as overhead or cantilevered applications) shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC193 for cracked concrete.
b. Manufacturers and Products:
   1) Powers Fasteners, Brewster, NY; Wedge-Bolt+ (ESR-2526).
   2) Hilti, Inc., Tulsa, OK; Kwik HUS-EZ Screw Anchor (ESR-3027).
   3) Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713).

9. Light-Duty Torque Controlled Expansion Anchors (Sleeve Anchors):
   a. Manufacturers and Products:
      1) ITW Ramset/Red Head, Addison, IL; Dynabolt Plus Sleeve Anchor.
      2) Powers Fasteners, Brewster, NY; Lok-Bolt AS.
      3) Simpson Strong-Tie Co., Inc., Pleasanton, CA; Sleeve-All Hex Head Anchor.
      4) Wej-It Corp., Tulsa, OK; Sleeve-Tite Sleeve Anchor.

10. Heavy-Duty Torque Controlled Expansion Anchors (Sleeve Anchors):
    a. Manufacturers and Products:
       1) Powers Fasteners, Brewster, NY; Power-Bolt+ Anchor (ESR-3260).
       2) Hilti, Inc., Tulsa, OK; HSL-3 Heavy Duty Sleeve Anchor (ESR-1545).

B. Adhesive Anchors (Epoxy Anchors):

1. If approved by Engineer, adhesive anchors used in sustained tension applications (such as overhead or cantilevered applications) shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC308 for cracked concrete.

2. Threaded Rod:
   a. ASTM F593 stainless steel threaded rod, diameter as shown on Drawings.
   b. Length as required, to provide minimum depth of embedment.
   c. Clean and free of grease, oil, or other deleterious material.
   d. For hollow-unit masonry, provide galvanized or stainless steel wire cloth screen tube to fit threaded rod.

3. Adhesive:
   a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions. For low temperature conditions, contact the Engineer for adhesive recommendations.
   c. Mixed Adhesive: Nonsag light paste consistency with ability to remain in 1-inch diameter overhead drilled hole without runout.
   d. Meet requirements of ASTM C881/C881M.
4. Packaging and Storage:
   a. Disposable, self-contained cartridge system capable of dispensing both components in proper mixing ratio and fitting into manually or pneumatically operated caulking gun.
   b. Store adhesive cartridges on pallets or shelving in covered storage area.
   c. Container Markings: Include manufacturer’s name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
   d. Dispose of when:
      1) Shelf life has expired.
      2) Stored other than in accordance with manufacturer’s instructions.

5. Manufacturers and Products:
   c. Powers Fasteners, Brewster NY, PE1000+ Adhesive anchoring system (ESR-2583).

C. Adhesive Threaded Inserts:
   1. Stainless steel, internally threaded inserts.

2.04 POST-INSTALLED MASONRY ANCHORS

A. General: AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Fastener Schedule at end of this section.

B. Current ICC Evaluation Report indicating acceptance per IBC 2012 for anchors at structural applications in masonry.

C. Manufacturers and Products:
   2. Powers Fasteners, Brewster NY, Power-Stud+ SD1 (ESR-2966) for grout-filled masonry.

2.05 STUD SHEAR CONNECTORS

A. Headed anchor studs (HAS), or threaded anchor studs (TAS), or stud shear connectors, as indicated on Drawings.
1. Carbon Steel: ASTM A108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless indicated otherwise.
2. Stainless Steel: ASTM F593, AISI Type 316, Condition CW, where indicated.

B. Manufacturers:
   1. Nelson Stud Welding, Doncasters Limited, Elyria, OH.

2.06 PIPE SLEEVES
   A. As specified in Section 402701, Process Piping Specialties.

2.07 STEEL LINTELS AND SHELF ANGLES
   A. ASTM A36/A36M, hot-dip galvanize after fabrication in accordance with ASTM A123/A123M.

2.08 EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING
   A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.
   B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.09 U-CHANNEL CONCRETE INSERTS
   A. Rolled ASTM A240/A240M, AISI Type 316 stainless steel, 0.105-inch-thick, 1-5/8 inches wide by 1-3/8 inches deep, with stainless steel anchors at 10-inch maximum spacing, styrofoam fillers, and end caps.
   B. Nut and Bolt Hardware: Type 316 stainless steel, 5/8-inch minimum diameter, unless indicated otherwise. Manufacturer’s standard to match insert.
   C. Manufacturers and Products:
      1. Power-Strut, Wayne, MI; PS 300 Series.
      2. Eaton B-Line Systems, Inc., Highland, IL; B32 Series.
      3. Halfen Anchoring Systems, Converse, TX; Channel Type HTA 52/34.

2.10 ABRASIVE NOSING FOR STAIRS
   A. Unless otherwise shown on Drawings, furnish flush type abrasive nosings on stairs.
B. Nosing Components:
   1. Homogeneous epoxy abrasive, with minimum 50 percent aluminum oxide content, formed and cured upon an extruded aluminum base.
   2. Epoxy abrasive shall extend over and form curved front edge of nosing.

C. Anchoring System: Double-set anchors consisting of two rows of integrally extruded anchors.

D. Size: 3 inches wide by 1/4 inch to 3/8 inch thick by length as shown.

E. Color: Selected by Engineer from manufacturer’s standard color range.

2.11 FLOOR PLATE

A. Material:
   1. Stainless Steel: ASTM A793, AISI Type 304.

B. Minimum Thickness:
   1. Steel: 1/4 inch, unless shown otherwise on Drawings.
   2. Aluminum: 3/8 inch, unless shown otherwise on Drawings.

C. Surface shall be raised-lug pattern or diamond tread, unless shown otherwise on Drawings.

D. Slip-Resistant Surface:
   1. Provide where indicated on Drawings.
   2. Manufacturers and Products:
      a. Harsco Industrial IKG; MEBAC #2.
      b. W.S. Molnar Co., Detroit, MI; SLIPNOT Grade 2–Medium.

2.12 ROOF ACCESS WALKWAYS AND FALL PROTECTION

A. Fall Arrest Post:
   1. Clamped to standing seams, fully OSHA compliant. Located as shown on Drawings.
   2. System to be installed by the system manufacturer or an installer approved by the system manufacturer.
   3. Manufacturers and Products:
      a. Miller Fusion; Roof Anchor Post X 10001.
      b. Approved equal.
B.  Walkways and Rails:

1.  PVC, FRP, or aluminum tread panels, aluminum rails both sides, open at end for access to fall arrest posts. Fully OSHA compliant.
2.  Clamped to standing seams. Located as shown on Drawings.
3.  System to be installed by the system manufacturer or an installer approved by the system manufacturer.
4.  Manufacturers and Products:
   a.  Kalzip; Suregrip.
   b.  Approved equal.

2.13 ROOF ACCESS LADDERS

A.  6061 T6 or 6063-T5 aluminum construction, powder coated to match wall panel color.

B.  Floor mounted, with midpoint supports located to connect with secondary wall framing (girts), fully OSHA compliant.

C.  Manufacturers and Products:

1.  O’Keeffe; Model 533A with platform and rail extensions.
2.  Approved equal.

2.14 FLOOR HATCHES

A.  Load Capacity: 300 psf with maximum deflection of 1/150th of span.

B.  Component Fabrication:

1.  Access Door Leaf(s): 1/4-inch-thick aluminum diamond pattern plate. Provide stainless steel safety chain and attachments for end of double-leaf door assembly when open.

C.  Door Hardware:

1.  Hinges: Heavy-duty brass or stainless steel with stainless steel pins, through-bolted to cover plate with tamper-proof stainless steel bolts flush with top of cover and to outside leg of channel frame with stainless steel bolts and locknuts.
2.  Lifting Mechanism: Stainless steel compression lift springs enclosed in telescoping vertical housing or stainless steel torsion lift springs.
3.  Hold-Open Arm:
   a.  Locks automatically in open position.
   b.  Disengages with slight pull on vinyl grip with one hand.
c. Door can be easily closed with one hand by pulling forward and
down on vinyl grip.

4. Snap Lock:
   a. Stainless steel snap lock mounted on bottom of door leaf with
      removable topside key wrench and inside fixed lever handle.
   b. Threaded plug for flush outside surface with key wrench removed.

D. Aluminum shall be mill finished with protective coating applied to surfaces to
   be in contact with concrete, as specified in Section 09 90 00, Painting and
   Coating.

E. Manufacturers and Products:
   2. Nystrom Products Co., Minneapolis, MN; FH Series.
   4. ITT Flygt Corporation, Trumbull, CT; FLE Series.
   5. Thompson Fabricating Co., Birmingham, AL; TI Series.
   6. Halliday Products, Orlando, FL; SS Series.

2.15 HATCH SAFETY NET

A. General:
   2. Size to fit hatch opening where indicated.

B. Components and Accessories:
   1. Rails and Slide Rings: Aluminum 6061-T6 extruded rails and
      aluminum-alloy 713.0 slide rings.
   2. Corner Hooks and Eyebolts: AISI Type 316 stainless steel.
   3. Netting: Polyester, 5-inch by 5-inch net openings; 5,000 pounds
      minimum breaking strength.
   4. Bolts, Nuts, and Concrete Anchors: AISI Type 316 stainless steel.


2.16 HINGED MANHOLE COVERS

A. Slab type rectangular manhole frame and cover with flush, waterproof lift
   handles, and stainless steel butt hinges.

B. ASTM A48/A48M, Class 35, cast iron, unpainted.
C. Furnish as shown in table:

<table>
<thead>
<tr>
<th>Mark</th>
<th>Duty</th>
<th>Size (inches)</th>
<th>Weight (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC-1</td>
<td>Light</td>
<td>24 x 36</td>
<td>275</td>
</tr>
<tr>
<td>HMC-2</td>
<td>Light</td>
<td>30 x 30</td>
<td>290</td>
</tr>
<tr>
<td>HMC-3</td>
<td>Light</td>
<td>30 x 36</td>
<td>335</td>
</tr>
<tr>
<td>HMC-4</td>
<td>Light</td>
<td>30 x 48</td>
<td>450</td>
</tr>
<tr>
<td>HMC-5</td>
<td>Heavy</td>
<td>30 x 36</td>
<td>525</td>
</tr>
<tr>
<td>HMC-6</td>
<td>Heavy</td>
<td>36 x 36</td>
<td>700</td>
</tr>
</tbody>
</table>

D. Manufacturers:

1. Neenah Foundry Co., Neenah, WI.
2. Flockhart Foundry Co., Newark, NJ.

2.17 LADDERS

A. Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, CFR Part 1910.27, and ALI A14.3.

1. Concentrated load of 200 pounds loads imposed by persons occupying ladder shall be considered to be concentrated at such points as will cause maximum stress in structural member being considered.
2. Weight of ladder and attached appurtenances together with live load shall be considered in design of rails and fastenings.

B. Flat Bar Ladder:

1. Punch rails, pass rungs through rails, and weld on outside.
2. Weld brackets to ladder for fastening ladder to wall.

C. Aluminum Pre-engineered Pipe Ladder:

1. Rungs:
   b. Nonslip grip surface, 1-inch wide flat top, and semicircular bottom with mill finish.
3. Ladder Attachments and Cage Assembly Fasteners: Stainless steel.
4. Welded, pop riveted, or glued construction is not acceptable.
5. Fabricate to longest length as practical but not to exceed 24 feet.
6. Furnish support attachments to side rails at 6 feet maximum spacing.
7. Manufacturer: Thompson Fabricating Co. Inc., Tarrant, AL.

D. Ladder Safety Post:

1. Telescoping tubular, spring balanced and automatically locking in raised position, with release lever for unlocking.
2. Post: Aluminum.
4. Furnish dissimilar metal protective coatings at connections.

2.18 SAFETY CLIMB DEVICE

A. General:

2. Belt and harness shall withstand minimum drop test of 250 pounds in 6-foot free fall.
3. Fall Prevention System Material: Stainless steel, AISI Type 316.

B. Components and Accessories:

1. Main Components: Sleeve or trolley, safety harness, and carrier or climbing rail.
2. Ladder rung clamps with stainless steel, AISI Type 316, mounting brackets and hardware.
3. Removable extension kit with tiedown rod or trolley gate, mandrel, and carrier rail for ladders under manholes and hatches.

C. Manufacturers and Products:

1. Miller Equipment, Franklin, PA; Sure Track Rail System.
2. TS Products, St. Charles, IL; TS Safety Rail System.

2.19 LADDER CLIMB PREVENTION SHIELD

A. Eight feet long with angled sides to within 2 inches of wall when closed.

B. Furnish dissimilar metals protective coatings at bolted connections.

C. Manufacturer and Product: North Safety Products, Specialty Products Division, Toronto, Ontario, Canada; Ladder Gate 770-000-001.
2.20 FALL ARREST ANCHORS

A. General:
   2. Minimum Breaking Strength: 5,000 pounds.
   3. Material: Stainless steel, AISI Type 304.

B. Components and Accessories:
   1. Forged combination eye and base assembly with headed anchor bolt, backer plate, lock washer, and nut.
   2. Suitable for embedding in concrete wall or slab.

C. Manufacturers and Products:
   1. Thaler Metal Industries, Buffalo, NY; FARA Wall Anchor.
   2. Rose Manufacturing Company, Pittsburgh, PA; Anchorage Connector.

2.21 FABRICATED UNITS

A. Shell Manhole:
   1. Flanged and bolted type with confined rubber gasket.
   2. Manhole Unit: Capable of withstanding pressure of full tank of water with no leakage.
   4. Cover: Hinged to tank.
   5. Grind welds and sheared edges smooth.

B. Weir and Baffle Plates: Fabricate plates and associated framing of stainless steel, AISI Type 316, unless indicated otherwise on Drawings.

C. Stop Gates and Guide Frames: Aluminum plate with aluminum channel or angle sections as stiffeners.
   1. Guides, Rests, and Fasteners: AISI Type 316 stainless steel.
   2. Identification Plate:
      a. 16-gauge aluminum or stainless steel securely mounted on each gate.
      b. Text: 1-inch die-stamped word “WATERSIDE” and corresponding gate number as shown in Gate Schedule.
      c. Mount plate on side opposite gate stiffeners.
2.22 ACCESSORIES

A. Antiseizing Lubricant for Stainless Steel Threaded Connections:

1. Suitable for potable water supply.
2. Resists washout.
3. Manufacturers and Products:
   a. Bostik, Middleton, MA; Neverseez.
   b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.

B. Neoprene Gasket:

1. ASTM D1056, 2C1, soft, closed-cell neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown on Drawings.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK1111LD.

2.23 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer’s instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.

F. Watertight Seal: Where required or shown, furnish neoprene gasket of a type that is satisfactory for use in potable water applications. Cover full bearing surfaces.

G. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

H. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.24 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct deficiencies.

2. Aluminum: AWS D1.2/D1.2M.
3. Stainless Steel: AWS D1.6/D1.6M.
PART 3  EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
2. Install rigid, substantial, and neat in appearance.
3. Install manufactured products in accordance with manufacturer’s recommendations.
4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

B. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.

C. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

D. Steel Lintels and Shelf Angles: Provide as required for support of masonry and other construction not attached to structural steel framing, unless otherwise shown on Drawings.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Locate and hold anchor bolts in place with templates at time concrete is placed.

B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.
3.03 CONCRETE AND MASONRY POST-INSTALLED ANCHORS

A. Begin installation only after concrete or masonry to receive anchors has attained design strength.

B. Install in accordance with manufacturer’s instructions.

C. Provide minimum embedment, edge distance, and spacing as follows, unless indicated otherwise by anchor manufacturer’s instructions or shown otherwise on Drawings:

<table>
<thead>
<tr>
<th>Anchor Type</th>
<th>Minimum Embedment (Bolt Diameters)</th>
<th>Minimum Edge Distance (Bolt Diameters)</th>
<th>Minimum Spacing (Bolt Diameters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion</td>
<td>9</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Undercut</td>
<td>9</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Adhesive</td>
<td>9</td>
<td>9</td>
<td>13.5</td>
</tr>
</tbody>
</table>

D. Use only drill type and bit type and diameter recommended by anchor manufacturer. Clean hole of debris and dust with brush and compressed air per manufacturer’s printed installation instructions.

E. For undercut anchors, use special undercutting drill bit and rotary hammer drill and apply final torque as recommended by anchor manufacturer.

F. When embedded steel or rebar is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than 10 degrees to clear obstruction, notify Engineer for direction on how to proceed.

G. Adhesive Anchors:

1. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F, unless cold temperature adhesives, compliant with ACI 308 are used. Refer to the respective ICC-ES report and manufacturer’s printed installation instructions.

2. Remove water from hole with oil-free compressed air. Damp or water filled holes may be allowed only if approved in manufacturer’s printed installation instructions and ICC-ES report.

3. For hollow-unit masonry, install screen tube in accordance with manufacturer’s printed installation instructions.

4. Do not disturb anchor during recommended curing time.

5. Do not exceed maximum torque as specified in manufacturer’s printed installation instructions.
3.04  U-CHANNEL CONCRETE INSERTS
A. Provide as indicated for pipe supports and where otherwise shown on Drawings.
B. Except for interior dry areas, use plastic clips or similar dielectric material to isolate channel anchors from concrete reinforcing steel.

3.05  ABRASIVE NOSINGS
A. Provide abrasive nosings on concrete steps not being supplied or coated with another type of nosing or nonskid material.

3.06  ACCESS COVERS
A. Install access covers, including sidewalk doors, floor hatches, and hinged manhole covers in accordance with manufacturer’s instructions.
B. Accurately position prior to placing concrete, such that covers are flush with floor surface.
C. Protect from damage resulting from concrete placement. Thoroughly clean exposed surfaces of concrete spillage to obtain a clean, uniform appearance.

3.07  SAFETY CLIMB DEVICE SYSTEM
A. Provide for each ladder where unbroken height between levels exceeds 20 feet, or at lesser height where indicated on Drawings.
B. Install in accordance with manufacturer’s instructions.
C. Furnish additional accessories required to complete system for each ladder.
D. Furnish one harness for each ladder equipped with safety climb device.
E. Furnish pivot section at platforms, landings, and roofs.
F. When installed to required height, fall prevention system shall be rigid and an integral part of the structure.

3.08  ELECTROLYTIC PROTECTION
A. Aluminum and Galvanized Steel:
   1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.
5. Should coating become marred, prepare and touch up in accordance with paint manufacturer’s written instructions.

B. Titanium: Where titanium equipment is in contact with concrete or dissimilar metal, provide full-face neoprene insulation gasket, 3/32-inch minimum thickness and 70-durometer hardness.

C. Stainless Steel:
1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
5. After treatment, visually inspect surfaces for compliance.

3.09 PAINTING

A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.

B. Field Painting of Shop Primed Surfaces: Prepare surfaces and field finish in accordance with Section 09 90 00, Painting and Coating.

3.10 FIELD QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings.
2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control:

1. Manufacturer’s Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements and Section 01 88 15, Anchorage and Bracing.
C. Stud Shear Connectors:

1. At start of each production period, conduct the following test to determine proper generator, control unit, and stud welding gun settings, in accordance with AWS D1.1/D1.1M, Chapter 7:
   a. Weld two test studs and visually inspect for full 360-degree flash.
   b. Bend test studs 30 degrees from vertical for headed anchor studs (HAS). Torque test threaded anchor studs (TAS) studs per AWS D1.1/D1.1M, Section 7.6.6.2.
   c. Test studs will be acceptable if there is no failure of welds.
   d. If weld fails, repeat test until two consecutive test studs test to be satisfactory.

2. During production, if visual inspection reveals weld does not exhibit full 360-degree flash or that stud has been repaired by welding, conduct the following test in accordance with AWS D1.1/D1.1M, Chapter 7:
   a. Bend HAS studs or stud shear connectors approximately 15 degrees from vertical, away from missing portion of flash. For TAS studs, torque test per AWS D1.1/D1.1M, Section 7.6.6.2.
   b. Studs meeting this test without exhibiting cracks in weld will be considered acceptable and left in bent position.
   c. Replace studs failing test.

3. Special inspection shall be provided by Owner where indicated on Drawings.

D. Concrete and Masonry Drilled Anchors: Special inspection and testing will be provided by Owner where indicated on Drawings.

3.11 MANUFACTURER’S SERVICES

A. Anchor Installation: Conduct site training of installation personnel for proper installation, handling, and storage of mechanical and adhesive anchor systems. Notify Engineer of time and place for sessions.

3.12 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

<table>
<thead>
<tr>
<th>Service Use and Location</th>
<th>Product</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings</td>
<td>Plain uncoated steel headed anchor bolts, unless indicated otherwise</td>
<td></td>
</tr>
<tr>
<td>Service Use and Location</td>
<td>Product</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Exterior and Interior Wet Areas</td>
<td>Stainless steel headed anchor bolts</td>
<td></td>
</tr>
<tr>
<td>Submerged and Corrosive Areas</td>
<td>Stainless steel headed anchor bolts with fusion bonded coating</td>
<td>See Section 09 90 00, Painting and Coating</td>
</tr>
</tbody>
</table>

**2. Anchor Bolts Cast Into Concrete for Equipment Bases**

| Interior Dry Areas | Stainless steel headed anchor bolts, unless otherwise specified with equipment | |
| Submerged, Exterior, Interior Wet, and Corrosive Areas | Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment | See Section 09 90 00, Painting and Coating |

**3. Drilled Anchors for Metal Components to Cast-in-Place Concrete (e.g., Ladders, Handrail Posts, Electrical Panels, and Equipment)**

| Interior Dry Areas | Zinc-plated or stainless steel wedge or expansion anchors | Use zinc-plated undercut anchors for overhead and ceiling installations. |
| Submerged, Exterior, Interior Wet, and Corrosive Areas | Adhesive stainless steel anchors | Use stainless steel undercut anchors for overhead and ceiling installations. |

**4. Anchors in Grout-Filled Concrete Masonry Units**

<p>| Exterior and Interior Wet and Dry Areas | Hot-dip galvanized steel headed anchor bolts, zinc-plated or stainless steel sleeve anchors, or stainless steel adhesive anchors | |</p>
<table>
<thead>
<tr>
<th>Service Use and Location</th>
<th>Product</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Anchors in Hollow Concrete Masonry Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior and Interior Wet and Dry Areas</td>
<td>Zinc-plated or stainless steel sleeve anchors, or stainless steel adhesive anchors with screen tube</td>
<td></td>
</tr>
<tr>
<td>6. Connections for Structural Steel Framing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior and Interior Wet and Dry Areas</td>
<td>High-strength steel bolted connections</td>
<td></td>
</tr>
<tr>
<td>7. Connections for Steel Fabrications and Wood Components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior and Interior Wet and Dry Areas</td>
<td>Stainless steel bolted connections</td>
<td></td>
</tr>
<tr>
<td>8. Connections of Aluminum Components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submerged, Exterior and Interior Wet and Dry Areas</td>
<td>Stainless steel bolted connections, unless otherwise specified with equipment</td>
<td></td>
</tr>
<tr>
<td>9. All Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior and Interior Wet and Dry Areas</td>
<td>Stainless steel fasteners</td>
<td></td>
</tr>
</tbody>
</table>

B. Antiseizing Lubricant: Use on stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION
Specification Document Control No.: 05 52 19  Revision No.: 0
Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: Structural
Specification Division: 5 – Metals  Date: 6/16/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Steel Railings

Revision History:

<table>
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<td>All</td>
</tr>
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</table>

Document Review & Approval:

Originator: Harry W. Elliott PE / Lead Structural Engineer

Design Verification Complete: Alex Firth/Senior Structural Engineer

Approved: W. Laird Ellis, Jr. PE/Design Manager
SECTION 05 52 19
STEEL RAILINGS

PART 1   GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Iron and Steel Institute (AISI): As applicable.
2. ASTM International (ASTM):
   c. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
3. International Code Council (ICC):
   b. Evaluation Services Reports, as applicable.

1.02 DEFINITIONS


B. Railings: This term shall include guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

C. Special Inspection: As defined by the ICC IBC.

D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.
1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
   b. Manufacturer’s literature and catalog data of railing and components.
   c. Design Data: Where proposed design of post base connections is different than details shown on Drawings, submit calculations or test data for alternate railing anchorages using ICC IBC design loads.

B. Informational Submittals:

1. Manufacturer’s assembly and installation instructions.
2. Special Inspection: Manufacturer’s instructions for Special Inspection of post-installed concrete anchors.
3. Test Reports: Test data for anchorages may supplement design data submitted for alternate anchorage details. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with the ICC IBC.

1.04 QUALITY ASSURANCE

A. Qualifications: Calculations required for alternate anchorage designs (if proposed) shall be stamped by a registered civil or structural engineer licensed in the state where the Project will be constructed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Railings adequately packaged and wrapped to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

PART 2 PRODUCTS

2.01 STEEL RAILINGS

A. Pipe Railings/Round HSS:

1. Painted carbon steel, ASTM A500/A500M Grade B.
3. Wall Thickness:
   a. Rail: 0.145-inch, minimum.
   b. Post: 0.200-inch, minimum.

B. Accessories, including railing components, flanges, wall brackets, anchor plates, shall conform to the following:

2. Wall Brackets:
   a. Malleable iron, round top, and painted.
   b. Manufacturers and Products:
      1) The Wagner Companies; No. 1765.
      2) Julius Blum & Co., Inc.; No. 1382.
3. Rail Terminals (including Wall Returns):
   a. Round, painted steel, welded to rail, with two 5/16-inch holes for 1/4-inch fasteners.
   b. Manufacturer: The Wagner Companies.
4. Railing System Gate:
   a. As specified herein for painted steel pipe.
   b. Gate Hardware: AISI Type 304 or Type 316 stainless steel.
5. Railing Picket Panels and Clamps:
   a. Painted steel, solid bar or pipe meeting minimum requirements specified for pipe rails.
   b. Fasteners: Stainless steel.
6. Toeboards and Accessories:
   a. ASTM A36/A36M steel painted.
   b. Toeboards: Provide slotted holes for expansion and contraction where required.
   c. Fasteners: Stainless steel.

C. Metal supports embedded in concrete: In accordance with Section 05 50 00, Metal Fabrications.

D. Miscellaneous Fasteners: Stainless steel.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: Painted ASTM A325 bolts.
C. Concrete Anchors:

1. Painted steel anchor rods conforming to ASTM F1554, Grade 36.
2. Post-installed anchors shall be in accordance with Section 05 50 00, Metal Fabrications, unless otherwise specified herein.

2.03 FABRICATION OF WELDED STEEL RAILINGS

A. Shop Assembly:

1. Post spacing and railing details shall be as shown on Drawings.
2. Post to Baseplate Connection: Field fit-up is required as shown on Drawings.
3. Alternate Post to Baseplate Connection:
   a. Field measure elevation of concrete at each post location and determine exact post length so baseplate is on concrete surface.
   b. Rails shall be in straight alignment when rails to posts and posts to baseplates are welded.
   c. Field weld posts to baseplates.
4. Remove burrs from cut edges.
5. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with finished surfaces smooth.
6. Cover exposed ends of steel pipe by welding 1/8-inch minimum thickness steel plate in place or use prefabricated fittings.
7. Welding:
   a. In accordance with Section 05 05 23, Welding.
   b. Thoroughly fuse without undercutting or overlap.
   c. Remove splatter, grind exposed welds to blend, and contour surfaces to match those adjacent.
   d. Grind welds prior to painting of railing sections.
8. Furnish explosion prevention holes at closed ends of pipes.
9. Form and assemble joints exposed to weather to prevent water and moisture from penetrating.

B. Shop/Factory Finishing: After fabrication paint steel components other than stainless steel components as specified in Section 09 90 00, Painting and Coating.

C. Tolerances:

1. Cut pipe square within 2 degrees and lengths within 1/8 inch.
2. Welding: Miter and cope intersections of posts and rails within 2 degrees, fit to within 0.020 inch, and perform continuous welds around joints.

D. Repair of Defective Work: Remove stains and replace defective Work.
PART 3 EXECUTION

3.01 GENERAL

A. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.

B. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

C. Modification to supporting structure is not permitted where railing is to be attached.

D. Mount railings only on completed walls. Do not support railings temporarily by means not satisfying structural performance requirements.

E. Protection from Entrapped Water:
   1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
   2. For posts mounted in concrete, bends, and elbows occurring at low points drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

A. Expansion Joints:
   1. Maximum intervals of 54 feet on center and at structural movement joints.
   2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
   4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span movement joints in structural walls and floors supporting the posts.

B. Posts and Rails:
   1. Surface Mounted and Side Mounted Posts:
      a. Bolt post baseplate connectors firmly in place.
      b. Install to account for small variation in leveling grouts and shims between adjacent posts.
   2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
4. Install posts and rails in same plane.
5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

C. Wall Brackets:
1. Support wall rails on brackets as shown on Drawings.
2. Install wall anchor backplates on solid blocking in stud walls.

D. Toeboard:
1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or on stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation, cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.

E. Railing System Gate: Install in accordance with manufacturer’s installation instructions.

3.03 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.

B. Coat metal surfaces as specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY CONTROL

A. Post-installed anchors supporting railing systems require special inspection.

B. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.
3.05 CLEANING

A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

B. Do not use acid solution, steel wool, or other harsh abrasive.

END OF SECTION
**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Metal Gratings

### Revision History:

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### Document Review & Approval:

**Originator:**

Harry W. Elliott PE / Lead Structural Engineer

**Design Verification Complete:**

Alex Firth/Senior Structural Engineer

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr. Date: 2017.06.21 13:28:21 -06'00"
PART 1    GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. ASTM International (ASTM):
   c. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. National Association of Architectural Metal Manufacturers (NAAMM):
   a. MBG 531, Metal Bar Grating Manual.
   b. MBG 532, Heavy-Duty Metal Bar Grating Manual.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
   b. Grating Anchorage: Show details of anchorage to supports to prevent displacement from traffic impact.
   c. Product data for grating, grating clips, anchors, accessories, and other manufactured products specified herein.
   d. Manufacturer’s specifications, including coatings, surface treatment, and finishes.

B. Informational Submittals:

1. Special handling and storage requirements.
2. Installation instructions.
1.03 DELIVERY, STORAGE, AND HANDLING

A. Insofar as is practical, factory assemble items.

B. Package and clearly tag parts and assemblies that are, due to necessity, shipped unassembled.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
2. IKG Industries, Houston, TX.
3. Ohio Gratings, Inc., Canton, OH.

2.02 GRATING MATERIALS

A. Aluminum: Provide alloy and temper as designated below.

1. Bearing Bars and Banding: ASTM B221 alloy 6061-T6 or 6063-T6.
2. Swaged Crossbar Rods: ASTM B221 alloy 6061 or 6063, or ASTM B210 alloy 3003.
3. Finish: Mill.

B. Stainless Steel:

1. Bearing Bars, Banding and Cross Bars: ASTM A666, Type 304L.
2. Finish: Mill.

2.03 METAL BAR GRATING

A. General Requirements:

1. Maximum Service Load:
   a. Light Duty (Type A): 100 psf uniformly distributed load.
   b. Medium Duty (Type B): 300 psf uniformly distributed load.
2. Maximum Deflection: Span/240 or 1/4 inch, whichever is less.
3. Bearing Bar Spacing:
   b. Medium Duty: 15/16 inch maximum, center-to-center.
4. Cross Bar Spacing: 4 inches maximum, center-to-center. For aluminum I-bar grating with depths greater than 2 inches, provide cross bars at 2 inches maximum, center-to-center.
5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 531 or as shown on Drawings.
B. Grating Materials:
   1. Aluminum, pressure-locked I-bar grating fabricated by swaging crossbars between extruded I-shaped bearing bars.
   2. Stainless steel pressure-locked rectangular bar grating fabricated by swaging crossbars between rectangular bearing bars.

C. Surface:
   1. Slip resistant, consisting of an applied abrasive finish of aluminum-oxide aggregate.

D. Stair Treads:
   1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
   2. Nosings: Integral ribbing and serrated edge on one long axis of tread, or nonslip abrasive on each tread along one long edge.
   3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.

2.04 HEAVY-DUTY METAL BAR GRATING (TYPE C)

A. General Requirements:
   5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 532 or as shown on Drawings.
   6. Grating Type: Galvanized steel, heavy-duty, rectangular bar grating fabricated by welding crossbars between rectangular bearing bars.

2.05 ACCESSORIES

A. Embedded Frames:
   1. As indicated on Drawings and as specified in Section 05 50 00, Metal Fabrications.

B. Grating Clamps:
   1. Use at flanged beam and bolted angle frame supports.
   2. Removable from above grating walkway surface.
   3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.
4. Manufacturers and Products:
   a. Direct Metals Company, LLC, Kennesaw, GA; Grating Clamp.
   b. Grating Fasteners, Inc., Harvey, LA; G-Clip.

C. Anchor Stud and Saddle Clip:
   1. Use at embedded angle frame supports with stud anchor and nut recessed below top of grating surface.
   2. Removable from above grating walkway surface.
   3. Provide Type 316 stainless steel welded threaded stud anchor, nut, washer, and saddle clip.
   4. Manufacturers and Products:
      a. Welded Stud Anchor:
         1) Nelson Stud Welding, Inc., Elyria, OH.
         2) Stud Welding Associates, Inc. Elyria, OH.
      b. Saddle Clip:
         1) Direct Metals Company, LLC, Kennesaw, GA; Saddle Clip.
         2) Grating Fasteners, Inc., Harvey, LA; Saddle Clip.
         3) Struct-Fast, Inc., Baltimore, MD; Gratefast.

2.06 FABRICATION

A. General:
   1. In accordance with NAAMM MBG 531 or NAAMM MBG 532.
   2. Do not weld aluminum grating.
   3. Conceal fastenings where practical.
   4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
   5. Cutouts:
      a. Fabricate in grating sections for penetrations indicated.
      b. Arrange to permit grating removal without disturbing items penetrating grating.
      c. Edge band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
   6. Do not notch bearing bars at supports to maintain elevation.
   7. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
   8. Section Length: Sufficient to prevent section from falling through clear opening when oriented in the span direction and one end is touching either the concrete or the vertical leg of grating support.
   9. Minimum Bearing: 1 inch for grating depth up to 2-1/4 inches and 2 inches for grating depth greater than 2-1/4 inches.
  10. Banding and Toe Plates: Same material as grating and welded to bearing bars in accordance with requirements of NAAMM MBG 531 and NAAMM MBG 532.
B. Metal Bar Grating: A single grating section shall be not less than 1.5 feet or greater than 3 feet in width, or weigh more than 150 pounds.

C. Heavy Duty Metal Bar Grating: Minimum width of grating sections shall be 2 feet regardless of length and weight.

D. Supports:
   1. Same material as grating, except that supports which are to be embedded in concrete shall be Type 316 stainless steel, unless part of an extruded aluminum system.
   2. Coordinate dimensions and fabrication with grating to be supported.

**PART 3 EXECUTION**

3.01 PREPARATION

A. Electrolytic Protection:
   1. Protect aluminum surfaces in contact with dissimilar metals, or embedded or in contact with masonry, grout, or concrete as specified in Section 09 90 00, Painting and Coating.
   2. Allow paint to dry before installation of material.

3.02 INSTALLATION

A. Until grating sections are securely fastened in place, area shall be appropriately barricaded or flagged to alert people working in the area of potential fall hazard.

B. Install manufactured products in accordance with manufacturer’s recommendations.

C. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.

D. Install grating supports plumb and level as applicable.

E. Install sections of welded frames with anchors to straight plane without offsets.

F. Field locate and install fasteners to fit grating layout.

G. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.

H. Each grating section shall be easily removable and replaceable.
I. Completed installation shall be rigid and neat in appearance.

J. Protect painted and galvanized surfaces during installation.

K. Repair damaged coatings as specified in Section 09 90 00, Painting and Coating.

END OF SECTION
Specification Document Control No.: 06 10 00  Revision No.: 0
Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: Architectural

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Rough Carpentry

Revision History:

<table>
<thead>
<tr>
<th>Revision No.</th>
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Document Review & Approval:

Originator: Mark Sharp, Lead Architect

Design Verification Complete: Stephen J. Silkworth - Quality Control

Approved:

W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 13:51:39 -06'00'
PART 1    GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. American Lumber Standards Committee’s Board of Review (ALSC).
3. American Wood Preservers’ Association (AWPA):
   a. U1, User Specification for Treated Wood.
   b. M4, Standard for the Care of Preservative-Treated Wood Products.
4. APA - The Engineered Wood Association (APA):
   a. PRP-108, Performance Standards and Qualification Policy for Structural-Use Panels (Form E445).
5. ASTM International (ASTM):
   b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. International Code Council (ICC):
   a. ESR-1539, Power-Driven Staples and Nails.
   a. PS 1, Structural Plywood.
   b. PS 2, Performance Standard for Wood-Based Structural-Use Panels.

1.02 SUBMITTALS

A. Action Submittals:

1. Product Data: Indicate component materials and dimensions, and include construction and application details for the following:
   a. Sheathing.
   b. Metal framing anchors.
   c. Construction adhesives.
   d. Construction panel thickness where not shown.

B. Informational Submittals:

1. ICC Evaluation Service Reports, including the following as a minimum:
   a. Wood Treatment.

2. Wood treatment manufacturer’s instructions for handling, storing, installation, and finishing of treated material.
   a. For each type of preservative-treated wood product, include certification by treatment plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
   b. For waterborne-treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to Site.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Upon delivery to Site, immediately place materials in area protected from weather. Do not store seasoned materials in wet or damp areas.

B. Protect sheet materials from breaking corners and damaging surfaces while unloading.

C. Store materials a minimum of 6 inches above ground on framework or blocking and cover with waterproof covering, providing for adequate air circulation and ventilation. Store sheet materials flat, not on edge.

D. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

E. Store materials for which maximum moisture content is specified in areas where humidity can be controlled.
PART 2 PRODUCTS

2.01 GENERAL

A. Lumber Standards:

1. In accordance with DOC PS 20 and applicable grading rules and wood species certified by ALSC.
2. Design values for wood members equal to those published in supplement to AF&PA 2.
3. Stamp or brand each unexposed piece of lumber with grade, species, and moisture content at time of mill surfacing.

B. Lumber sizes shown on Drawings are nominal, unless shown otherwise. Provide actual sizes as required by DOC PS 20 for use.

C. Dressed lumber S4S, unless shown otherwise on Drawings.

D. Moisture content of lumber not to exceed 19 percent, unless otherwise specified and marked “DRY”.

E. Each plywood panel identified with designated grade trademark of APA.

2.02 LUMBER

A. Framing lumber shall be Southern Pine Select or better unless indicated otherwise below:

<table>
<thead>
<tr>
<th>Usage</th>
<th>Minimum Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plates, sills, blocking, furring, braces, and nailers</td>
<td>Southern Pine Stud grade, nondense</td>
</tr>
<tr>
<td>Structural light framing, general framing, studs 2 inches to 4 inches thick by 2 inches to 6 inches wide</td>
<td>Southern Pine No. 1</td>
</tr>
<tr>
<td>Structural joists, headers, posts and planks, 2 inches to 4 inches thick by 5 inches and wider</td>
<td>Southern Pine No. 1</td>
</tr>
<tr>
<td>Posts and timbers</td>
<td>Southern Pine Select Structural</td>
</tr>
<tr>
<td>Beams and stringers</td>
<td>Southern Pine Select Structural</td>
</tr>
<tr>
<td>Baffles and tank liners</td>
<td>Eastern Hemlock-Tamarack No. 1</td>
</tr>
</tbody>
</table>
2.03 CONSTRUCTION PANELS

A. Plywood:

1. General:
   a. Where construction panels are shown on Drawings for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements designated under each application for grade designation, span rating, exposure durability classification, and thickness.
   b. Construction Panel Standards: Comply with DOC PS 1 for plywood construction panels and for products not manufactured under DOC PS 1 provisions, in accordance with APA PRP-108 and APA Form B445.
   c. Trademark: Each construction panel factory-marked with APA trademark evidencing compliance with grade requirements.

   a. Exposure Durability Classification: EXTERIOR.
   b. Span Rating: 12/0, 16/0, 20/0 for stud spacing of 16 inches or less.

B. Plywood Backing Panel: Mounting electrical, telephone, and like equipment; provide fire-retardant treated plywood panel with grade designation, APA C-D Plugged Exposure 1, in thickness shown on Drawings, or, if not shown on Drawings, not less than 15/32 inch.

2.04 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

A. Where lumber or plywood is indicated as preservative-treated wood, in accordance with AWPA U1 and AWPA M4, mark and grade each treated item in accordance with SPIB 1003 or WWPA G5.

1. Kiln-dry after treatment to maximum moisture content of 19 percent.
2. Treat wood in contact with masonry or concrete.
3. Treat wood less than 18 inches above grade.

B. Aboveground Materials:

1. Pressure treat items with waterborne preservatives to a minimum retention of 0.25 per cubic foot.
2. Interior Use: After treatment, kiln-dry lumber and plywood to maximum moisture content of 19 percent and 15 percent respectively.
3. Treat the following items:
   a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
C. Materials in Contact with Ground or Freshwater: Pressure treat in accordance with applicable AWPA U1.

D. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.05 HARDWARE

A. Fasteners and connectors in contact with preservative-treated or fire-retardant-treated wood shall be hot-dipped zinc-coated galvanized steel or stainless steel in accordance with ASTM A153/A153M.

B. Conform to ASTM F1667.

C. Nails:
   1. Conform to ASTM F1667.
   2. Steel common nails or alternatives listed in rough carpentry section of General Structural Notes found on Drawings.
   3. Use hot-dipped zinc-coated nails wherever exposed.
   4. Use deformed shank nails for fastening underlayment.

D. Power Driven Fasteners: Conform to ICC ESR-1539.

E. Bolts and Screws: Conform to ASTM A307, galvanized where exposed.


2.06 MISCELLANEOUS

A. Construction Adhesives: Elastomeric glue conforming to ASTM D3498 for gluing subfloor to joists.

B. Roofing Felt: Asphalt-saturated organic felt conforming to ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.
3.02 GENERAL

A. Lay out, cut, fit, and install rough carpentry items. Anchor sufficiently to ensure rigidity and permanence.

B. Install items accurate to dimension, true to line, level, and square unless shown otherwise on Drawings. Provide for installation and support of other Work.

C. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.

D. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

E. Field cuts and holes in pressure-treated lumber shall be field treated with preservative in accordance with AWPA M4.

F. Provide washers under bolt heads and nuts bearing on wood.

3.03 INSTALLATION

A. Sills and Plates:
   1. Set level and flush with outside face of foundation or as shown on Drawings.
   2. Blocking:
      a. Install in continuous, staggered horizontal row where shown on Drawings or required by code.
      b. Locate blocking to facilitate installation of finishing materials, fixtures, specialty items, hardware, and trim.

3.04 PRESERVATIVE-TREATED WOOD PRODUCTS

A. Provide preservative-treated wood for framing, blocking, furring, nailing strips built into exterior masonry walls, wood in contact with concrete or masonry and in conjunction with gravel stops, and built-up roofing.

B. Apply two brush coats of same preservative used in original treatment to sawed or cut surfaces of treated lumber.

END OF SECTION
## Quality Control

The Quality Control section of the document is signed by W. Laird Ellis, Jr. on June 23, 2017. The document is digitally signed by W. Laird Ellis, Jr. with a signature date of 2017.06.23 09:23:29 -06'00'.
PART 1   GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

3. Builders Hardware Manufacturers Association (BHMA):
   a. 156.9, Cabinet Hardware.
   b. 156.11, Cabinet Locks.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Show details and dimensions not controlled by job conditions and required field measurements.
   b. Describe and illustrate features of design showing field measurements, construction details, dimensions, materials, and finish.
      1) Use full-size or 1/4-size scale drawings.
      2) Key to Contract Drawings.
   c. Furnish manufacturer’s descriptive literature of specialty items not manufactured by woodwork manufacturer.

2. Samples: Each finish to be applied by woodwork manufacturer.

B. Informational Submittals: Proof of woodwork manufacturer qualifications.

1.03 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:

1. Successful completion of comparable work on similar size project within 2 years before start of construction on this Project.
3. Current member of AWI.
4. Engineer reserves right to approve woodwork manufacturer selected to furnish Work.

B. Casework and Paneling:
   1. Reference to Custom Grade: As defined in AWI, WI Architectural Woodwork Standards.
   2. Provide Custom Grade, unless otherwise specified.

C. Cabinet Hardware: In accordance with BHMA 156.9 and BHMA 156.11.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Defer delivery to Site until installation and storage areas are complete and dry of wet type construction, and excessive moisture has been out of building for at least 10 days.
   B. Protect casework and paneling from damage and dampness. Store in weathertight, well-ventilated areas. Do not subject to extreme changes of temperature or humidity.

1.05 ENVIRONMENTAL REQUIREMENTS
   A. For a minimum of 72 hours prior to installation, allow woodwork to come to equilibrium onsite in space where it is to be installed.
   B. Humidity: For 24 hours before, during, and after installation, maintain relative humidity between 25 percent and 55 percent.
   C. Temperature: For 24 hours before, during, and after installation, maintain ambient temperature between 65 degrees F and 75 degrees F.

PART 2 PRODUCTS

2.01 CASEWORK FINISH
   A. Plastic Laminate:
      1. Meet requirements of AWI, AWMAC, WI Architectural Woodwork Standards Section 10.
      2. Furnish casework exposed surfaces, including top, edges, front face, and backsplashes, with plastic laminate in colors indicated in Interior Finish Schedule and on Drawings.

2.02 CASEWORK HARDWARE
   A. Hinges: For conventional flush without face frames, use European style hinge; 626 finish.
1. Manufacturers:
   a. Blum, Inc.
   b. Grass America, Inc.
   c. Stanley.

B. Continuous Hinges: Stanley No. Sc 311-1/4; 625 bright chrome finish.

C. Locks: Sargent and Co. 1654 MKD or Schlage 46-002; 626 satin chrome finish.

D. Catches: Stanley No. 46; 628 aluminum finish, magnetic.

E. Pivot Door Slides: Knape and Vogt No. 8085, medium duty.

F. Pulls: Solid brass or bronze, Stanley No. 4484, Baldwin No. 4676; 626 satin chrome finish.

G. Drawer Slides: Knape and Vogt No. 1300 or Grant No. 336SC.

H. Heavy-Duty Drawer Slides: Knape and Vogt No. 1429 or Grant No. 4930.

I. Shelf Supports: Knape and Vogt No. 255/256 or Grant No. 120/121, nickel-plated finish.

J. Heavy-Duty Shelf Supports: Knape and Vogt slotted standard No. 82 and bracket No. 182; or Stanley No. 6783 and 6785, clear anodized aluminum finish.

K. Shelf and Rod Support: Stanley No. 7046 or Knape and Vogt No. 1194.

L. Hanging Rod with Flanges: Knape and Vogt No. 770-1 with 734 and 735, or Builders Brass Works 7770-5 with 7775-5 and 7776-5.

M. Heavy-Duty Folding Bracket: Stanley No. V772 heavy-duty folding shelf bracket.

N. Heavy-Duty Pivot Door Slides: HAWA-Turnaway 35/X3, pivot sliding door fitting.

2.03 PLASTIC LAMINATE

A. Counter Tops:
   1. NEMA LD 3, Grade GP 50; solid color, standard velvet finish.
   2. Color as indicated in Interior Finish Schedule.
   3. Manufacturers and Products:
      a. Wilson Art; Tuf-Surf.
      b. Westinghouse; Micarta.
      c. Formica Corp.
B. General Use and Paneling: NEMA LD 3, Grade GP 38; in colors indicated in Interior Finish Schedule.

C. Casework Liner: Thermally fused melamine.
   1. Color as indicated in Interior Finish Schedule.
   2. Apply to all exposed interior surfaces.
   3. Thermoset, or equal.

2.04 EPOXY RESIN COUNTERTOPS
   1. Counter and backsplash, 3/4-inch thick minimum with 1/8-inch beveled edge and continuous drip groove.
   2. Heat resistance minimum 175 degrees C per ASTM D648, water resistance less than 0.015 percent per ASTM D570.
   3. Color as indicated in Interior Finish Schedule.
   4. As shown on Drawings.

2.05 ANCILLARY MATERIALS
   A. Adhesives:
      1. Woodwork: Phenol-resin or resorcinol-resin.
   B. Woodwork Putty: Single component, acrylic latex polymer, color to match finish.
   C. Hardware: Furnish fasteners and miscellaneous hardware required for assembling and anchoring woodwork, including casework.

2.06 FABRICATION
   A. Moisture Content: Kiln dry lumber to an average moisture content range as follows:
      1. Exterior Work: 9 percent to 15 percent.
      2. Interior Work: 5 percent to 10 percent.
   B. Casework Construction: AWI, AWMAC, WI Architectural Woodwork Standards Section 10, Custom Grade, Type A, Style 1, flush overlay.
   C. Casework Fronts: Plastic laminate.
   D. Casework Units: Shop assembled for field installation.
   E. Install concealed hinges on doors.
   F. Drawer Slides: Use side-mounted, heavy-duty type.
G. Install casework hardware in accordance with manufacturer’s instructions.
   1. Provide items where indicated and as required for a complete installation.
   2. Provide pulls and catches on casework doors unless indicated otherwise.

**PART 3 EXECUTION**

**3.01 PREPARATION**

A. Examine grounds, stripping, and blocking for cabinet attachment.

B. Do not proceed to install until conditions are acceptable to installer.

C. Verify surfaces to receive architectural woodwork items are properly prepared.

**3.02 CASEWORK INSTALLATION**

A. Coordinate installation of, and cut openings for mechanical, electrical, and other items that penetrate casework surfaces and tops.

B. Install casework in true alignment, level, and plumb.

C. Secure units with nails or screws to cleats that have been anchored to building structure or wall framing.

D. Install wall-hung cabinets to rigidly support cabinet weight plus normally expected weight of cabinet contents.

E. Accurately scribe and closely fit faceplates, filler strips, and trim strips to irregularities of adjacent surfaces.

F. Adhere plastic laminate as recommended by laminate manufacturer.
   1. Apply with as few cross joints as possible and no longitudinal joints.
   2. Scribe neatly to vertical surfaces.

G. Toe Space at Front of Cabinets: Provide by installing front face of cabinets 3 inches in front of base face.

**3.03 ADJUSTING AND CLEANING**

A. Adjust hardware and leave in smooth working condition.

B. Adjust doors and drawers to operate without restriction.
C. Surfaces: Clean and ready for use.
D. Staining or Discoloration of Finish: Restore to original finish or replace unit.

END OF SECTION
### Quality Control

**Bituminous Dampproofing**

### Revision History:

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### Document Review & Approval:

**Originator:**
Mark Sharp, Lead Architect

**Design Verification Complete:**
Stephen J. Silkworth - Quality Control

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 09:25:47 -06'00'
PART 1  GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):

1.02 SUBMITTALS

A. Action Submittals: Manufacturer’s product data for dampproofing materials.

B. Informational Submittals:

   1. Manufacturer’s current application instructions for dampproofing materials.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Engage experienced installer who has completed bituminous dampproofing work similar in material, design, and extent for Project.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store materials in area where temperatures are not less than 50 degrees F or over 85 degrees F.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Weather: Proceed with dampproofing Work only when existing and forecast weather conditions will permit Work. Do not apply dampproofing in rainy
conditions or within 3 days after surfaces become wet from rainfall or other moisture.

B. Temperature:
   1. Do not apply materials when ambient temperature is less than 50 degrees F.
   2. Do not apply materials when low temperature of 40 degrees F or less is predicted within a period of 24 hours after application.

C. Ventilation: Provide adequate ventilation during application of solvent-based components in enclosed spaces. Maintain ventilation until dampproofing membrane has thoroughly cured.

PART 2    PRODUCTS

2.01 BITUMINOUS DAMPPROOFING, GENERAL
   A. Odor Elimination: For interior and concealed-in-wall uses, provide type of bituminous dampproofing material warranted by manufacturer to be substantially odor-free after drying for 24 hours under normal conditions.

2.02 COLD-APPLIED ASPHALT CUT-BACK DAMPPROOFING
   A. Asphalt Compound: Asphalt and solvent compound, compounded to penetrate substrate and build to firm, moisture-resistant, vapor-resistant, elastic coating.

   B. Manufacturers:
      1. Celotex Corp.
      2. ChemRex Inc./Sonneborn Building Products Div.
      4. Karnak Chemical Corp.

   C. Bond Coat Type: Where asphalt dampproofing is indicated as bond coat for bonding of plaster or other materials to substrate, provide tack-surfaced material recommended by manufacturer for application shown.

2.03 MISCELLANEOUS ACCESSORIES
   A. Glass-Fiber Mat: Nonwoven fiberglass fabric of continuous filament or jack-straw filament/yarn pattern of glass fiber, impregnated and bound together with type of organic/synthetic binder compatible with type of bituminous
compound indicated to be reinforced, weighing 1.5 pounds per 100 square feet, 36-inch wide rolls.

B. Plastic Cement: Asphalt based, except provide coal-tar base where specifically recommended by manufacturer of bituminous dampproofing materials.

C. Where not covered by rigid insulation, install one of the following Protection Courses:
   1. Board Type: Asphalt-impregnated and coated organic fiberboard, 1/2 inch thick.
   2. Roll Roofing Type: ASTM D6380, smooth-surfaced roll roofing weighing not less than 55 pounds per 100 square foot.

PART 3        EXECUTION

3.01 SURFACE PREPARATION
   A. Clean surfaces to remove dust, dirt, oil, wax, efflorescence, and other foreign materials, in accordance with dampproofing manufacturer’s instructions.
   B. Allow 3 days’ drying time following washing down of substrate surfaces.
   C. Fill cracks, voids, and honeycombs with mortar to provide sound surface for dampproofing.

3.02 APPLICATION
   A. Apply dampproofing with a brush, trowel, or low pressure airless spray equipment with a coarse nozzle, as recommended by dampproofing manufacturer.
   B. Apply materials at rate and as recommended by the manufacturer and in two coats.
   C. Start application at top of wall and work down surface, keeping a wet edge at all times, forming a continuous, unbroken film, free from pinholes and other surface breaks.

3.03 FIELD QUALITY CONTROL
   A. Inspection: Examine surfaces to receive dampproofing to assure conditions are satisfactory for application of materials.
   B. After dampproofing has dried spray surfaces with water.
C. Recoat, as recommended by manufacturer, surfaces showing water absorption. To prevent blistering, protect surfaces from heat and direct sunlight until dried, then backfill.

3.04 ADJUST AND CLEAN

A. Clean spillage and overspray from adjacent surfaces as recommended by manufacturer.

3.05 APPLICATION SCHEDULE

A. Apply dampproofing to exterior surfaces of cast-in-place concrete structures below finish ground level that enclose spaces that may be occupied, such as stairways, galleries, pump rooms, mechanical and electrical equipment rooms, and other areas as shown, but not including water-holding basins.

B. On belowgrade walls apply dampproofing from top of footings to 6 inches below finished grade or as shown on Drawings.

END OF SECTION
Belowgrade Composite Waterproofing

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Document Review & Approval:

Originator:
Mark Sharp, Lead Architect

Design Verification Complete:
Stephen J. Silkworth - Quality Control

Approved:
W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.
PART 1 GENERAL

1.01 SUMMARY

A. Belowgrade water resistant system under horizontal slabs, footings, sumps, and vertical concrete surfaces to finished grade elevation. The work of this section includes, but is not limited to, the following:

1. Rubberized asphalt sheet membrane waterproofing systems.
2. Protection board and prefabricated drainage composite.
3. Lap seals, closures, expansion joints, penetration specials and protection details as recommended by manufacturer.

B. Furnish all labor, materials, tools, equipment, and services to install belowgrade water resistance, including watertight treatments and flashings around all penetrations by other trades through the water resistant membrane. Coordinate with work of other trades.

1. Complete all hydrostatic testing of process tank structures for water tightness prior to installation of any post applied waterproofing systems. All crack and leak repairs shall be completed prior to the installation of any water proofing.
2. Allow sufficient concrete cure time in accordance with manufacturer’s recommendations prior to installing waterproofing systems.

C. Apply Belowgrade Water Resistant System to:

1. Grit Pump Building: From bottom of under slabs to finish grade elevation. Seal all pile, piping penetrations per manufacturer’s instructions.
2. Storm and Base Flow flumes.

1.02 QUALITY ASSURANCE

A. ASTM International (ASTM) Standards:

12. E154, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
13. Others as indicated in Product Description.

B. Belowgrade Water Resistant System Manufacturer and Applicator Qualifications:

1. Manufacturer: Minimum of 20 years’ experience in the production and sales of sheet membrane waterproofing. Submit a list of projects of similar design and complexity completed within the past 5 years.
2. Applicator: Applicator shall be licensed or certified in writing by waterproofing manufacturer. Applicator shall have completed at least three similar sized projects with material specified in the last 5 years.
3. Only the qualified applicator shall be permitted to install any and all parts of the waterproofing system described in this Specification.

C. Pre-Installation Conference: A pre-installation conference several weeks in advance of construction shall be held prior to installation with the manufacturer’s technical representative to establish the procedures and requirements. Attendance by appropriate representatives of Contractor, applicator, and interfacing trades will be required. Submittals must also have been approved prior to holding this conference.

D. Manufacturer’s Inspection:

1. Manufacturer’s technical representative shall inspect the installation on a regular basis to verify that the waterproofing system is being installed in accordance with the manufacturer’s requirements.
2. In addition to a general inspection of the installation, the manufacturer’s technical representative shall inspect all horizontal to vertical transitions, all horizontal and vertical overlap points, and all sealing work around piles and pipe penetrations.
3. Manufacturer’s technical representative shall inspect preparation of the subgrade and all other substrates prior to application of waterproofing.

1.03 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project Site.
   2. Installer and applicator are synonymous.

B. Waterproof:
   1. Waterproof is defined as the absence of visible leakage on the interior surface of any horizontal slab or vertical wall that has the waterproofing system specified herein applied to its exterior and system is subject to hydrostatic head.
   2. Visible leakage is defined as the presence of liquid water flowing or seeping with a visible water surface sheen. Surface dampness as evidenced by discoloration of the concrete without a visible water sheen will not constitute visible leakage.

1.04 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer’s standard catalog cut sheets indicating product to be used and conformance to specifications.
      b. Product samples, including all accessories.
      c. Shop or layout drawings.
      d. Construction details to be utilized for all types of joints, penetrations, footings, fasteners, laps, seams and horizontal to vertical transitions.
      e. Fastening and sealing details.
   2. Project Information: Manufacturer’s certification of installer qualifications.
   3. Project Inspection Documentation:
      a. Manufacturer’s written documentation of all inspections, including acceptability of subgrade/substrate preparation as well as all other inspected work.
         1) Documentation shall clearly note any deficiencies in the work as well as the recommended procedures to remedy these deficiencies. The installer shall remedy all deficiencies noted in the documentation.
      b. Manufacturer’s written certification that the system was installed in accordance with the manufacturer’s requirements.
1.05 DELIVERY, STORAGE, AND HANDLING

A. In accordance with the manufacturer's written instructions.

1.06 WARRANTY

A. Written 5 year warranty agreeing to repair or replace work performed under this section which fails.

1. Manufacturer’s standard warranty covering materials.
2. Applicator’s standard warranty covering workmanship.

B. Failure includes but not limited to, defects in materials, workmanship, waterproof integrity, adhesion to substrate, surface degradation or other defect which affects its ability to perform as a watertight envelope.

C. The warranty for the period indicated also includes the cost to remove and replace to match existing the overburden, drainage mediums, protection boards, and other surface improvements necessary for access to the waterproofing membrane repair.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Belowgrade Water Resistant System:

1. Pre-applied Integrally Bonded Sheet Waterproofing Membrane (horizontal below slab, sumps, blind side applications):
   a. Preprufe 300R Membrane by WR Grace Construction Products.
   b. Or equal.
   a. Bituthene System 4000 Membrane by WR Grace Construction Products.
   b. Or equal.

B. Other Accessory Materials Required:

2. EPS protection boards with Hydroduct Tape for exterior side vertical walls.
3. Prefabricated Drainage Composite: (Hydroduct® 220) (Hydroduct® 660) Drainage Composite by WR Grace. Drainage Composite shall be designed to promote positive drainage while serving as a protection course.
5. Other accessories as noted in Manufacturer’s installation instructions.

2.02 MATERIALS

A. The Belowgrade Water Resistant System shall be an impermeable sheet membrane waterproofing system consisting of a combination of pre-applied (prior to concrete placement) membrane for use under horizontal slabs, sumps, blind side applications; and a post applied self-adhesive sheet membrane for use on vertical exterior concrete surfaces. System shall be installed complete in accordance with manufactures instructions including all piling penetration details, surface preparations, ancillary component installations, laps, terminations, and special details.

B. Use Pre-applied Integrally Bonded Sheet Waterproofing Membrane for All Sump Pits and Below Slab Horizontal Applications.

1. Pre-applied Integrally Bonded Sheet Waterproofing Membrane: Composite sheet membrane 1.2 mm (0.046 inch) nominal thickness comprising 0.8 mm (0.030 inch) of high density polyethylene film, and layers of specially formulated synthetic adhesive layers. The membrane shall form an integral and permanent bond to poured concrete to prevent water migration at the interface of the membrane and structural concrete. Suitable for application in temperatures down to 25 degrees F.

   a. Physical Properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>Thickness</td>
<td>ASTM D3767 Method A</td>
<td>1.2 mm (0.046 in.) nominal</td>
</tr>
<tr>
<td>Low Temperature Flexibility</td>
<td>ASTM D1970</td>
<td>Unaffected at -23°C (-10°F)</td>
</tr>
<tr>
<td>Elongation</td>
<td>ASTM D412 Modified¹</td>
<td>&gt;300%</td>
</tr>
<tr>
<td>Crack Cycling at -23°C (-10°F), 100 Cycles</td>
<td>ASTM C836</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Tensile Strength, Film</td>
<td>ASTM D412</td>
<td>27.6 MPa (4,000 lbs/in.²) minimum</td>
</tr>
<tr>
<td>Peel Adhesion to Concrete</td>
<td>ASTM D903 Modified²</td>
<td>880 N/m (5.0 lbs/in.)</td>
</tr>
<tr>
<td>Lap Adhesion</td>
<td>ASTM D1876 Modified³</td>
<td>440 N/m (2.5 lbs/in.)</td>
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## Property Test Method Typical Value

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<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Value</th>
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<tbody>
<tr>
<td>Resistance to Hydrostatic Head</td>
<td>ASTM D5385</td>
<td>&gt;70 m (231 ft)</td>
</tr>
<tr>
<td></td>
<td>Modified</td>
<td></td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM E154</td>
<td>990 N (180 lbs) minimum</td>
</tr>
<tr>
<td>Permeance</td>
<td>ASTM E96 Method B</td>
<td>&lt;0.6 ng/m²sPa (0.01 perms)</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D570</td>
<td>&lt;0.5%</td>
</tr>
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</table>

2. **Sheet Membrane Waterproofing System:** Bituthene membrane, self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 inch) of rubberized asphalt and 0.1 mm (0.004 inch) of cross-laminated, high density polyethylene film specially formulated for use with water-based surface conditioner. Provide rubberized asphalt membrane covered with a release sheet which is removed during installation. No special adhesive or heat shall be required to form laps.

a. **Physical Properties:**

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td>Dark gray-black</td>
</tr>
<tr>
<td>Thickness</td>
<td>ASTM D3767 Method A</td>
<td>1.5 mm (0.060 in.) nominal</td>
</tr>
<tr>
<td>Flexibility, 180° bend over 25 mm (1 in.) mandrel at -43°C (-45°F)</td>
<td>ASTM D1970</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Tensile Strength, Membrane Die C</td>
<td>ASTM D412 Modified¹</td>
<td>2240 kPa (325 lbs/in.)² minimum</td>
</tr>
<tr>
<td>Tensile Strength, Film</td>
<td>ASTM D882 Modified¹</td>
<td>34.5 MPa (5,000 lbs/in.)² minimum</td>
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<tr>
<td>Elongation, Ultimate Failure of Rubberized Asphalt</td>
<td>ASTM D412 Modified¹</td>
<td>300% minimum</td>
</tr>
<tr>
<td>Crack Cycling at -32°C (-25°F), 100 Cycles</td>
<td>ASTM C836</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Property</td>
<td>Test Method</td>
<td>Typical Value</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Lap Adhesion at Minimum Application Temperature</td>
<td>ASTM D1876 Modified^2</td>
<td>880 N/m (5 lbs/in.)</td>
</tr>
<tr>
<td>Peel Strength</td>
<td>ASTM D903 Modified^3</td>
<td>1576 N/m (9 lbs/in.)</td>
</tr>
<tr>
<td>Puncture Resistance, Membrane</td>
<td>ASTM E154</td>
<td>222 N (50 lbs) minimum</td>
</tr>
<tr>
<td>Resistance to Hydrostatic Head</td>
<td>ASTM D5385</td>
<td>70 m (231 ft) of water</td>
</tr>
<tr>
<td>Permeance</td>
<td>ASTM E96, Section 12 – Water Method</td>
<td>2.9 ng/m²sPa (0.05 perms) maximum</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D570</td>
<td>0.1% maximum</td>
</tr>
</tbody>
</table>

C. Accessory Items: Provide all waterproofing system products from a single source as required by manufacturer.

PART 3 EXECUTION

3.01 PREPARATION - GENERAL

A. Remove debris and surface contamination (oil/grease, etc.) as recommended by manufacturer.

B. Grind surface protrusions and fill bug-holes. Fill all voids, seal all penetrations, and remove all fins, ridges and other protrusions that could result in punctures. Surfaces shall be smooth and free of irregularities as required by the manufacturer.

1. Seal around pipes and other penetrations.
2. Over tie-holes filled with nonshrink grout.
3. Other areas as indicated or recommended by manufacturer for watertight installation.

C. Surface must be clean and dry.

D. Apply surface conditioner at rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of surface conditioner.
3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions and per the approved Shop Drawing details.

1. Seal around all penetrations in accordance with manufacturer's recommendations.
   a. Penetrations made after the waterproofing system is complete shall be sealed by a method approved by the Engineer and the manufacturer prior to installation.
2. Provide all waterstops, sealants, tubing, tape, termination bars, fasteners and other accessories required for a watertight installation.
3. Lap seams as required by manufacturer.
4. Cover and seal all joints as required by the manufacturer.

B. Apply protection board and related materials in accordance with manufacturer’s recommendations.

1. Arrange prefabricated drainage composite board to allow drainage around perimeter of building from higher fill on South side to the lower filled area at the North side. Route drains to surface flow toward catch basin at north side of building.

C. Termination at Grade:

1. Utilize continuous metal termination bar.
2. Attach every 8 inches.
3. Seal top edge as required by the manufacturer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer’s technical representative shall inspect the substrate, all horizontal to vertical transitions, all horizontal and vertical overlap points, and all sealing work around piles and pipe penetrations and instruct installer's personnel during application of the systems.

1. Manufacturer's technical representative shall provide written documentation that the substrate was inspected and found to be acceptable for installation of the system.
2. Manufacturer’s technical representative shall make regular inspections during installation and prior to concrete pours to verify that the system is being installed in accordance with manufacturer’s requirements and instructions. Manufacturer’s technical representative shall document field inspections as required by this Specification.

B. Provide written documentation that the concrete substrate has been prepared in accordance with Manufacturer’s recommendations and is ready for the
application of the water proofing system prior to water resistant water proofing system.

3.04 PROTECTION

A. Protect installation from damage until backfill can be placed.

3.05 REPAIR AND CLEANING

A. Repair areas which have been damaged prior to installation of backfill.

B. Repair areas where waterproofing sheets have become damaged.

1. Damage includes points where vertical attachment nails/bolts are removed (leaving a pinhole) or did not penetrate correctly.

C. Repair areas which have failed, or do not comply with Specifications.

D. Remove debris resulting from these operations.

END OF SECTION
**Specification Document Control No.:** 07 21 00  
**Revision No.:** 0  
**Project:** Outfall 200 Mercury Treatment Facility  
**Engineering Discipline:** Architectural  
**Specification Division:** 7 - Thermal and Moisture Protection  
**Date:** 6/23/2017  

**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)  
Thermal Insulation  

**Revision History:**  
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**Document Review & Approval:**  
**Originator:** Mark Sharp, Lead Architect  
NAME/POSITION:  
SIGNATURE:  
DATE: 6/22/2017  

**Design Verification Complete:** Stephen J. Silkworth - Quality Control  
NAME/POSITION:  
SIGNATURE:  
DATE: 6/22/2017  

**Approved:** W. Laird Ellis, Jr PE/Design Manager  
NAME/POSITION:  
SIGNATURE:  
DATE: Digitally signed by W. Laird Ellis, Jr.  
Date: 2017.06.23 09:31:02 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Manufacturer’s product literature identifying products proposed for use.

1.03 DELIVERY, STORAGE, AND HANDLING

A. On packaging clearly identify manufacturer, contents, brand name, applicable standard, and R-value.

B. Store materials off ground and keep them dry. Protect against weather, condensation, and damage.

PART 2 PRODUCTS

2.01 BATT INSULATION AND FASTENERS

A. Fiberglass or Mineral Wool Batts:

1. ASTM C665, Type I, with no vapor retarder, III, Class B, with 0.5 perm rating, reflective aluminum foil vapor retarder membrane laminated to one side with R-values as shown.
2. Manufacturers:
   a. CertainTeed Corp.
   b. Owens-Corning Insulating Systems.
   c. Johns Manville.

B. Fasteners: As recommended by insulation manufacturer.

C. Tape: As recommended by insulation manufacturer.

2.02 VAPOR RETARDER

A. Plastic Sheeting: ASTM D4397, minimum thickness of 6 mils.

B. Sealant and Tape: As recommended by vapor retarder manufacturer.

2.03 RIGID INSULATION

A. Glass Fiber Reinforced Polyisocyanurate Insulation:
   1. ASTM C1289, Type 1 Class 2.
   2. Class A fire rated.
   3. Thickness and R-Value: As shown.
   4. For use at metal building walls.
   5. Manufacturers and Products:
      a. Dow, Thermax Heavy Duty.
      b. Approved equal.

B. Extruded Polystyrene Foam:
   1. ASTM C578, Type IV. Min 25 PSI compressive strength.
   2. Flame Spread: Less than 25 when tested in accordance with ASTM E84.
   3. Thickness and R-Value: As shown.
   4. For use at metal building roof.
   5. Manufacturers and Products:
      a. Owens Corning, Foamular Thermapink (approved for roofing).
      b. DOW, Blue Board.
      c. Kinspan XPS.

C. Aerosol Foam Insulation:
   1. Open cell polyurethane foam.
   2. For use at pipe penetrations as shown on Drawings.
   3. Manufacturers:
      a. Great Stuff.
      b. Loc Tite.

D. Adhesives and Fasteners: As recommended by insulation manufacturer.
PART 3 EXECUTION

3.01 BATT INSULATION

A. Install in accordance with manufacturer’s instructions and as specified below:

1. Install in widths required by framing spacing.
2. Fit tightly to ensure continuous seal. Where electrical outlets, ducts, pipes, vents, or other utility items occur, place insulation on cold weather side of obstruction.
3. Protect installed insulation from tears and other damage until covered with finish material.
4. Remove and replace damaged material.

3.02 VAPOR RETARDER

A. Install in accordance with the following:

1. Apply to wall and ceiling framing in sheets as large as possible.
2. Lap joints 6 inches.
3. Seal joints with sealant and tape as recommended by vapor retarder manufacturer.
4. Fit tightly and seal around penetrations.
5. Repair minor tears or holes with tape.
6. Replace sheets with tears or holes, which require more than 6-inch length of tape to repair.

3.03 RIGID INSULATION

A. Install in accordance with the following:

1. Install boards in location and in thickness and R-value as shown on Drawings.
2. Cut insulation with saw, knife, or other sharp tool to fit tightly around obstructions.
3. Butt insulation boards together tightly at joints.
4. Where thickness required exceeds 1-1/2 inches, install two layers of boards.

3.04 FACED INSULATION BOARD

A. Install, in sizes as large as possible, in accordance with manufacturer’s recommendations, and as specified below:

1. Apply insulation board using PVC T-strips at vertical board joints.

END OF SECTION
**Quality Control**

W. Laird Ellis, Jr.  
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Date: 2017.06.23 09:34:21 -06'00'

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Date: 6/22/2017

**Approved:**

W. Laird Ellis, Jr.  
NAME/POSITION  
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Date: 2017.06.23 09:34:21 -06'00'
SECTION 07 26 13
ABOVEGRADE AIR BARRIER

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

1.02 SUBMITTALS

A. Action Submittals: Product data indicating material characteristics, performance criteria, limitations, and product sample.

B. Informational Submittals: Manufacturer’s preparation and installation requirements, instructions, and techniques.

1.03 QUALITY ASSURANCE

A. Provide manufacturer’s standard material warranty in which manufacturer agrees to provide replacement material for water-resistive vapor permeable air barrier and drainage matrix sheets installed in accordance with manufacturer’s instructions that fails due to material defects within 20 years of the date of purchase.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
1. VaproShield, Wrapshield.
2. Henry, Blueskin 160.
3. Approved equal.

2.02 MATERIALS

A. Sheet: Primary water-resistive air barrier sheet and drainage matrix membrane shall be WrapShield IT® Integrated Tape Water-Resistive Vapor Permeable Air Barrier sheet.
   1. Water Resistance tested to AATCC 127, 55 cm hydrostatic head for 5 hours: No leakage.
   2. Tensile Strength tested to ASTM D882: 50.8 pound force per inch (8.89 N/mm).
   3. Surface Burning Characteristics tested to ASTM E 84: Class A, Flame-spread index of 0, Smoke-developed index of less than 55.
   4. Application Temperature: No temperature restrictions.
   5. Allowable UV Exposure Time: 180 days.


C. Liquid Applied Flashing:
   2. Liquid-applied window and door flashing, vapor permeable water resistive barrier flashing material, compatible with the primary water barrier membrane.

D. Accessories as needed to provide a full vapor barrier system.

E. Sealant: Silicon based as recommended by manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Do not install vapor retarder until items penetrating vapor retarder are in place.

B. Remove loose or foreign matter capable of impairing adhesion.

C. Clean and prime substrate surfaces to receive adhesive and sealants.
3.02 INSTALLATION

A. Cladding Attachment Components, Clips, and Insulation Fasteners:

1. Install attachment components over primary water-resistive barrier membrane using corrosion-resistant, or stainless steel screws with integral gaskets, recommended.
2. Secure clips and masonry ties with corrosion-resistant, or stainless steel screws with gasketed fasteners.
3. Consult manufacturer or architect for recommendations on appropriate fastener types and methods to seal penetrations.

B. Vapor Retarder for Stud Framed Walls: Secure water resistive barrier to outside face of building sheathing. Lap edges of sheet, and lap ends onto adjacent construction according to manufacturer’s instructions.

C. For windows without nail flange, install specified backing rod and sealant or tape around perimeter of opening to accommodate placement of backer rod and sealant between window frame and self-adhered vapor permeable water resistive barrier membrane.

3.03 PROTECTION

A. Protect wall areas covered with primary water-resistive barrier from damage due to construction activities, high wind conditions, and extended exposure to inclement weather.

B. Cladding material must be installed within 6 months (180 days) of installation of water-resistive barrier installation.

C. Review condition of water-resistive barrier prior to installation of cladding. Repair, or remove and replace damaged sections.

D. Remove and replace water-resistive barrier affected by chemical spills and surfactants.

END OF SECTION
**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Belowgrade Vapor Retarders

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Mark Sharp, Lead Architect

**Design Verification Complete:**
Stephen J. Silkworth - Quality Control

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 09:36:43 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 302, Guide for Concrete Floor and Slab Construction.
2. ASTM International (ASTM):
   e. E154, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or a Ground Cover.
   f. E1643, Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
   g. E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.02 SUBMITTALS

A. Action Submittals: Manufacturer’s material specifications.

B. Informational Submittals: Manufacturer’s written instructions for preparation, installation/application, repair, protection and maintenance.
PART 2  PRODUCTS

2.01 UNDERSLAB VAPOR RETARDER

A. Meet or exceed ASTM E1745, Class A, with the following properties:

1. Water Vapor Permeance: 0.03 perm maximum when tested in accordance with ASTM E96/E96M or ASTM F1249.
2. Tensile Strength: 45-foot-pounds per inch minimum, when tested in accordance with ASTM D882.
3. Puncture Resistance: 2,200 grams minimum, when tested in accordance with ASTM D1709.
4. Thickness: 10 mils minimum, in accordance with ACI 302.

B. Manufacturers and Products:

1. Fortifiber Building Systems Group; Moisstop Ultra 10.
3. Stego Industries, LLC; Stego Wrap Class A Vapor Retarder.

2.02 ANCILLARY MATERIALS

A. Fasteners, Tape, Adhesive, or Sealant: As recommended by vapor retarder manufacturer.

B. Pipe Boots: Manufacturer’s recommended prefabricated or field fabricated item.

PART 3  EXECUTION

3.01 PREPARATION

A. Examine conditions of substrates and other conditions under which work is to be performed. Do not proceed with work until satisfactory conditions are obtained.

3.02 INSTALLATION

A. Underslab Vapor Retarder:

1. Apply in accordance with manufacturer’s instructions.
2. After base for slab has been leveled and tamped, apply vapor retarder with roll width parallel to direction of concrete pour.
3. Lap vapor retarder over footings and seal to foundation walls.
4. Overlap joints 6 inches and seal with tape.
5. Seal penetrations with pipe boots.
6. Repair damaged areas with patches of vapor retarder, overlapping damaged area by 6 inches and sealing sides of patch with tape.
3.03 CLEANING

A. Upon completion of vapor retarder installation, remove waste materials and debris resulting from this operation and dispose offsite.

END OF SECTION
Quality Control

Roofing and Siding Panels
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. ASTM International (ASTM):
   b. A446, Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
   d. A525, General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
   e. A526, Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
   f. A792, Steel Sheet, Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements.
   g. C612, Mineral Fiber Block and Board Thermal Insulation.
   h. D226, Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

1.02 SYSTEM DESCRIPTION

A. Provide all necessary materials for a complete exterior and interior wall and exterior roof panel system as shown in the Drawings at the following structures:

1. Grit Pump Building.
2. Dumpster Shelter.
3. MTF Building.
4. Storage Tank Shelter.
1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Layouts of panels on walls and roofs including details of edge conditions, joints, corners, panel profiles, supports, anchorages, trim, flashings, and closures. Distinguish between factory and field assembly work.
   b. Product data including manufacturer’s product specifications, and general recommendations, as applicable to materials and finishes for each component and for total panel system.

2. Samples: For initial selection purposes, submit manufacturer’s color charts or chips showing full range of colors, textures, and patterns available for roof and wall panels with factory-applied finishes.

B. Quality Control Submittals:

1. Manufacturer’s recommended installation instructions.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Meet requirements for Class A roof per ASTM E108.
2. Wind Uplift: Roof panel system, including supports meeting requirements of Underwriters Laboratories, Inc. for Class 90 wind uplift resistance.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Protect panel coating either by application of removable film or by packing plastic film or other suitable material between panels to properly protect the finish. Package wall and roof panels for protection against transportation and handling damage.

B. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall and roof panels so that they will not accumulate water. Do not store panels in contact with other materials resulting in staining, denting, or other surface damage.

C. Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Roof and Wall Panels:
   1. AEP-Span, Klip Rib 16-inch concealed fastener wall panels, Span Lok hp 16-inch standing seam roof panels.
   4. Flexospan FE 12, 12-inch concealed fastener wall panels, FSS 16-inch standing seam roof panels.

B. Steel Soffit Panels:
   1. AEP Span, Prestige series.
   3. Flexospan, FE-12.

C. Steel Liner Panels:
   1. AEP Span, manufacturer’s standard.
   3. Flexospan, manufacturer’s standard.

2.02 MATERIALS

A. Sheet Materials:
   1. Refer to Section 13 34 19, Metal Building Systems, for general sheet material requirements.

B. Refer to Section 13 34 19, Metal Building Systems.

2.03 ACCESSORIES

A. Trim:
   1. All ridge, eave, rake, inside and outside corner, wall to roof, sill and base, opening flashing, and all other trim needed to provide a complete, weather resistant system.
   2. Rain gutters and downspouts.
B. Fasteners:

1. Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
2. Exposed: Factory-applied coating, or plastic caps for fastener heads; color to match panel.
3. Washer: Metal-backed neoprene washers.

C. Felts: Asphalt-saturated organic felts, ASTM D226, Type II (No. 30).

D. Closure Strips: Closed-cell, self-extinguishing, expanded cellular rubber or cross-linked polyolefin foam flexible closure strips. Cut or premold to match configuration of roof and wall panels.

E. Sealing Tape: Pressure-sensitive 100 percent solids polyisobutylene compound sealing tape with release paper backing, permanently elastic, nonsag, nontoxic, nonstaining tape.

F. Joint Sealant: One-part elastomeric polyurethane sealant. Refer to Section 07 92 00, Joint Sealants.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC paint 12.00, compounded for 15-mil dry film thickness per coat.

2.04 PANEL FABRICATION

A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer’s standard procedures and processes. Comply with indicated profiles and dimensional and structural requirements.

B. Fabricate panel joints with captive gaskets or separator strips, which provide a tight seal and prevent metal-to-metal contact in a manner that will minimize noise from movements within panel system.

C. Face Sheets: Fabricate wall and roof panel face sheets to the profile or configuration shown from 24-gauge (0.0239-inch) zinc-coated or aluminum-zinc-coated steel sheets.

D. Standing Seam Roof Panels: Manufacturer’s standard factory-formed standing-seam roof panel system designed for mechanical attachment of panels to roof purlin using a concealed clip.

1. Clips: 16-gauge (0.0598-inch) panel clips.
2. Cleats: Factory-caulked, mechanically seamed cleats formed from 24-gauge (0.0239-inch), Grade C, zinc-coated steel sheets.
E. Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer’s standard procedures and processes.

F. Metal Finishes: Apply coatings either before or after forming and fabricating panels. Furnish air-drying spray finish in matching color for touchup.

2. Fluoropolymer Coating: Manufacturer’s standard two-coat, thermocured, full-strength 70 percent “Kynar 500” coating consisting of a primer and a minimum 0.75-mil dry film thickness with a total minimum dry film thickness of 0.9-mil and 30 percent reflective gloss when tested in accordance with ASTM D523.

PART 3 EXECUTION

3.01 GENERAL

A. Panel Supports and Anchorage: Install girts, purlin, and other secondary panel support members and anchorage in accordance with AISC Manual of Steel Construction “Code of Standard Practice.”

B. Apply bituminous coating on panel surfaces where panels would otherwise be in direct contact with different materials of structure that are noncompatible or could result in corrosion or deterioration of either material or finishes.

C. Except as specified in other sections, provide components as needed for a complete preformed roof and wall panel system, including but not limited to trim, copings, fascias, gravel stops, mullions, sills, corner units, ridge closures, clips, seam covers, battens, flashings, gutters, gaskets, and fillers. Match materials and finishes of panels.

3.02 PANEL INSTALLATION

A. Comply with manufacturers’ instructions and recommendations for installation. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of exterior panels by torch is not permitted.
2. Install panels with: exposed exterior and interior fasteners, prefinished to match panel finishes.

B. Accessories: Install components required for a complete roof or wall panel system.

C. Joint Sealers: Install gaskets, joint fillers, and joint sealants required for weatherproofing of panel systems. Weather seal under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.
D. Standing Seam Roof Panel System: Fasten roof panels to supports with concealed clips.

1. Install clips at each support with self-drilling or tapping fasteners.
2. At endlaps of panels, install sealing tape between panels.
3. Install factory-sealed cleats at standing-seam joints. Apply snap-on batten to the panels to achieve a weathertight joint.
4. Seaming: Complete seaming of panel joints by type of operation recommended by panel manufacturer to provide a weathertight joint.

E. Wall Panels: Apply joint sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary to ensure weathertight conditions. Handle and apply sealant and backup in accordance with the sealant manufacturer’s recommendations.

1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
2. Locate and space exposed fasteners in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.
3. Install screw fasteners to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
4. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

F. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 feet and within 1/8-inch offset of adjoining faces, and of alignment of matching profiles.

3.03 CLEANING

A. Remove temporary protective coverings and removable films as each panel is installed. Upon completion of panel installation, clean finished surfaces as recommended by panel manufacturer, and maintain in a clean and undamaged condition during construction.

END OF SECTION
**UCOR-FM-001, REV. 0 - SPECIFICATION COVER SHEET**

**Specification Document Control No.:** 07 62 00  
**Revision No.:** 0

**Project:** Outfall 200 Mercury Treatment Facility

**Engineering Discipline:** Architectural

**Specification Division:** 7 - Thermal and Moisture Protection  
**Date:** 6/23/2017

**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Sheet Metal Flashing and Trim

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### Revision History:

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### Document Review & Approval:

**Originator:** Mark Sharp, Lead Architect  
**Signature:** [Signature]  
**Date:** 6/22/2017

**Design Verification Complete:** Stephen J. Silkowski - Quality Control  
**Signature:** [Signature]  
**Date:** 6/22/2017

**Approved:** W. Laird Ellis, Jr. PE/Design Manager  
**Signature:** [Signature]  
**Date:** 2017/06/23 09:40:53 -06'00'
PART 1  GENERAL

1.01  REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

2. FM Global (FM): Loss Prevention Data Sheet 1-49, Perimeter Flashing.

1.02  PERFORMANCE REQUIREMENTS

A. Pertains to Flashing that will be installed at penetrations in the Treatment Building walls, Chemical Storage Tank roof, and Headworks Dumpster Shelter roof.

B. General: Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

C. Fabricate and install roof edge flashing capable of resisting the following forces according to recommendations in FM Loss Prevention Data Sheet 1-49.

D. Wind Zone 1: For velocity pressures of 21- to 30-foot pounds per square foot, 60-foot pounds per square foot perimeter uplift force, 90-foot pounds per square foot corner uplift force, and 30-foot pounds per square foot outward force.
E. Thermal Movements:

1. Provide sheet metal flashing and trim that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures for preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
   a. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

2. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.

3. Base engineering calculation on surface temperatures of materials as a result of both solar heat gain and nighttime-sky heat loss.

F. Water Infiltration: Provide sheet metal flashing and trim that does not allow water infiltration to building interior.

1.03 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA 1793. Conform to dimensions and profiles shown, unless more stringent requirements are indicated.

1.04 SUBMITTALS

A. Action Submittals:

   1. Shop Drawings:
      a. Show joints, types and location of fasteners, and special shapes.
      b. Catalog data for stock manufactured items.

   2. Samples: Color Samples for items to be factory finished.

1.05 DELIVERY, HANDLING, AND STORAGE

A. Inspect for damage, dampness, and wet storage stains upon delivery to Site.

B. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.

C. Carefully handle to avoid damage to surfaces, edges, and ends.

D. Do not open packages until ready for use.

E. Store materials in dry, weathertight, ventilated areas until immediately before installation.
1.06 SPECIAL GUARANTEE

A. Product: Furnish manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction or, at the option of the Owner, removal and replacement of factory-applied fluoropolymer coating, finish, and accessories found defective during a period of 15 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

B. Conditions:

1. Finish: No cracking, blistering, flaking, chipping, checking, chalking, peeling, or fading.
2. All Components: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.01 METAL

A. Galvanized Sheet Steel: ASTM A924/A924M, Grade A or ASTM A653/A653M, G90 zinc coating, commercial quality copper bearing steel, thickness 0.0239-inch (24 U.S. Standard gauge), unless otherwise shown.

B. Prefinished Galvanized Steel Sheet: ASTM A924/A924M, Grade A or ASTM A653/A653M, G90 zinc coating; 24-gauge (0.02-inch) core steel, shop prefinished with fluoropolymer coating (Kynar polyvinylidene fluoride resin) coating; color to match adjacent metal panels, unless scheduled in Exterior Finish Schedule.

2.02 REGLETS AND COUNTERFLASHING

A. For Concrete:

2. Manufacturers and Products:
   a. Fry Reglet Corp.; Fry Springlok Type CO and Springlok Flashing.
   b. Cheney Flashing Co.; Type A reglet and Snap Lock Cap Flashing.

B. Surface Mounted:

2. Manufacturers and Products:
   a. Fry Reglet Corp.; Fry Springlok Type SM and Springlok Flashing.
   b. Cheney Flashing Co.; Type D reglet and Snap Lock Cap Flashing.
2.03 DOWNSPOUTS, GUTTERS, SCUPPERS, AND CONDUCTOR HEADS

A. Same metal and thickness as flashing.
B. Color as indicated in Exterior Finish Schedule.

2.04 ANCILLARY MATERIALS

A. Solder: ASTM B32, alloy composition Sn 50 Soldering Flux: ASTM B32, Type RA.
B. Sealing Tape: Polyisobutylene sealing tape.
C. Isolation Paint: As specified in Section 09 90 00, Painting and Coating.
D. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil thick minimum polyester.
E. Plastic Roof Cement: ASTM D4586/D4586M, Type II.
F. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
H. Fasteners:
   2. Zinc or Aluminum Work: Stainless steel or aluminum; reglet fasteners may be galvanized or cadmium-plated steel.

2.05 FABRICATION OF FLASHING

A. Field measure prior to fabrication.
B. Fabricate in accordance with SMACNA 1793 that applies to design, dimensions, metal, and other characteristics of item indicated.
   1. Counter Flashing Systems: Figure 4-3.
   2. Roof Penetration Flashings: Figures 4-13, 4-14, 4-15, 4-16, and 4-17.
C. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
D. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

E. Seams:
   2. Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

F. Reinforcements and Supports: Provide same material as flashing, unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.

G. Rigid Joints and Seams: Make mechanically strong solder galvanized and stainless steel metal joints. Do not use solder to transmit stress.

H. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

I. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with butyl sealant concealed within joints.

J. Fabricate sheet metal in 10-foot maximum lengths, unless otherwise indicated.

K. Provide watertight closures at exposed ends of counterflushing.

L. Fabricate corners in one-piece with legs extending 30 inches each way to field joint. Lap, rivet, or solder corner seams watertight. Apply sealant if necessary.

M. Neutralize soldering flux.

N. Solvent clean sheet metal. Surfaces to be in contact with roofing or otherwise concealed shall be coated with isolation paint.

O. Pipe Penetrations through Roof: As specified in Section 07 70 01, Roof Specialties and Accessories, and as shown on Drawings

P. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

Q. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
1. Thickness: As recommended by SMACNA 1793 and FM Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

2.06 FABRICATION OF DOWNSPOUTS, GUTTERS, SCUPPERS, AND CONDUCTOR HEADS

A. Form downspouts and gutters in maximum lengths as practicable to sizes and shapes indicated on Drawings:
   1. Telescope end joints 1-1/2 inches and lock longitudinal joints of downspouts.
   2. Provide elbows at bottom where downspouts empty onto splash blocks.
   3. Fit downspouts into cast iron boots or drainpipes where indicated on Drawings; neatly caulk or cement joints.

B. Form scuppers and conductor heads to shapes and sizes indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set and cant strips and reglets in place.

B. Verify nailing strips and blocking are properly located.

C. Verify membrane termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Flashing:
   1. General:
      a. Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA 1793.
      b. Provide concealed fasteners where possible, set units true to line, and level as indicated.
      c. Install work with laps, joints, and seams that will be permanently watertight.
   2. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
      a. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 16-inch centers.
3. Isolate metal from wood and concrete and from dissimilar metal with isolation tape or two coats of isolation paint.

4. Use only stainless steel fasteners to connect isolated dissimilar metals.

5. Joints: 10-foot maximum spacing and 2-1/2 feet from corners, butted with 3/16-inch space centered over matching 8-inch-long backing plate with sealing tape in laps.

6. Set flanges of flashings and roof accessories on continuous sealing tape or in plastic roof cement on top of envelope ply of roofing. Nail flanges through sealing tape and at 3-inch maximum spacing. Touch up isolation paint on flanges.

7. Joints, Fastenings, Reinforcements, and Supports: Sized and located as required to preclude distortion or displacement as a result of thermal expansion and contraction.

8. Provide continuous holddown clips at counterflashings.

9. Conceal fastenings wherever possible.

10. Set flashing and sheet metal to straight, true lines with exposed faces aligned in proper plane without bulges or waves.

B. Prefabricated Metal Systems:

1. Follow system manufacturer’s printed instructions.

2. Place color variations in pieces so no extremes are next to each other.

C. Downspouts, Gutters, Scuppers, and Conductor Heads: Anchor downspouts to wall with straps of same material as downspouts. Install gutters, scuppers, and conductor heads as indicated on Drawings.

3.03 FINISH

A. Exposed Surfaces of Flashing and Sheet Metalwork: Free of dents, scratches, abrasions, or other visible defects, and clean and ready for painting where applicable.

3.04 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
### Quality Control

W. Laird Ellis, Jr.

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#### Document Review & Approval:

**Originator:**

Mark Sharp, Lead Architect

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

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Date: 2017.06.23 09:42:59 -06'00'
SECTION 07 70 01
ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Movement and Control Association International (AMCA).
3. ASTM International (ASTM):
4. Underwriters Laboratories Inc. (UL).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings of each item specified showing materials, details, flashing, anchorage, and relation to adjacent structure.
2. Catalog cuts of each specified item.

1.03 SEQUENCING AND SCHEDULING

A. Coordination: Schedule and coordinate work of this section with work of Section 23 77 00, Air Handling Units, and Section 07 62 00, Sheet Metal Flashing and Trim.

PART 2 PRODUCTS

2.01 EQUIPMENT SUPPORT CURBS

A. Prefabricated Galvanized Steel: Minimum 12-inch-high curb with counterflashing, factory installed insulation, and treated wood nailer as required for conditions shown on Drawings.

B. Metal Gauge and Reinforcement: To suit imposed loads of equipment to be supported.

C. Fabricate curbs to fit roof slope.
D. Manufacturers and Products:
   1. ThyCurb; Model TC 3.
   2. RPS Corporation; RC-2A.

2.02 FLEXIBLE BASE PIPE SEALS

A. Prefabricated one-piece aluminum flanged base with stepped, graduated EPDM cap and adjustable stainless steel clamps. Aluminum base shall be capable of bending to match profile of sheet metal roofing panels.

B. Manufacturers and Products:
   1. Pate Co.; Dektite.

2.03 VENT PIPE FLASHING

A. Prefabricated flashing with elastomeric collar and 24-gauge galvanized steelbase, sized to fit vent pipe.

B. Manufacturer and Product: Oatey; No-Caulk Roof Flashing.

C. Or as provided by roof system manufacturer.

2.04 SNOW GUARDS

A. Manufacturers and Products:
   1. Snowblox; Ace or Deuce model.
   2. Zaleski; Model No. 15.

2.05 ANCILLARY MATERIALS

A. Isolation Paint: As specified in Section 09 90 00, Painting and Coating.

B. Coat aluminum surfaces in contact with concrete or dissimilar metals as specified in Section 09 90 00, Painting and Coating.

C. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil-thick minimum polyester.
D. Plastic Roof Cement: ASTM D4586, Type II.
E. Fasteners: Stainless steel of type required.

PART 3   EXECUTION

3.01  PREPARATION

A. Examine surfaces and structures to receive the Work of this section.

B. Take measurements at Site and fabricate work to suit. No changes shall be made in supporting structure to accommodate this Work.

3.02  INSTALLATION

A. General:

1. Install roof specialties and accessories as detailed in approved shop drawings and in conformance with manufacturer’s instructions, recommendations, and standards.
2. Use appropriate pipe curb assembly, pipe seal, flexible base pipe seal, or vent pipe flashing where pipe, conduit, or cable, etc., penetrate roofing membrane.
3. Factory Finished Units: Place color variations in pieces so no extremes are next to each other.
4. Make Work weathertight and free of expansion and contraction noise.
5. Maintain separation between aluminum surfaces and concrete or dissimilar metals as specified in Section 09 90 00, Painting and Coating, with isolation paint or with isolation tape.

B. Snow Guards: Install in strict accordance with manufacturer’s written instructions, including recommended spacing for roof type, slope, and location, and attachment method.

END OF SECTION
**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Firestopping

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**Originator:**

Mark Sharp, Lead Architect  

**Name/Position**

Mark Sharp  

**Signature**

Mark Sharp  

**Date**

6/22/2017

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control  

**Name/Position**

Stephen J. Silkworth  

**Signature**

Stephen J. Silkworth  

**Date**

6/22/2017

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager  

**Name/Position**

W. Laird Ellis, Jr.  

**Signature**

W. Laird Ellis, Jr.  

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**Date:** 2017.06.23 09:45:10 -06'00"
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):

2. Underwriters Laboratory, Inc. (UL):
   a. 1479, Fire Tests of Through-Penetration Firestops.

1.02 SYSTEM DESCRIPTION

A. Provide systems of material or combination of materials used to fill openings around penetrating items to prevent the spread of fire and retain integrity of fire rated construction by maintaining an effective barrier against spread of flame, smoke, water, and hot gases through penetrations in fire rated wall and floor assemblies.

B. Provide Fire Safing:

1. At slot gaps between edge of floor slabs and exterior walls.
2. Gaps between top of walls and structure above.
3. Expansion joints in walls, floors, and ceilings.

C. Performance Requirements: Provide firestop systems with materials that have been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.

D. Regulatory Requirements:

1. Firestop Systems: Meet requirements of ASTM E814, UL 1479, or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
2. Proposed Firestop Materials and Methods: Conform to applicable governing codes having local jurisdiction.
3. Meet F and T ratings of ASTM E814 for a period equal to construction penetrated.
4. Underwriters Laboratories classified as fill, void, or cavity materials under UL 1479.
1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Show layout, profiles, and product components; include UL Systems Number on Shop Drawings and diagram of UL approved assembly.
2. Product Data: Include manufacturer’s SPEC-DATA® product sheet for products selected for use.

B. Informational Submittals:

1. Manufacturer’s installation instructions.
2. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
3. Certificates:
   a. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
   b. Certificate indicating installer qualifications.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Experienced in performing Work of this section and specialized in the installation of work similar to that required for this Project.

B. Preinstallation Meetings: Conduct preinstallation meeting to identify where seals are required and verify Project requirements, substrate conditions, manufacturer’s installation instructions, and manufacturer’s warranty requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at Project Site.

B. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification and UL listing mark intact.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer’s requirements.

D. Follow recommended procedures, precautions, or remedies described in Material Safety Data Sheets as applicable.

1.06 SEQUENCING AND SCHEDULING

A. Firestopping requirements may be created by mechanical and electrical portions of the Work:
1. Identify locations requiring firestopping.
2. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

PART 2 PRODUCTS

2.01 GENERAL
A. Furnish firestop system products from a single manufacturer.

2.02 MANUFACTURERS
A. 3M Corp.; Firestopping Products.
B. Hilti Construction Chemicals; High Performance Firestop Systems.
C. International Protective Coatings Corp. (IPC); Flamesafe Firestop Products.
D. Isolatek International (Cafco); TPS.
E. Specified Technologies; Inc. (STI).
F. United States Gypsum Co. (USG); Firestop Systems and Thermafiber Safing Insulation.

2.03 MIXES
A. For those products requiring mixing prior to application, follow firestopping manufacturer’s directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.01 EXAMINATION
A. With manufacturer’s representative, examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Surface Cleaning: Clean openings and joints immediately prior to installing firestopping in accordance with firestop manufacturer recommendations and the following requirements:
1. Remove foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer’s recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping seal with substrates.

3.03 INSTALLATION

A. Manufacturer’s Instructions: Follow manufacturer’s instructions for installation of through-penetration systems selected for use.

1. Seal holes or voids made by penetrations for pipes, conduits and ducts through fire-rated floors, walls, and roofs and to ensure air and water resistant seals.
2. Receive Engineer’s approval prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

B. Fire Safing: Install, following manufacturer’s instructions, to completely fill gaps between tops of fire-rated walls and floor or roof deck above, between edge of floors and walls, and other locations indicated on Drawings.

C. Meet Underwriters Laboratories and Factory Mutual requirements.

3.04 FIELD QUALITY CONTROL

A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of Work accessible until inspection by applicable code authorities.

C. Perform patching and repairing of firestopping caused by cutting or penetrating existing firestop systems.
3.05 MANUFACTURER’S SERVICES

A. Provide manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for installation assistance, inspection and certification of proper installation, and training of installer’s personnel in proper installation procedures.

3.06 PROTECTION

A. Protect installed product from contact with contaminating substances and from damage during construction.

END OF SECTION
**Specification Title & Description:**
(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

<table>
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**Document Review & Approval:**

**Originator:**
Mark Sharp, Lead Architect

**Signature:**

Mark Sharp

**Date:**
6/22/2017

**Design Verification Complete:**
Stephen J. Silkworth - Quality Control

**Signature:**

Stephen J. Silkworth

**Date:**
6/22/2017

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

**Signature:**

W. Laird Ellis, Jr.

**Digitally signed by W. Laird Ellis, Jr.**
Date: 2017.06.23 10:10:58 -06'00'
PART 1    GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.
2. Samples: Material proposed for use showing color range available
3. Proposed UL assembly for fire rated penetrations.

B. Informational Submittals:

1. Installation instructions.
2. Documentation showing applicator qualifications.
3. Special guarantee.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum of 5 years’ experience installing sealants in projects of similar scope.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 degrees F and 80 degrees F (4 degrees C and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

1.05 SPECIAL GUARANTEE

A. Product: Furnish manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of the Owner, removal and
replacement of Work specified in this section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

B. Conditions: No adhesive or cohesive failure of sealant.

C. Sealed Joints: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.01 SEALANT MATERIALS

A. Characteristics:

1. Uniform, homogeneous.
2. Free from lumps, skins, and coarse particles when mixed.
3. Nonstaining, nonbleeding.
4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
5. Immersible may be substituted for nonimmersible.

B. Color: Unless specifically noted, match color of the principal wall or floor material adjoining area of application.

C. Type 2—Multipart Polyurethane, Self-leveling, Immersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products:
   a. BASF; Sonneborn, SL-2.
   b. Pecora Corp.; Urexspan NR-200.
   c. Tremco; THC-900/901.
   d. Sika Chemical Corp.; Sikaflex 2c SL.

D. Type 3—Multipart Polyurethane, Nonsag, Immersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products:
   a. Pecora; DynaTrol II.
   b. Tremco; Dymeric 240.
   c. BASF; Sonneborn NP-2.
   d. Sika Chemical Corp.; Sikaflex 2c NS.
E. Type 5—One-part Polyurethane, Immersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products for Nonsag:
   a. Sika Chemical Corp.; Sikaflex-1a.
   b. Tremco; Vulkem 116.
4. Manufacturers and Products for Self-leveling:
   a. BASF; Sonneborn, SL-1.
   b. Tremco; Vulkem 45.
   c. Sika Chemical Corp.; Sikaflex 1c SL.

F. Type 6—One-Part Polyurethane, Nonimmersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Manufacturers and Products:
   a. Pecora Corp.; Dynatrol 1 XL.
   b. Tremco; Dymonic.
   c. BASF; Sonneborn, NP-I.

G. Type 10—Sanitary Sealant:

1. Silicone sealant similar to Type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color.
2. Manufacturers and Products:
   a. Dow Corning; 786.
   b. General Electric; Sanitary Sealant SCS1700.

H. Type 11—Fire Penetration Seal:

1. To comply with UL 1479.
2. Manufacturers and Products:
   a. 3M Corp.; Fire Barrier Caulk CP25 WB+.
   b. General Electric; Pensil Sealant or Foam.
   c. Unifrax Corporation; Fyre Putty.
   d. Hilti USA; CP 606.

I. Type 13—Tape Sealant:

1. Compressible polyurethane foam impregnated with polybutylene or polymer-modified asphalt.
2. Color: Black.
3. Size: 3/4 inch wide by length required by expanded thickness recommended by manufacturer for particular application.
4. Manufacturers and Products:
   b. Dayton Superior; Polytite Standard.
   c. PARR Technologies; PARR Sealant EP-7212-T.

2.02 BACKUP MATERIAL

A. Nongassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16 inch wide.

C. Manufacturers and Products:
   1. Sonneborn; Sonolastic Closed-cell Backing Rod.
   2. Tremco; Closed-cell Backing Rod.
   3. Pecora Corporation; Green Rod.

2.03 ANCILLARY MATERIALS

A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

2.04 PREFORMED SEALS

A. Preformed Compressible Joint Seals:
   1. Widths Up to 5 Inches:
      a. BASF, Watson Bowman Acme Div.; Wabo Weatherseal II.
      b. Emseal Joint Systems Limited; Colorseal.
      c. LymTal International; Iso-flex Joint System.
   2. Other Widths: Series or model recommended by sealant manufacturer.

PART 3  EXECUTION

3.01 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by sealant manufacturer.
B. Install joint sealants in accordance with ASTM C1193.

C. Horizontal and Sloping Joints up to 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.

D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.

E. Use joint sealant as required for the applicable application and as follows:

<table>
<thead>
<tr>
<th>Joint Size</th>
<th>Sealant Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1&quot;</td>
<td>2, 3, 5, 6, 10</td>
</tr>
<tr>
<td>Less than 2&quot;</td>
<td>2, 3, 11</td>
</tr>
<tr>
<td>Over 2&quot;</td>
<td>Follow manufacturer’s recommendation</td>
</tr>
</tbody>
</table>

3.02 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.
   1. Mask adjacent surfaces where necessary to maintain neat edge.
   2. Starting of work will be construed as acceptance of subsurfaces.
   3. Apply primer to dry surfaces as recommended by sealant manufacturer.

C. Verify joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Follow manufacturer’s instructions for mixing multi-component products.

3.03 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.
   1. Install backup material as recommended by sealant manufacturer.
   2. Where possible, provide full length sections without splices; minimize number of splices.
   3. Tape sealant may be used as joint filler if approved by sealant manufacturer.

B. Use bond breaker where recommended by sealant manufacturer.
C. Seal joints around window, door and louver frames, expansion joints, control joints, and elsewhere as indicated.

D. At fire rated joints, submit UL assembly for specific application for review and approval by Engineer.

E. Joint Sealant Materials: Follow manufacturer’s recommendation and instructions, filling joint completely from back to top, without voids.

F. Joints: Tool slightly concave after sealant is installed.
   1. When tooling white or light color sealant, use a water wet tool.
   2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

G. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer’s instructions.

3.04 PREFORMED SEALS

A. Prepare joint surfaces clean and dry, free from oil, rust, laittance, and other foreign material.

B. Construct joints straight and parallel to each other and at proper width and depth.

C. Apply joint sealant manufacturer’s approved primer and adhesive in accordance with manufacturer’s instructions.

D. Install seal in accordance with manufacturer’s instructions.

3.05 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

3.06 JOINT SEALANT SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of Project.
<table>
<thead>
<tr>
<th>Joint Locations</th>
<th>Sealant Type(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expansion/Contraction and Control Joints At:</strong></td>
<td></td>
</tr>
<tr>
<td>Concrete Walls (except water-holding and belowgrade portions of structures)</td>
<td>3, 5, 6</td>
</tr>
<tr>
<td>Concrete Floor Slabs (except for water-holding Structures)</td>
<td>2, 5</td>
</tr>
<tr>
<td>Slabs Subject to Vehicle and Pedestrian Traffic</td>
<td>2, 5</td>
</tr>
<tr>
<td><strong>Material Joints At:</strong></td>
<td></td>
</tr>
<tr>
<td>Metal Door, Window, and Louver Frames (Exterior)</td>
<td>5, 6</td>
</tr>
<tr>
<td>Metal Door, Window, and Louver Frames (Interior)</td>
<td>5, 6</td>
</tr>
<tr>
<td>Wall Penetrations (Exterior)</td>
<td>5, 6</td>
</tr>
<tr>
<td>Wall Penetrations (Interior)</td>
<td>5, 6</td>
</tr>
<tr>
<td>Floor Penetrations</td>
<td>5, 6</td>
</tr>
<tr>
<td>Ceiling Penetrations</td>
<td>3, 5, 6</td>
</tr>
<tr>
<td>Roof Penetrations</td>
<td>5</td>
</tr>
<tr>
<td>Sheet Metal Flashings</td>
<td>5, 13</td>
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<tr>
<td>Sheet Metal Roofing and Siding</td>
<td>5, 13</td>
</tr>
<tr>
<td>Precast Concrete Wall Panels</td>
<td>3, 5, 6, 13</td>
</tr>
<tr>
<td><strong>Other Joints:</strong></td>
<td></td>
</tr>
<tr>
<td>Fire Rated Joints</td>
<td>11</td>
</tr>
<tr>
<td>Threshold Sealant Bed</td>
<td>5</td>
</tr>
<tr>
<td>Between Counter Tops and Backsplashes</td>
<td>10</td>
</tr>
<tr>
<td>Around Plumbing Fixtures</td>
<td>10</td>
</tr>
<tr>
<td>Concrete Form Snap-Tie Holes</td>
<td>3, 5</td>
</tr>
</tbody>
</table>

B. Use sealant Type 5 for building joints and elsewhere as indicated.

C. Use sealant Type 10 for joints between counter tops and backsplashes and around plumbing fixtures where they fit against walls and floors.

**END OF SECTION**
**Quality Control**

**Metal Doors and Frames**

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### Document Review & Approval:

**Originator:**

Mark Sharp, Lead Architect  
**NAME/POSITION**  
**SIGNATURE**

6/22/2017  
**DATE**

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control  
**NAME/POSITION**  
**SIGNATURE**

6/22/2017  
**DATE**

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager  
**NAME/POSITION**  
**SIGNATURE**  
Digitally signed by W. Laird Ellis, Jr.  
Date: 2017.06.23 10:13:42 -06'00'  
**DATE**
SECTION 08 11 00
METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):
   a. A250.6, Hardware on Standard Steel Doors (Reinforcement - Application).
   c. A250.11, Recommended Erection Instructions for Steel Frames.

2. ASTM International (ASTM):
   c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.


1.02 SUBMITTALS

A. Action Submittals: Applicable information for each type of door and frame, including:

1. Frame conditions and complete anchorage details, supplemented by suitable schedules covering doors and frames.
2. Glass and louver opening sizes and locations in doors.
3. Connections of door frames to structural steel framing concealed in frames.
4. Joints required to accommodate expansion joint movement.
5. Relate to door numbers used in Contract Drawings.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Properly identify each item with number used in Contract Drawings.

B. Store doors upright, in protected dry area, at least 1 inch off ground or floor and at least 1/4 inch between individual pieces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Curries Manufacturing.
2. The Ceco Corp.
3. Fenestra Division, Marmon Group.
4. Mesker Industries, Inc.
5. Monarch Steelcraft, Ltd.
6. Overly Manufacturing Co.
7. Pioneer Industries.
8. Precision Metals, Inc.
9. Republic Steel Corp.
10. Steelcraft Manufacturing Co.
11. Trussbilt, Inc.
12. Williamsburg Steel Products Co.
13. Stiles Custom Metal, Inc.

2.02 MATERIALS

A. Basic Metal Material:

1. ASTM A1008/A1008M; sheet steel, cold-rolled, stretcher level.
2. ASTM A167, Type 316 stainless steel.

B. Hollow Metal Frames:

1. Products of hollow metal door manufacturer.
2. ANSI 250.8, except as modified herein.
3. Frames for Doors 16 gauge for interior and 14 gauge with thermal break, for exterior, welded type, of cross-section shown.
4. Prepare floor and wall anchors, reinforcement, and cutouts for hardware to meet requirements of BHMA A156.115 and ANSI A250.6.
5. Finished size, shape, and profile of frame members as shown.
6. Concealed fasteners or welding are preferred to through-the-face fasteners.
7. Identification: Stamp opening number, as shown on Drawings, on center hinge reinforcement of each frame.

C. Hollow Metal Doors: ANSI A250.8, except as modified herein. BHMA A156.115 and ANSI A250.6 to receive hardware specified in Door and Hardware Schedule.

1. Interior:
   b. Flush end closure at top of doors.
2. Exterior:
   b. Double Doors: Overlapping astragals for active leaf, except as noted or detailed otherwise.
   c. Flush end closure at top of doors.
   d. R-Value: Minimum 4.75.

D. Labeled Fire Doors and Frames:

1. Conform to listing requirements of Underwriters Laboratories, Inc. (UL).
2. Label each door and frame for class of rating required.
3. Overlapping astragal on active leaf of double doors.
4. Label requirements, dimensions, and type of door are indicated in Door and Hardware Schedule.
   a. Modify drawing details if required to secure label.
   b. Clearly identify modifications on Shop Drawings.

E. Glazing:

1. Doors: Furnish with formed flush-type glazing strips with butt corner joints to permit selection of secure side in field.
2. Glazing Arrangements: Accommodate glass of type and thickness indicated and as specified in Section 08 80 00, Glazing.

2.03 MISCELLANEOUS ITEMS

A. Furnish manufacturer’s standard core filler, anchors, fasteners, and other ancillary items.

2.04 FACTORY FINISHING REQUIREMENTS

A. Galvanized with A60 zinc coating in accordance with ASTM A653/A653M (Wipe Coat galvanized coating is not acceptable).
B. Phosphate treat metal for paint adhesion.

C. One shop coat of baked-on rust-inhibiting prime coating compatible with finish coating as specified in Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.01 INSTALLATION

A. Frames:

1. Follow ANSI A250.11 and manufacturer’s instructions.
   a. Maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.
   b. Secure anchorages and connections to adjacent construction.
   c. Wherever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached.

B. Doors:

2. Hardware: In accordance with manufacturer’s templates and instructions.
   a. Adjust operable parts for correct function.
   b. Remove hardware, with exception of prime coated items, tag, box, and reinstall after finish paint work is completed.
3. Labeled Doors: NFPA Pamphlet No. 80.

3.02 FIELD PAINTING

A. Where prime coat has been damaged, sand smooth and touch up with same primer as applied at shop.

1. Remove rust before painting.
2. Touch Up: Not obvious.
3. Perform immediately after door and frame installation.

3.03 PROTECTION

A. Protect installed doors and frames against damage from other construction work.
3.04  SCHEDULES

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Door and Hardware Schedule on Drawings.

END OF SECTION
Specification Document Control No.: 08 33 23  
Revision No.: 0  
Project: Outfall 200 Mercury Treatment Facility  
Engineering Discipline: Architectural  
Specification Division: 8 - Openings  
Date: 6/23/2017  

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)  
Overhead Coiling Doors

Revision History:

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Signature: Mark Sharp  
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Signature: Stephen J. Silkworth  
Date: 6/22/2017

Approved: W. Laird Ellis, Jr. PE/Design Manager  
Digitally signed by W. Laird Ellis, Jr.  
Date: 2017.06.23 10:16:26 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):


3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   c. MG 1, Motors and Generators.

4. Underwriters Laboratories Inc. (UL):
   b. 10B, Standard Safety for Fire Tests of Door Assemblies.
   c. 325, Standard Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
2. Product Data: General construction, component connections and details, wiring diagram and electrical equipment.

B. Informational Submittals:

1. Third party testing documentation or manufacturer’s literature qualifying door model as meeting required developed wind pressures
2. Manufacturer's Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.
3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data, include lubrication requirements and frequency, and periodic adjustments required.
4. Seismic Anchorage and Bracing:
   a. Drawings and product data as required by Section 01 88 15, Anchorage and Bracing.
   b. Calculations as required by Section 01 88 15, Anchorage and Bracing.
   c. Installer’s factory authorization.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 5 years’ experience.
2. Installer: Company specializing in performing work of this section with minimum 3 years’ experience, approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Cookson Co.
2. Cornell Iron Works, Inc.; Dynaflair Corp.
3. Raynor Garage Door.
4. Overhead Door Co.

2.02 GENERAL

A. Wind Loads: Design door assembly to withstand wind/suction load of 30 psf, with maximum deflection of 1/120, and without damage to door or assembly components.

B. Wind Loads: Design door assembly to withstand wind/suction load of 30 psf, with a maximum deflection of 1/120 without damage to door or assembly components.

C. Operation: Design door assembly including operator, to operate for not less than 10,000 cycles.

1. NFPA 252.
2. UL 10B.

D. Fire Rated Assemblies: Fire alarm system activated with automatically governed closing speed.

1. Design release mechanism for easy resetting by facility maintenance personnel.
2. Provide units allowing manual lifting for emergency exit after automatic closing, with curtain closing when released.

E. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.

F. Surface Burning Characteristics, Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

2.03 COMPONENTS

A. Curtain: Conform to following:

1. Steel Slats:
   a. Interlocking, minimum 24 gauge (0.75 mm) thick of ASTM A653/A653M steel, minimum galvanized coating designation G90 (Z275) in accordance with ASTM A924/A924M.
   b. Type: S-configuration slat.
      1) At external doors, sandwich slat construction with manufacturer’s standard insulated core with maximum U-value of 0.16 and backing to match face slat, thermally separated from face slat.
      2) At internal doors, same configuration without insulation, and as required for fire rating.
   2. Nominal Slat Size: 3 inches wide by required length.
   3. Slat Ends: Each slat fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   4. Curtain Bottom: Fitted with angles, channels, or tubes to provide reinforcement and positive contact with floor in closed position.

B. Guides:

1. Minimum 3/16 inch (5 mm) thick; galvanized steel conforming to ASTM A653/A653M, minimum galvanized coating designation G90 (Z275) in accordance with ASTM A924/A924M.
2. Furnish continuous angles of profile to retain door in place mounting brackets of same metal.

C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.

D. Hood Enclosure and Fascia: Square shape, minimum 24 gauge (0.75 mm) thick galvanized steel; internally reinforced to maintain rigidity and shape.

a. Rubber, neoprene, or vinyl water seal at hood to prevent airflow around coil on exterior doors.
b. Weather seal sealing strip on guide to close space between guide and curtain on exterior doors.


F. Electric Operation:

2. UL 325, side mounted, open drip-proof motor.
3. Motor Enclosure: NEMA MG1 Type 1 enclosure.
4. Motor Rating: 1/3 hp (375 W); continuous duty.
5. Motor Voltage: 120 volts single-phase, 60 Hz.
7. Controller Enclosure: NEMA 250 Type 1.
8. Door Speed: 12 inches per second (300 mm/s).
10. Control Station: Standard three button (Open-Stop-Close) momentary control for each operator, 24-volt circuit, surface mounted.
11. Safety Edge:
   a. At exterior doors, manufacturer’s standard safety edge and weather seal located at door bottom, full width, sensitized type, wired to reverse upon striking object.
   b. At interior doors, same feature, with smoke stop as required for fire rating.

2.04 FINISHES

A. Curtain Slats: Steel, galvanized, primed and painted.
B. Steel Guides and Hood Enclosure: Primed and painted.

2.05 SOURCE QUALITY CONTROL

A. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.

1. Oversize Door Certification: Provide UL Certificate of Inspection or comparable certification acceptable to authorities having jurisdiction, in lieu of label for oversize door assemblies exceeding 120 square feet (11.15 square m) or 24 feet (7.3 m) in any dimension.

B. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION
A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
B. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
D. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.
E. Complete wiring from disconnect to unit components and from fire alarm system to door operator.
F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 92 00, Joint Sealants.
G. Install perimeter trim and closures.

3.03 TOLERANCES
A. Maintain dimensional tolerances and alignment with adjacent Work.
B. Maximum Variation from Plumb: 1/16 inch.
C. Maximum Variation from Level: 1/16 inch.
D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.04 ADJUSTING
A. Adjust door, hardware and operating assemblies for smooth and noiseless operation.
B. Test smoke activated assemblies for proper activation.
3.05 CLEANING

A. Leave door and components clean. Remove labels and visible markings.

END OF SECTION
Translucent Wall and Roof Assemblies

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Document Review & Approval:

Originator:

Mark Sharp, Lead Architect

Design Verification Complete:

Stephen J. Silkworth - Quality Control

Approved:

W. Laird Ellis, Jr. PE/Design Manager
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Architectural Manufacturers Association (AAMA):

2. ASTM International (ASTM):
   e. E72, Standard Methods of Conducting Strength Tests of Panels for Building Construction.

3. International Conference of Building Officials (ICBO).


1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Indicate fabrication and erection of insulated translucent panels. Include engineering calculations and details for subframes, where applicable.

2. Samples: Aluminum extrusions finished with scheduled colors.

B. Informational Submittals:

1. Test Reports: Certified test reports made by independent testing organization for each type and class of panel system. Reports shall
verify that material will meet performance requirements of this Specification. Previously completed test reports will be acceptable if current and indicative of products used on this Project. Test reports required are:

- Flame Spread and Smoke Development (ASTM E84).
- Burn Extent (ASTM D635).
- Color Difference (ASTM D2244).
- Impact Strength (Falling Ball Method).
- Bond Strength (ASTM C297 and ASTM D1002).
- Accelerated Aging (ASTM D1037).
- Beam Bending Strength (ASTM E72).
- Insulation U-Factor (NFRC 100).

2. Qualifications: Translucent panel manufacturer and panel erector shall show, upon request, proof of their ability to perform Work.

1.03 QUALITY ASSURANCE

A. Panel System Manufacturer: Listed by recognized building code authority including International Conference of Building Officials that requires quality control inspections for sandwich panel construction.

B. Installer: Approved by manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store translucent panels on long edge, several inches above ground, blocked and under cover to prevent warping.

B. Ship units assembled and ready for erection.

1.05 SPECIAL GUARANTEE

A. Manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this Specification section found defective during period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

B. Conditions:

1. Joint guarantee signed by Contractor, installer, and manufacturer.
2. No leakage of water to interior.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials and products specified in this section shall be products of Kalwall Corp., Manchester, NH.

2.02 MATERIALS AND COMPONENTS

A. Translucent Fiberglass Face Sheets:

1. Exterior: Crystal, 0.070 inch thick.
2. Interior: Crystal, 0.045 inch thick.
3. Interior flamespread rating no greater than 50 and smoke developed no greater than 250, when tested in accordance with ASTM E84. Burn extent by ASTM D635 shall be no greater than 1 inch.
4. Exterior faces shall not change color more than 3.0 units (DE LTA-E by ASTM D2244) after 5 years outdoor weathering South Florida at 5 degrees facing south, determined by average of at least three white samples.
5. Exterior faces shall have permanent glass veil erosion barrier and high performance thermoset acrylic protective surface (minimum thickness 1.2 mils) for maximum resistance to erosion and weather, applied in factory under controlled temperature conditions. Plastic overlay films are not acceptable. This coating shall be fully field refinishable if damaged.
6. Uniform in color.
7. Faces shall be completely free of ridges and wrinkles, which prevent proper surface contact in bonding to aluminum grid core. Clusters of air bubbles/pinholes that collect moisture and dirt will not be acceptable.
8. Strength: Exterior face sheet shall be uniform in strength and repel impact equal to 60 foot-pounds without fracture or tear.

B. Grid Core: Noncombustible aluminum I-beams thermally broken at flat panels; 6063-T6; mechanical interlocking of muntin-mullion and perimeter; 7/16 inch width.

C. Adhesive:

1. Heat and pressure resin type.
2. ICBO approved for use in sandwich panel construction.
3. Minimum Strength:
   a. Tensile: After 2 exposures to six cycles each of aging conditions in accordance with ASTM D1037; 750 psi by ASTM C297.
   b. Shear: After five separate aging conditions in accordance with ASTM D1002:
1) 50 Percent Relative Humidity at 73 degrees F: 540 psi.
2) 182 degrees F: 100 psi.
3) Accelerated Aging by ASTM D1037 at Room Temperature: 800 psi.
5) 500-Hour Oxygen Bomb, by ASTM D572: 1400 psi.

D. Battens and Perimeter Closure Systems:

2. Fasteners: Stainless steel screws.

E. Flexible Sealing Tape: Manufacturer’s standard; preapplied to closure system at factory under controlled conditions.

F. Corrosion-Resistant Finish: Fluoropolymer fortified thermoset acrylic/urethane system that meets performance requirements of AAMA 605.2.

1. Uniform in appearance.
2. Factory applied under controlled conditions:
   a. All aluminum to be wash-primed in accordance with MIL DOD-P-15328D.
   b. Even over entire exposed aluminum surface.
   c. Minimum dry thickness of 2 mils (0.002 inch).
3. Shall remain adhered to aluminum substrate with no blistering or peeling, and color change shall be no greater than 3 DELTA-E Adams Units after 10 years’ outdoor exposure at 5 degrees from vertical, facing south in South Florida.
4. Resistant to most chemicals, including acids, alkalies, gases, salt solutions, and water.
5. Color as shown in Exterior Finish Schedule, selected from manufacturer’s standard color range.

2.03 WALL PANEL FABRICATION

A. Translucent Wall Panels (TWP): True structural composite flat sandwich panels of flat face sheets bonded to thermally broken grid core of mechanically interlocking aluminum I-beams. Laminate together under controlled process of heat and pressure. Tape bond systems are not allowed. Fiberglass batt insulation.
2. “U” Value: 0.23.
3. Light Transmission: 30 percent.
4. Shading Coefficient: 0.33.

B. Preassemble and seal panels at factory under controlled process of heat and pressure. Field assembly of major components will not be allowed.

C. Panel deflection for 10-foot clear span tested flat in accordance with ASTM E72 shall not exceed 1.9 inches at 30 pounds per square foot loading.

D. Grid Pattern: 24 inches by 12 inches nominal, and symmetrical about vertical centerline of each panel.

E. Adhesive Bonding Line: Straight, cover entire width of I-beam, and have a neat, sharp edge. In order to ensure bonding strength, white spots at intersections of muntins and mullions shall not exceed 4 for each 40 square feet of panel nor shall they be more than 3/64 inch in width.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare openings, including isolating aluminum system, from dissimilar materials that may cause damage by electrolysis.

3.02 ERECTION OF TRANSLUCENT PANELS

A. Erect insulated translucent panel systems in strict accordance with manufacturer’s instructions. Fasten and seal in strict accordance with manufacturer’s shop drawings. Clean aluminum before applying sealants.

B. After other trades have completed work on adjacent material, carefully inspect translucent panel unit installation and make adjustments necessary to ensure proper installation and weathertight conditions.

3.03 CLEANING

A. Leave translucent panels in undamaged condition and ready for final cleaning. On completion: No shifting or rattling of panels.

B. Clean both faces of panels in accordance with manufacturer’s instructions.
3.04 PROTECTION OF COMPLETED WORK

A. Install marker tape across panels secured to frames or structure. No tape or marking allowed on panels after final cleaning.

END OF SECTION
Quality Control

W. Laird Ellis, Jr.

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 10:23:33 -06'00'

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**Document Review & Approval:**

**Originator:**
Mark Sharp, Lead Architect

NAME/POSITION

[Signature]

DATE: 6/22/2017

**Design Verification Complete:**
Stephen J. Silkworth - Quality Control

NAME/POSITION

[Signature]

DATE: 6/22/2017

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

[Signature]

DATE: Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 10:23:33 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:


   d. 701, Combined Voluntary Specification for Pile Weather Strip.
   e. 800, Voluntary Specification and Test Methods for Sealants.

3. ASTM International (ASTM):
   g. C1036, Standard Specification for Flat Glass.
   i. D3656, Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.


1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Large scale details and layout of windows, operators, anchorages, and adjoining construction with all materials indicated accurately to scale.
   b. Manufacturer’s literature including brochures or catalogs, specifications, instructions, and standard details illustrating products proposed for use and other window products available.

B. Informational Submittals: Manufacturer’s Certification of Compliance.

1.03 QUALITY ASSURANCE

A. All Units: Meet construction and testing requirements of AAMA 101.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store window units in vertical upright position and off the ground on dunnage, preferably inside a building.

B. Protect units from weather, abuse, defacement, and damage.

C. Store units inside in areas free of dust and corrosive fumes, as close as possible to point of installation.

D. Prevent contaminants from contacting aluminum.

E. Keep water away from stored units and assemblies.

F. Handle units according to recommendations of AAMA.

1.05 SPECIAL GUARANTEE

A. Provide manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of
Work specified in this Specification section found defective during period of 10 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum: Proper alloy and temper to meet specified requirements.

B. Hardware: Corrosion-resistant and compatible with aluminum; suitable for intended use and the same as used on the tested units.

C. Anchors and Fasteners:
   1. Exposed: Aluminum, Type 304 stainless steel, or ASTM B456 nickel-plated brass.
   2. Concealed: Aluminum, cadmium-plated steel, ASTM B633 or ASTM A123 zinc-plated steel, or Type 304 stainless steel.
   3. Concealed anchors may be of carbon steel, painted after fabrication with zinc chromate primer.
   4. Other Fasteners and Components: Carbon steel or ASTM B456 Nickel plus Chromium plated.

D. Sealants:
   1. AAMA 800 to seal metal to metal, nonworking joints.
   2. Color to be compatible with adjacent materials.

E. Weatherstripping: High quality materials capable of meeting environmental exposure and performance requirements.

F. Glass and Glazing: As Specified in Section 08 80 00, Glazing.

G. Manufacturer and Product:
   1. Kawneer; 8225 TL Thermal Custom.
   2. Approved equal.
2.02 FABRICATION

A. Fabricate and assemble frame, sash, and ventilator members into windows and window systems in accordance with reviewed Shop Drawings, and as required by AAMA 101.

B. Mechanical fasteners, welded components, and hardware items shall not bridge thermal barriers unless the window units tested also have thermal bridges.

C. Sealing Insulating Glass Units: Designed so that water entering space around unit will drain and not remain in contact with edge seal of the glass.

D. Glazing Beads:
   1. Square and coped to uniformly tight hairline joints at corners.
   2. Material may be prefinished.

2.03 FINISH

A. Finish components after fabrication, except those that may be prefinished as specified.

B. Exposed framing members shall be free of scratches and other surface blemishes.

C. Pigmented Organic Coating: AAMA 605.2, color as shown on Exterior Finish Schedule on Drawings.

2.04 ANCILLARY MATERIALS

A. Isolation Tape:
   1. Manufacturers and Products:
      a. Tremco; 440.
      b. 3M; EC1202.
      c. Presstite; 579.6

B. Isolation Paint: Provide as specified in Section 09 90 00, Painting and Coating.

C. Screens:
   1. Furnish rigid metal frame screens to match window frames for operating vents and sash.
   2. ASTM D3656, Class 1, 18 by 16 mesh.
2.05 AWNING AND FIXED WINDOWS

A. Meet requirements of AAMA 101 Designation P-C20 or F-C20.

B. Provide polyvinyl chloride thermal break separator between inside and outside for all frames.

2.06 SOURCE QUALITY CONTROL

A. Tests:
   1. Resistance to Air Infiltration: No greater than 0.06 cfm per square foot of fixed area, as tested in accordance with ASTM E283.
   2. Resistance to Water Infiltration: No leakage in frame at test pressure difference of 8 psf, as tested in accordance with ASTM E331.
   3. Resistance to Uniform Loading: When tested under load of 20 psf, in accordance with ASTM E330:
      a. Maximum Deflection: No greater than 1/175 times span for any member.
      b. When load is removed, no evidence of permanent deformation or damage.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify dimensions by taking measurements at the Site.

B. Verify that openings are within allowable dimensional tolerances, are plumb, level, clean, and provide a solid anchoring surface.

C. Verify conformance with Shop Drawings and that dimensions and conditions are correct before installing windows.

3.02 INSTALLATION

A. Window and Window Components:
   1. Plumb and align window faces in a single plane for each wall plane.
   2. Erect windows and materials square and true and in proper alignment with other work, anchored to maintain position when subjected to normal thermal and building movement and specified. 30 pounds per square foot wind loads.
   3. Install in accordance with manufacturer’s instructions.
   4. Installation shall be weathertight as specified under Article Source Quality Control.
B. Coat aluminum surfaces in contact with concrete, cement plaster, or stucco with isolation paint, sealant, or isolation tape cut to neat line.

3.03 GLAZING
A. Glass may be factory or field installed.
B. Install in accordance with Section 08 80 00, Glazing, and glass manufacturer’s instructions.

3.04 ADJUSTING AND CLEANING
A. Remove protective materials and clean windows with potable water, or water with household soap or detergent.
B. Inspect and readjust glazed ventilators as necessary for free operation at completion.
C. Adjust windows for proper operation after installing.
D. Lubricate hardware and movable units.
E. Leave windows in closed position after adjusting and cleaning.

3.05 PROTECTION
A. Protect installed window units from materials that could cause damage, such as lime, mortar, runoff from concrete and copper, careless handling of tools, weld splatter, acids, roofing asphalt, solvents, and abrasive cleaners.

3.06 SCHEDULE
A. For window types, sizes, glass, and other requirements, see Window Schedule on Drawings.

END OF SECTION
Specifications:

**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Skylights

**Revision History:**

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**Document Review & Approval:**

**Originator:**

Mark Sharp, Lead Architect

NAME/POSITION

SIGNATURE

DATE: 6/22/2017

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control

NAME/POSITION

SIGNATURE

DATE: 6/22/2017

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

SIGNATURE

DATE: Digitally signed by W. Laird Ellis, Jr.

Date: 2017.06.23 10:26:23 -06'00'
SECTION 08 60 00
SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, material, plant and services required to complete fabrication and shipment of skylights as specified herein.

B. Work is limited to skylight system only, and includes the following.
   1. Thermal aluminum vinyl frame system.
   2. Glazing and glazing gaskets.
   3. Factory installation or installation by factory approved contractor with site supervision as required.

1.02 RELATED SECTIONS

A. Section 07 40 00, Roofing and Siding Panels.
B. Section 07 62 00, Sheet Metal Flashing and Trim.
C. Section 07 92 00, Joint Sealants.
D. Section 08 80 00, Glazing.

1.03 REFERENCES

A. Aluminum Association (AA):

B. American Architectural Manufacturer's Association (AAMA):
   1. 501.2, Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.

C. Architectural Aluminum manufacturers Association (AAMA):
   2. 612, Voluntary Specifications and Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent
Coatings on Architectural Aluminum, for Finishes such as Anodized Plus.

D. American Society for Testing and Materials (ASTM):

5. E774, Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units.

E. AWS Structural Welding Code.

1.04 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Indicate materials, finishes and installation procedures recommended by manufacturer.
4. Indicate compliance with specified design criteria.
5. Indicate compliance with performance requirements.
6. Include product specific glazing details.

B. Shop Drawings:

1. Indicate material types, gauges and finishes, fabrication details and installation details.
2. Show glazing types, methods of attachment and thermal movement provisions.

C. Indicate compliance with specified structural design criteria.

1. Submitted design calculations shall bear seal of a professional engineer licensed in the State in which the skylight is to be installed.
D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Skylight manufacturer shall have a minimum of 5 years’ experience in skylight manufacturing, qualified by having performed similar work and having experienced workmen to perform work of type required by contract documents and licensed where appropriate.

B. Installer Qualifications:

1. Installer shall be trained and approved by manufacturer.
2. Installer shall have 5 years’ experience with skylight type, size and complexity.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

A. Skylights are guaranteed for a period of 5 years from date of purchase against defects in materials or workmanship.

B. Custom skylight systems are guaranteed for a period of 2 years from date of installation against leakage and defects in materials or workmanship.

C. The guarantee is limited to repair or replacement, at manufacturer's discretion, and does not cover freight, installation, or consequential damages.
PART 2  PRODUCTS

2.01  MANUFACTURERS

A. Acceptable Manufacturers and Products:

1. Artistic Skylight Domes Ltd., which is located at: 255 Regina Rd.; Vaughan, ON; Canada Model R-CL-FF including insulated curb.
2. Approved equal.

2.02  SKYLIGHT PERFORMANCE

A. Load:

1. Deflection of framing members shall not exceed L/180 or 1 inch (25 mm) whichever is less.
2. Acrylic and/or polycarbonate unit skylights shall meet the requirements of uniform load test ASTM E330 that requires glazing to withstand a positive and negative test pressure of 60 psf.

B. Air Infiltration: Acrylic and/or polycarbonate unit skylights shall meet the requirements of ASTM E283 that allows a maximum air infiltration of 0.06 cfm (.0017 cu. m/m) of the total glazed surface area.

C. Water Infiltration: Acrylic and/or polycarbonate unit skylights shall meet the requirements of ASTM E547/E331 that allows for no water infiltration at a test pressure of 12 psf (571 Pa).

2.03  CURB MOUNT SKYLIGHTS

A. Product: Removable Insulated Curb Skylight Model R-CL-FF as manufactured by Artistic Skylight Domes Ltd.

1. The skylight shall consist of rigid high-impact extruded vinyl curb frame which incorporates a high capacity 8-degree sloped condensation gutter with drainage to exterior, and co-extruded rubber draft seal. Retaining cap frame shall be extruded, mill finish or baked enamel, 6063-T5 aluminum alloy with heliarc welded corners. Curb shall be, 9 inches (229 mm) high or 12 inches (305 mm) high as indicated or scheduled mill finish aluminum, 2 piece construction of .050 inch (1.3 mm) outer wall and .050 inch (1.3 mm) inner wall, with 2 inches (51 mm) thick fiberglass insulation and 3 inches (76 mm) aluminum mounting flange.
2. Includes stainless steel latches which are lockable.
3. Heavy duty aluminum lifting plates at each side.
2.04 MODEL SIZE

A. Model Size:
   1. 6 feet by 6 feet inside opening.
   2. Curb as shown on Drawings.

2.05 MATERIAL

A. Framing systems shall be extruded aluminum, 6063-T5 alloy, with extruded rigid vinyl thermal break.

B. Exposed aluminum surfaces shall be standard mill finish or brown or clear anodized. Custom finishes and colors as scheduled or indicated.

C. Sealants, as designated on drawings, shall be neutral cure architectural grade silicone.

D. Fasteners shall be stainless steel or cadmium plated steel. Exposed fasteners to match specified color of adjacent aluminum.

E. Gaskets to be continuous co-extruded vinyl, neoprene, EPDM, or Santoprene rubber held with constant pressure.

F. Glazing shall be:
   1. Plastic glazed units to be triple glazed acrylic of thickness and colors as required by design criteria.
      a. Clear middle and bottom layer.
      b. 2447 White top layer.

2.06 FABRICATION

A. Skylights shall be factory assembled and shipped as such. Work which cannot be permanently assembled will be shipped in pre-assembled sections to minimize field assembly.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Installer shall inspect area to receive skylights to determine that the conditions are in accordance with shop drawings and specifications. Any variance shall be recorded in writing and corrections made before beginning installation.

B. Installation shall be in strict accordance with these specifications and the manufacturers shop drawings and installation instructions.

C. All materials provided by installer shall be in accordance with those shown on the shop drawings.

3.04 PROTECTION

A. Installer shall remove all labels and protective packaging from components and shall leave the installation free of all heavy construction dirt and sealant smears.

B. Final cleaning and physical protection of all installed materials shall be performed by the general contractor.

C. Protect installed products until completion of project.

D. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
**Quality Control**

Door Hardware

### Revision History:

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### Document Review & Approval:

**Originator:**

Mark Sharp, Lead Architect

NAME/POSITION

SIGNATURE

DATE: 6/22/2017

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control

NAME/POSITION

SIGNATURE

DATE: 6/22/2017

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

W. Laird Ellis, Jr.

SIGNATURE

Digitally signed by W. Laird Ellis, Jr.  
Date: 2017.06.23 10:21:20 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Builders Hardware Manufacturer’s Association (BHMA):
   a. A156.1, Butts and Hinges.
   b. A156.2, Bored and Preassembled Locks and Latches.
   c. A156.3, Exit Devices.
   d. A156.4, Door Controls - Closers.
   e. A156.13, Mortise Locks & Latches.
   f. A156.16, Auxiliary Hardware.
   g. A156.18, Materials and Finishes.


1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data: Manufacturer’s literature for each item of finish hardware required herein, clearly marked.
   b. Finish Hardware Schedule: Furnish complete and detailed schedule, show product items, numbers, and finishes for hardware for each separate opening.
   c. Special Tools: Provide listing and description of usage.

B. Informational Submittals:

1. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
3. Certification of Hardware Consultant.
4. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.03 QUALITY ASSURANCE

A. Qualifications of Supplier: Recognized supplier of architectural finish hardware, with warehousing facilities, who has been furnishing hardware in
vicinity of Project for not less than 5 years, and who is, or who employs, architectural hardware consultant.

B. Qualifications of Architectural Hardware Consultant (AHC): Certified by Door and Hardware Institute.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Before delivery, clearly identify and tag each item of hardware with respect to specified description and location of installation.

B. Provide secure storage for finish hardware until installation is made.

1.05 EXTRA MATERIALS

A. Special Tools: Two sets for installation and maintenance of hardware.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide end products of one manufacturer for each product in order to achieve standardization for appearance, maintenance, and replacement.

B. Finishes: BHMA A156.18.

C. Some products listed below may not be used on this Project.

2.02 FASTENERS

A. Stainless steel.

2.03 BUTT HINGES

A. BHMA A156.1.

B. Quantity per Door Leaf (Minimum):

<table>
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<th>Door Height</th>
<th>Hinges</th>
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<tr>
<td>Up to 5'-0&quot;</td>
<td>1 pair</td>
</tr>
<tr>
<td>5'-1&quot; to 7'-7&quot;</td>
<td>1-1/2 pair</td>
</tr>
<tr>
<td>7'-8&quot; to 10'-0&quot;</td>
<td>2 pairs</td>
</tr>
<tr>
<td>10'-1&quot; to 12'-6&quot;</td>
<td>2-1/2 pairs</td>
</tr>
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</table>
C. Hinge Height (Minimum):

<table>
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<tr>
<th>Door Width</th>
<th>Hinge Height</th>
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<tr>
<td>Up to 3'-0&quot;</td>
<td>4-1/2&quot;</td>
</tr>
<tr>
<td>3'-1&quot; to 4'-0&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td>Over 4'-0&quot;</td>
<td>6&quot;</td>
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D. Width: Minimum for clearance of trim and 180-degree swing.

E. Exterior Hinges: Nonremoveable pin.

F. Joint Tolerance: 0.012 inch maximum, gauged in CLOSED position.

G. Finish: Satin stainless steel No. 630 or Satin chromium-plated steel No. 652.

H. Coordinate number of circuits at Magnetic Monitor Hinge with final system requirements.

I. Types and Manufacturers:

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<th>No.</th>
<th>Type Description</th>
<th>Stanley</th>
<th>McKinney</th>
<th>Lawrence</th>
<th>BHMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Regular weight, two ball-races, full mortise, stainless steel</td>
<td>FBB191-32D</td>
<td>TB2314</td>
<td>BB4101-32D</td>
<td>A5112</td>
</tr>
<tr>
<td>H2</td>
<td>Two H1 hinges and one Magnetic Monitor Hinge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.04 LOCKS AND LATCH SETS

A. Mortise Locks: BHMA A156.13, Series 1000, Grade 1.

1. Materials: Brass or stainless steel.
2. Trim: Wrought or forged lever handles and roses.
3. Core Cylinders: Interchangeable, removable; minimum of six pins.
6. Manufacturers and Products:
   a. Sargent; LNJ.
   b. Schlage; 03.
   c. Best; 3H Fairbanks.

B. Finish: Satin stainless steel No. 630 or satin chromium-plated No. 626.

C. Keying: Coordinate keying with Owner’s existing system.

D. Coordinate end-of-line resistor code with access control system vendor.

E. Types and Manufacturers:

<table>
<thead>
<tr>
<th>No.</th>
<th>Type Description</th>
<th>Best</th>
<th>Sargent</th>
<th>Schlage</th>
<th>BHMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Mortise entrance lock with lever handle</td>
<td>45H7TA3H</td>
<td>8245-LNJ</td>
<td>L9456P-03</td>
<td>F12, F13</td>
</tr>
<tr>
<td>L2</td>
<td>Electrified mortise entrance lock with lever handle</td>
<td>8271-R03</td>
<td>ETI 24V dc</td>
<td>RX</td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td>Mortise latch with lever handle</td>
<td>45H0N3H</td>
<td>8215-LNJ</td>
<td>L9010-03</td>
<td>F01</td>
</tr>
<tr>
<td>L5</td>
<td>Mortise utility room lock with lever handle</td>
<td>45H7D3H</td>
<td>8204-LNJ</td>
<td>L9080-03</td>
<td>F07</td>
</tr>
<tr>
<td>L8</td>
<td>Mortise privacy lock with lever handle</td>
<td>45H7L3H</td>
<td>8265-LNJ</td>
<td>L9040-03</td>
<td>F19, F22</td>
</tr>
<tr>
<td>L10</td>
<td>Cabinet lock, drawer and door</td>
<td>3L7RD</td>
<td>1654</td>
<td>46-002</td>
<td>E07121</td>
</tr>
</tbody>
</table>

F. Keying:

1. Lock Cylinders: Operate by grand master key system that allows for future expansion.
2. Keylocks: Key new locks into existing Best master key system, as directed by Owner.
3. Keys: Two per lock; tag with schedule information.
4. Master Keys: Four; send by registered mail to Owner.
5. Key cabinet and casework locks into building system.

2.05 CONSTRUCTION KEY SYSTEM

A. Removable construction core system for locks.

B. See Article Manufacturer’s Services under Part 3, Execution.
2.06 CONSTRUCTION KEY SYSTEM

A. Assemble permanent cylinders with construction inserts and ship with all lock sets.

B. Change Keys: Pack in separately identified envelopes and ship.

C. Construction Keys: Pack in cartons marked “packing list” and ship.

D. Construction Insert Extractor Keys, Master Keys, and Grand Master Keys: Ship by registered mail to Owner.

E. On completion of job, deliver construction keys to Owner.

2.07 EXIT DEVICES

A. BHMA A156.3.

B. Furnish fire exit devices at fire-rated doors as shown on Door and Hardware Schedule.

C. Trim:

1. Levers: Sargent ETJ; Von Duprin 03.

D. Finish:

1. Exit Device: Satin chromium-plated No. 626.

E. Types and Manufacturers:

<table>
<thead>
<tr>
<th>No.</th>
<th>Type Description</th>
<th>Sargent</th>
<th>VonDuprin</th>
<th>BHMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>Electrified mortise entrance lock with lever handle</td>
<td>8955-76 ETL 24V dc RX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>Electrified mortise entrance lock with lever handle, surface vertical rod</td>
<td>8955-76 ETL 24V dc RX and 646, 624 strikes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X3</td>
<td>Vertical rod type</td>
<td>8713PRK</td>
<td>9927K</td>
<td>Type 2 08</td>
</tr>
<tr>
<td>No.</td>
<td>Type/Description</td>
<td>Sargent</td>
<td>VonDuprin</td>
<td>BHMA</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>------------</td>
</tr>
<tr>
<td>X4</td>
<td>Vertical rod type for pairs</td>
<td>8713PRK and 8710, 8713ETJ and 8710</td>
<td>9927K and 9927EO, 9927L and 9927EO</td>
<td>Type 2 08 and 01</td>
</tr>
<tr>
<td>X11</td>
<td>Vertical rod type, latch function</td>
<td>8715PRK</td>
<td>9927K-BE</td>
<td>Type 2</td>
</tr>
</tbody>
</table>

2.08 CLOSERS

A. BHMA A156.4.

B. Size closers in accordance with manufacturer’s standards. Mount regular arm closers on pull side of doors. Mount parallel arm closers on push side of doors. On pair of doors provide closer on active leaf only, unless noted otherwise.

C. Finish: Satin chromium-plated No. 626.

D. Types and Manufacturers:

<table>
<thead>
<tr>
<th>No.</th>
<th>Type/Description</th>
<th>LCN</th>
<th>Sargent</th>
<th>BHMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3</td>
<td>Regular arm with hold-open</td>
<td>4010H Series</td>
<td>351-H Series</td>
<td>C02051</td>
</tr>
<tr>
<td>C4</td>
<td>Parallel arm with integral stop</td>
<td>4110 Cush-N-Stop Series</td>
<td>351-PS Series</td>
<td>C02021</td>
</tr>
<tr>
<td>C5</td>
<td>Parallel arm with hold-open</td>
<td>4110H Series</td>
<td>351-PH Series</td>
<td>C02061</td>
</tr>
<tr>
<td>C6</td>
<td>Parallel arm with integral stop and hold-open</td>
<td>4110H Cush-N-Stop Series</td>
<td>351-PSH Series</td>
<td>C02061</td>
</tr>
</tbody>
</table>

2.09 STOPS AND HOLDERS

A. BHMA A156.16.

B. Machine Screws: In threaded anchors at concrete or masonry.

C. Self-Tapping Screws: At stud partitions, wood, or metal mountings.

D. Metal Risers: For mounting at carpet floors.

E. Finish: Satin chromium-plated No. 626.
F. Types and Manufacturers for Each Leaf:

<table>
<thead>
<tr>
<th>No.</th>
<th>Type Description</th>
<th>BBW or GJ</th>
<th>Baldwin</th>
<th>BHMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Floor stop F121X 4086 L02131</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>Wall bumper WC9X 4031 L02241</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>Wall stop-holder W140 4090 L02251</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td>Floor stop-holder F823X 4096 L01371</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S8</td>
<td>Heavy-duty overhead stop GJ79HDS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.10 BOLTS

A. BHMA A156.16.

B. Finish: Bright nickel No. 645.

C. Types and Manufacturers:

<table>
<thead>
<tr>
<th>No.</th>
<th>Type/Description</th>
<th>Stanley</th>
<th>Lawrence</th>
<th>BHMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2</td>
<td>Top and bottom surface bolts</td>
<td>CD4060</td>
<td>283</td>
<td>(L04151)</td>
</tr>
</tbody>
</table>

2.11 KICKPLATES

A. Solid metal, not plated. Bevel four edges.

B. Width of door leaf less than 1-1/2 inches at single leaf and less than 1 inch at pairs.

C. Finish: Satin stainless steel No. 630.

D. Types and Manufacturers: Builders Brass Works, Baldwin, or Cipco as follows:

1. K1 10 inches high by 0.05-inch thick.

2.12 THRESHOLDS

A. Thresholds: One-piece full width of opening; extend beyond jamb where indicated.

B. Provide with stainless steel machine screws in threaded expansion anchors at concrete.

C. Finish: Mill finish aluminum, unless indicated otherwise.
D. Types and Manufacturers:

<table>
<thead>
<tr>
<th>No.</th>
<th>Type Description</th>
<th>Pemko</th>
<th>Reese</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>Saddle (serrated, 4&quot; x 1/4&quot;)</td>
<td>270A</td>
<td>S404A</td>
</tr>
<tr>
<td>T4</td>
<td>Thermal break saddle (6-1/8&quot;)</td>
<td>253XAFG</td>
<td>S473A</td>
</tr>
<tr>
<td>T6</td>
<td>Panic exit saddle</td>
<td>2005AV</td>
<td>S483AV</td>
</tr>
</tbody>
</table>

2.13 WEATHERSTRIP

A. Finish: Clear anodized aluminum, unless indicated otherwise.

B. Seal Types and Manufacturers:

<table>
<thead>
<tr>
<th>No.</th>
<th>Type Description</th>
<th>Pemko</th>
<th>Reese</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>Rubber or vinyl bulb at jambs and head, and at meeting stiles of pairs</td>
<td>S88D</td>
<td>797B</td>
</tr>
<tr>
<td></td>
<td>Door shoe</td>
<td>222AV</td>
<td>DB596AF</td>
</tr>
<tr>
<td>W3</td>
<td>Rubber vinyl bulb at jambs and head, and at meeting stiles of pairs</td>
<td>S88D</td>
<td>797B</td>
</tr>
<tr>
<td></td>
<td>Door bottom with drip</td>
<td>345AV</td>
<td>353A</td>
</tr>
<tr>
<td>W6</td>
<td>Rubber or vinyl bulb at jambs and head, and at meeting stiles of pairs</td>
<td>S88D</td>
<td>797B</td>
</tr>
<tr>
<td></td>
<td>Automatic door bottom</td>
<td>412CRL</td>
<td>320C</td>
</tr>
</tbody>
</table>

2.14 MISCELLANEOUS ITEMS

A. Provide as indicated in Door and Hardware Schedule:

<table>
<thead>
<tr>
<th>M1</th>
<th>Nameplate as specified in Section 10 14 00, Signage, in text noted in Door and Hardware Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>M7</td>
<td>Coordinator:</td>
</tr>
<tr>
<td></td>
<td>GJ</td>
</tr>
<tr>
<td></td>
<td>Ives</td>
</tr>
<tr>
<td></td>
<td>Model</td>
</tr>
<tr>
<td></td>
<td>COR-65</td>
</tr>
<tr>
<td></td>
<td>469</td>
</tr>
</tbody>
</table>
2.15 SILENCERS
   A. Ives, Glynn-Johnson.
   B. At metal frame of each hinged door that does not have seals scheduled.
   C. Three at single leaves and two at pairs.

2.16 NAMEPLATES
   A. Material: Plastic plate; 1/8 inch thick with beveled edges.
   B. Removable adhesive backing.
   C. Types and Manufacturers: Builders Brass Works, Trimco, and as follows:

   | N1 | 2"-high black plate with 1"-high white Helvetica medium letters in text noted in Door and Hardware Schedule |

2.17 TEMPLATES
   A. Fabricate to template hardware applied to metal doors and frames.
   B. Ensure that required templates are furnished to various manufacturers for fabrication purposes.
   C. Templates: Make available not more than 10 days after receipt of approved Hardware Schedule.

2.18 EXIT AND FIRE DOORS
   A. Exit Doors: Always openable from inside by simple turn of lever handle or push on panic bar without use of key or any special knowledge or effort, to include each leaf of door pairs.

2.19 KEY CONTROL SYSTEM
   A. System: Key Control Systems Co., Telkee, Inc., expandable system with 150 (E8351))-key capacity.
B. Cabinet:
   1. Manufacturer’s standard surface mounted cabinet, single-door with continuous hinge, and pin tumbler lock, color as selected from standard colors to match Engineer’s color schedule. Use Telkee AWC 150-S.
   2. Complete system with standard components such as envelopes, transient key tags, reserve key tags, receipts and holders, and card index.

PART 3 EXECUTION

3.01 INSTALLATION
   A. In accordance with manufacturer’s written instructions.
   B. Make Work neat and secure, develop full strength of components, and provide proper function.
   C. Prevent marring, scratching, or otherwise damaging adjacent finishes during hardware installation.
   D. Latchbolts:
      1. Install to engage in strikes automatically, whether activated by closers or manually.
      2. In no case shall additional manual pressure be required to engage latchbolt in strike.
   E. Stops and Holders: Set to allow doors to open as far as possible.
   F. Wall Mounted Hardware: Install over solid structural backing or solid blocking in hollow walls.
   G. Thresholds:
      1. Cope ends neatly to profile of jamb.
      2. Set in sealant and seal ends to jambs.
   H. Key Control System Cabinet: Install where shown.
   I. Hardware: Adjust for easy, noise-free operation.
   J. Replace damaged hardware items.

3.02 MOUNTING DIMENSIONS
   A. Standard Door Hardware Locations: As recommended and published by Door and Hardware Institute, except as noted or detailed otherwise.
B. Door Silencers: Install 3 inches from top and bottom of jamb and 1 inch above strike at single doors, and 3 inches from edges of doors in head for pairs of doors.

C. Nameplates: Attach to doors or walls adjacent to doors 5 feet 6 inches above floor using Phillips head screws at exterior doors and self-sticking removable adhesive at interior doors.

3.03 MANUFACTURER’S SERVICES

A. Deliver permanent lock cores to Site.

B. Remove temporary construction cores and insert permanent cores.

C. Inspect each lock set to ensure permanent cores are operating satisfactorily.

D. Deliver to Owner change and control keys for permanent system.

E. Return temporary construction cores to manufacturer.

F. Furnish manufacturer’s representative for the following services at Site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance, inspection, and Manufacturer’s Certificate of Proper Installation.
2. 1 person-day for functional testing.

3.04 PROTECTION

A. Cover and protect exposed surfaces of hardware during installation and until Substantial Completion.

B. Fit, dismantle, and reinstall finish hardware as required for finish painting work.

C. Protect and prevent staining of hardware during construction in accordance with manufacturer’s recommendations.

D. Remove protective measures and permanent lock cylinders installed prior to final cleaning.

3.05 DOOR AND HARDWARE SCHEDULE

A. Door and Hardware Schedule on Drawings is guide to functional requirements of each opening.
B. Provide finish hardware as scheduled. Sizes omitted shall be as recommended by manufacturer.

3.06 HARDWARE SETS

<table>
<thead>
<tr>
<th>HDW-1:</th>
<th>Double Interior door – fire rated</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Pair butts</td>
<td></td>
<td>H1</td>
</tr>
<tr>
<td>1 Exit device at active leaf</td>
<td></td>
<td>X11</td>
</tr>
<tr>
<td>1 Surface mounted bolts at inactive leaf</td>
<td></td>
<td>B2</td>
</tr>
<tr>
<td>2 Closers</td>
<td></td>
<td>C4</td>
</tr>
<tr>
<td>1 Metal kickplate at active leaf</td>
<td></td>
<td>K1</td>
</tr>
<tr>
<td>1 Threshold</td>
<td></td>
<td>T6</td>
</tr>
<tr>
<td>2 Auto Door Bottoms</td>
<td></td>
<td>W6</td>
</tr>
<tr>
<td>1 Set weatherstrip</td>
<td></td>
<td>W6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HDW-2:</th>
<th>Double Interior door</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Pair butts</td>
<td></td>
<td>H1</td>
</tr>
<tr>
<td>1 Latch</td>
<td></td>
<td>L3</td>
</tr>
<tr>
<td>1 Surface mounted bolts at inactive leaf</td>
<td></td>
<td>B2</td>
</tr>
<tr>
<td>2 Closers</td>
<td></td>
<td>C6</td>
</tr>
<tr>
<td>1 Weatherstrip (for noise reduction)</td>
<td></td>
<td>W6</td>
</tr>
<tr>
<td>2 Metal kickplates</td>
<td></td>
<td>K1</td>
</tr>
<tr>
<td>1 Coordinator</td>
<td></td>
<td>M7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HDW-3:</th>
<th>Double Exterior Entry door, monitored</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Pair butts</td>
<td></td>
<td>H1 and H2</td>
</tr>
<tr>
<td>1 Lock</td>
<td></td>
<td>L1</td>
</tr>
<tr>
<td>1 Surface mounted bolts at inactive leaf</td>
<td></td>
<td>B2</td>
</tr>
<tr>
<td>2 Closers</td>
<td></td>
<td>C5</td>
</tr>
<tr>
<td>1 Metal kickplate at active leaf</td>
<td></td>
<td>K1</td>
</tr>
<tr>
<td>2 OH stops</td>
<td></td>
<td>S8</td>
</tr>
<tr>
<td>1 Threshold</td>
<td></td>
<td>T4</td>
</tr>
<tr>
<td>1 Set weatherstrip</td>
<td></td>
<td>W3</td>
</tr>
<tr>
<td>1 Coordinator</td>
<td></td>
<td>M7</td>
</tr>
</tbody>
</table>
### HDW-4: Double Exterior Entry door, monitored

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Pair butts</td>
<td>H1 and H2</td>
</tr>
<tr>
<td>1 Exit device at active leaf</td>
<td>X4</td>
</tr>
<tr>
<td>1 Surface mounted bolts at inactive leaf</td>
<td>B2</td>
</tr>
<tr>
<td>2 Closers</td>
<td>C4</td>
</tr>
<tr>
<td>1 Metal kickplate at active leaf</td>
<td>K1</td>
</tr>
<tr>
<td>2 OH stops</td>
<td>S8</td>
</tr>
<tr>
<td>1 Threshold</td>
<td>T4</td>
</tr>
<tr>
<td>1 Set weatherstrip</td>
<td>W3</td>
</tr>
<tr>
<td>1 Coordinator</td>
<td>M7</td>
</tr>
</tbody>
</table>

### HDW-5: Single Interior Passage door- fire rated

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2 Pair butts</td>
<td>H1</td>
</tr>
<tr>
<td>1 Exit Device</td>
<td>X11</td>
</tr>
<tr>
<td>1 Closer</td>
<td>C4</td>
</tr>
<tr>
<td>1 Floor stop</td>
<td>S1</td>
</tr>
<tr>
<td>1 Threshold</td>
<td>T1</td>
</tr>
<tr>
<td>1 Set weatherstrip</td>
<td>W6</td>
</tr>
</tbody>
</table>

### HDW-6: Single Interior door- fire rated

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2 Pair butts</td>
<td>H1</td>
</tr>
<tr>
<td>1 Latch</td>
<td>L3</td>
</tr>
<tr>
<td>1 Closer</td>
<td>C4</td>
</tr>
<tr>
<td>1 Threshold</td>
<td>T2</td>
</tr>
<tr>
<td>1 Set weatherstrip</td>
<td>W6</td>
</tr>
<tr>
<td>HDW-7</td>
<td>Single Interior Lockable door</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------</td>
</tr>
<tr>
<td></td>
<td>1-1/2 Pair butts</td>
</tr>
<tr>
<td></td>
<td>1 Lock</td>
</tr>
<tr>
<td></td>
<td>1 Closer</td>
</tr>
<tr>
<td></td>
<td>1 Floor stop</td>
</tr>
<tr>
<td></td>
<td>1 Metal kickplate</td>
</tr>
<tr>
<td></td>
<td>1 Threshold</td>
</tr>
<tr>
<td></td>
<td>1 Nameplate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HDW-8:</th>
<th>Single Restroom door</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-1/2 Pair butts</td>
<td>H1</td>
</tr>
<tr>
<td></td>
<td>1 Privacy lock</td>
<td>L8</td>
</tr>
<tr>
<td></td>
<td>1 Closer</td>
<td>C3</td>
</tr>
<tr>
<td></td>
<td>1 Metal kickplate</td>
<td>K1</td>
</tr>
<tr>
<td></td>
<td>1 Wall bumper</td>
<td>S2</td>
</tr>
<tr>
<td></td>
<td>1 Nameplate</td>
<td>N1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HDW-9:</th>
<th>Single Interior Utility Door</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-1/2 Pair butts</td>
<td>H1</td>
</tr>
<tr>
<td></td>
<td>1 Utility Lock</td>
<td>L5</td>
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Quality Control

Glazing

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Document Review & Approval:

Originator: Mark Sharp, Lead Architect

Design Verification Complete: Stephen J. Silkworth - Quality Control

Approved: W. Laird Ellis, Jr. PE/Design Manager
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

3. ASTM International (ASTM):
   h. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
   i. D2843, Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.

5. Glass Association of North America (GANA):

   a. 100, Procedure for Determining Fenestration Product U-Factors.

   a. 80, Safety Standard for Fire Doors and Other Opening Protectives.
   c. 257, Safety Standard on Fire Test for Window and Glass Block Assemblies.


9. Underwriters Laboratories Inc. (UL):

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Complete schedule of glass and glazing material to be used for each purpose.
   b. Indicate sizes, layout, thicknesses, and loading conditions for glass.

2. Product Data:
   a. Catalog cuts of glazing materials with inclusion of glass edge cutting procedures.
   b. Glass Plastic: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
   c. Glazing Sealants, Compounds, and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.
B. Informational Submittals:

1. Manufacturer’s Certificate of Compliance for each type of glazing, in accordance with Section 01 61 00, Common Product Requirements.
2. Details and methods of glazing for each type of glazing condition; include manufacturer’s recommendations for setting, sealing materials, and installing each type of glazing.

1.03 QUALITY ASSURANCE

A. Preinstallation Meeting: Convene minimum 1 week prior to commencing work of this section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage:

1. Support cases on both sides when stored vertically.
2. After unpacking, place interleaving protection between lites.
3. Keep glass and interleaving dry by storing inside where temperatures are above dewpoint, or if outside storage is necessary, cover glass interleaving with opaque tarpaulins or plastic and inspect periodically. Wet interleaving can stain glass.
4. Avoid exposing stored glass to direct sunlight.

B. Handling:

1. Stack individual lites on edge and lean them against sturdy uprights at a slope of 5 degrees to 7 degrees from vertical.
2. Cushion bottom edges with soft, firm pads free of dirt, grit, glass chips, or other foreign material.

PART 2 PRODUCTS

2.01 GENERAL

A. Single Source Fabrication Responsibility: Fabrication processes, including Low-E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single fabricator.

B. Structural Design: Design in accordance with applicable code for most critical combination of wind, snow, seismic, and dead loads.
C. Roof Loads: Design skylight glazing to resist dead loads.

1. Roof Snow Loads: As calculated in accordance with applicable code and ASCE 7. Ground snow load and exposure as stated in Structural general notes.
2. Dead Loads: Actual weight of materials incorporated into Work.

D. Wind Loads: Design and size glass to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.

1. Design Wind Load: As calculated in accordance with applicable code and ASCE 7 with loads as stated in Structural general notes.
2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.
3. Exterior Glass Deflection: Maximum of $1/175$ of glass edge length or $3/4$ inch (19 mm), whichever is less with full recovery of glazing materials.
4. Interior Glass Deflection: Maximum differential deflection for two adjacent unsupported edges when 50 plf (730 N/m) force is applied to one panel at any point up to 42 inches (1067 mm) above finished floor less than thickness of glass.
5. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
   a. U-Values: NFRC 100.

E. Fire Rated:

1. Door Glazing: Tested in accordance with one of the following and complying with NFPA 80.
   a. NFPA 252; with neutral pressure level at 40 inches (1015 mm) maximum above sill at 5 minutes into test.
   b. UL 10C.
2. Apply label from agency approved by authority having jurisdiction to identify each fire rated glass lite.

F. Light Transmitting Plastics:

1. Acrylic Dome: Extruded sheet, high impact acrylic, triple layer. White frosted top layer with UV protection, clear middle and bottom layers.
2. Light Transmissions: ASTM D-1003, 91 percent at 0.177 thickness.
4. Impact Strength:
   a. ASTM D-256 (IZOD).
   b. 1.2 at 73 degrees F and 0.5 at 0 degrees F.

5. Smoke Developed Index: Maximum 450 when tested in accordance with ASTM E84 or maximum 75 when tested in accordance with ASTM D2843 in thickness for intended use.

2.02 FLOAT GLASS MATERIALS

A. Annealed Glass:
   1. ASTM C1036, Type 1 transparent flat, Quality Q3, float glass.
   2. Furnish annealed glass except where heat strengthened or tempered glass is required to meet specified performance requirements.

B. Heat Strengthened Glass:
   1. ASTM C1048, Type 1 transparent flat, Quality Q3, Kind HS heat strengthened, Condition A uncoated, float glass.
   2. Furnish heat strengthened glass where annealed glass cannot meet specified performance requirements.

C. Tempered Glass:
   1. ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering.
   2. Furnish tempered glass where heat strengthened glass cannot meet specified performance requirements.
   3. Conforming to CPSC 16 CFR 1201 Category II at locations where safety glass is required by applicable code.

2.03 FLOAT GLASS PRODUCTS

A. Clear Glass:
   1. Annealed (FG-CA or Tempered (FC-CT) float glass as specified; Class 1 clear.

B. Low E Glass:
   1. Annealed, clear (FG-ECA) or Tempered, clear (FG-ECT) float glass as specified.
5. Solar Heat Gain Coefficient: 0.44 maximum.

C. Manufacturers:

1. ACH Glass Operations.
2. AFG Industries, Inc.
3. Guardian Industries Corp.
4. Oldcastle Glass.
5. Viracon.
7. PPG.

2.04 FIRE RESISTIVE GLASS PRODUCTS

A. Fire Resistive Ceramic Glass:

1. Transparent unpolished on both surfaces. Clear ceramic safety glass (FRSC).
2. Thickness: Manufacturer’s standard.
4. Safety Glazing: Comply with CPSC 16 CFR 1201 Category II.
5. Product: Super Lite X-60 manufactured by Saftifirst, or approved equal.

2.05 INSULATING GLASS PRODUCTS

A. Insulating Glass:

1. ASTM E2190, certified by Insulating Glass Certification Council; with glass elastomer edge seal; place reflective film within unit; purge interpane space with dry hermetic air.
2. Total Unit Thickness: 1-inch.
3. Insulating Glass Unit Edge Seal Construction: Aluminum thermally broken, bent and soldered corners.
4. Insulating Glass Unit Edge Seal Material: black color.

B. Double Pane Insulating Vision Glass (IG-DP):

1. Total Unit Thickness: 1 inch.
2. Outer Pane: Glass Type clear.
3. Inner Pane: Glass Type tempered.
4. Product: Sungate 400 clear, manufactured by PPG, or approved equal.
5. U-Factor Winter: 0.32 maximum.
6. U-Factor Summer: 0.31 maximum.
7. Solar Heat Gain Coefficient: 0.44 maximum.
8. UV Transmittance: 28 percent maximum.
10. Solar Transmittance: 51 percent maximum.

2.06 PLASTIC GLAZING PRODUCTS

A. Acrylic Sheet as specified in Section 08 60 00, Skylights.

2.07 GLAZING SEALANTS

A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, insulating glass seals, and glazing channels.

1. Silicone Glazing Sealant:
   a. ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component; chemical curing; capable of water immersion without loss of properties; nonbleeding, nonstaining, cured Shore A Hardness Range 15 to 25.
   b. Color: black, or to match adjacent window material.
   c. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   d. Product: Refer to Section 07 92 00, Joint Sealants.
   e. Polyurethane Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component, chemical curing, nonstaining, nonbleeding, Shore A Hardness Range 20 to 35.
   f. Color: To match adjacent window material.
   g. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   h. Product: Refer to Section 07 92 00, Joint Sealants.

B. Preformed Glazing Tape:

   1. Size to suit application.
   2. Preformed butyl compound; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
   3. Butyl Corner Sealant: ASTM C920 single component non-skinning butyl compatible with glazing tape; color to match tape.

2.08 GLAZING ACCESSORIES

A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by
width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3-inch (75-mm) long by one half the height of glazing stop by thickness to suit application, self-adhesive on one face.

C. Glazing Clips: Manufacturer's standard type.

PART 3  EXECUTION

3.01  EXAMINATION

A. Verify openings for glazing are correctly sized and within acceptable tolerance.

B. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear and ready to receive glazing.

3.02  PREPARATION

A. Do not perform glazing work in damp, foggy, or rainy weather, or when temperatures are not within range recommended by GANA "Glazing Manual".

B. Surfaces:
   1. Smooth, even, sound, dry, and clean.
   2. Clean contact surfaces with solvent and wipe dry.

C. Priming:
   1. Complete and cured.
   2. Prime surfaces scheduled to receive sealant.

D. Measure size of frames to receive glass and compute actual glass size allowing for edge clearances.

E. Use fire rated glass in glazed openings in labeled fire doors and tempered glass in other doors.

F. Do not proceed with glazing until unsatisfactory conditions have been corrected.
3.03 GLAZING INSTALLATION

A. General: Follow recommendations of glass manufacturer GANA “Sealant Manual, GANA “Glazing Manual” and the following:

2. Fire Rated Openings: Comply with NFPA 80.

B. Interior Dry Method (Tape and Tape) Installation:

1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
2. Place setting blocks at 1/3 points with edge block no more than 6 inches (150 mm) from corners.
3. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
4. Place glazing tape on free perimeter of glazing in same manner described above.
5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

C. Interior Wet/Dry Method (Tape and Sealant) Installation:

1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
2. Place setting blocks at 1/3 points with edge block no more than 6 inches (150 mm) from corners.
3. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
4. Install removable stops, spacer shims inserted between glazing and applied stops at 24-inch (600-mm) intervals, 1/4 inch (6 mm) below sight line.
5. Fill gaps between pane and applied stop with elastomeric glazing sealant to depth equal to bite on glazing, to uniform and level line.
6. Trim protruding tape edge.

D. Interior Wet Method (Compound and Compound) Installation:

1. Install glazing resting on setting blocks.
2. Install applied stop and center pane by use of spacer shims at 24-inch (600-mm) centers, kept 1/4 inch (6 mm) below sight line.
3. Locate and secure glazing pane using spring wire clips.
4. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.
3.04 CLEANING
A. Leave glass and glazing in undamaged condition and ready for final cleaning.
B. Remove excess glazing compound from installed glass.
C. Remove labels from glass surface at time of final cleaning.
D. Wash and polish both faces of glass.
E. Clean adjacent surfaces of glass.

3.05 PROTECTION OF COMPLETED WORK
A. Protection:
   1. Keep glass free from contamination by materials capable of staining glass.
   2. Install tape across lights secured to frames or structure.
   3. No tape or marking allowed on glass.
B. Replacements and Repairs: Prior to Substantial Completion, replace broken, defective, or scratched glass and repair damaged compounds.

END OF SECTION
### Specification Title & Description

(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Louvers and Vents

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### Document Review & Approval

**Originator:**

Mark Sharp, Lead Architect

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.

Date: 2017.06.23 10:31:49 -06'00'
PART 1  GENERAL

1.01  REFERENCES

A. The following is a list of standards which may be referenced in this section:

3. ASTM International (ASTM):

1.02  DESIGN REQUIREMENTS

A. Installed Louvers: Capable of resisting wind load of 30 pounds per square foot.

1.03  SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Large scale details of louvers, anchorage, and relationship to adjoining construction.
   a. Manufacturer’s Literature:
      1) Descriptive and performance data of louvers, including standard drawings and louver-free area.
   2. Samples: Manufacturer’s standard finishes and colors.

B. Informational Submittals:

1. Factory test data.
2. Certificates of AMCA ratings.
3. Installation instructions.
4. Parts list, if applicable.
5. Maintenance procedures.

PART 2 PRODUCTS

2.01 GENERAL

A. Nonacoustical louver sizes are based on 50 percent free area and 800 fpm maximum velocity through free area. If louvers furnished do not meet these parameters, Contractor is responsible for resizing louvers and wall openings, and for making other adjustments to allow for larger openings.

B. Water Penetration Rate: No greater than 0.02 ounce per square foot.

C. Louvers: Rated and tested in accordance with AMCA 500-L.

D. Furnish louvers with interior duct collars.

2.02 FIXED DRAINABLE LOUVER (TYPE DB)

A. Frame: Extruded aluminum channel, 0.081-inch thick, 6 inches deep, interior duct collar, concealed mullions.

B. Blades: Extruded aluminum, minimum 0.081-inch thick, 35-degree to 45-degree pitch angles, with integral front drain gutter, spaced 3 inches to 4 inches on center.

C. Pressure Loss: AMCA certified rating of no greater than 0.10-inch WC.

D. Sizes: As scheduled.

E. Screen: Inside mounted, painted aluminum, 1/2-inch mesh.

F. Finish: Kynar 500 fluorocarbon coating in color as scheduled or selected.

G. Manufacturers and Products:

1. Construction Specialties; Model A6097.
2. Ruskin; Model ELF6375DX.

2.03 ACCESSORIES

A. Anchors and Fasteners: Stainless steel.

B. Flashings: Match louver frame.
C. Isolation Tape: Tremco 440, 3M EC1202, or Presstite 579.6.

D. Isolation Paint: ASTM D1187, bituminous coating.

2.04 SOURCE QUALITY CONTROL

A. Factory Performance Tests:
   1. Airflow versus pressure loss.
   2. Rain penetration data.
   3. Air infiltration leakage through closed operating louvers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check openings to ensure dimensions conform to Drawings.

B. Ensure openings are free of irregularities that would interfere with installation.

C. Do not install louvers until defects have been corrected.

3.02 INSTALLATION

A. Install louvers as shown on reviewed Shop Drawings. Coordinate with heating or ventilation ductwork to be connected.

B. Follow procedures in manufacturer’s recommended installation instructions.

C. Separate aluminum from other metals with isolation tape or paint.

3.03 CLEANING

A. After erection, protect exposed portions from damage by machines, paint, lime, acid, cement, or other harmful compounds.

B. Remove protective materials and clean with plain water, water with soap, or household detergents.

END OF SECTION
Nonstructural Metal Framing

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**Document Review & Approval:**

- **Originator:**
  - Mark Sharp, Lead Architect
  - Signature: [Signature]
  - Date: 6/22/2017

- **Design Verification Complete:**
  - Stephen J. Silkworth - Quality Control
  - Signature: [Signature]
  - Date: 6/22/2017

- **Approved:**
  - W. Laird Ellis, Jr. PE/Design Manager
  - Signature: [Signature]
  - Date: 2017.06.23 10:34:09 -06'00'
PART 1    GENERAL

1.01 REFERENCES

   A. The following is a list of standards that may be referenced in this section:

       1. ASTM International (ASTM):
          a. C645, Standard Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

1.02 SUBMITTALS

   A. Action Submittals:

      1. Shop Drawings:
         a. Seismic anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.

   B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.03 DELIVERY, STORAGE, AND HANDLING

   A. Deliver materials to Site in manufacturer’s original, unopened, undamaged containers, with labels intact clearly indicating manufacturer and material.

   B. Storage:

      1. Store materials inside, under cover, stacked flat, off floor.
      2. Avoid overloading floor system of storage area.

PART 2    PRODUCTS

2.01 MANUFACTURERS

   A. National Gypsum Company; Gold Bond.

   B. Clark Dietrich Building Systems.

   C. Dale/Incor.
D. G-P Gypsum Corporation.
E. United States Gypsum Company.

2.02 MATERIALS

A. Furnish materials from a single manufacturer.

B. Studs, Tracks, Furring Channels, and Accessories:
   1. ASTM C645.
   2. 25- and 20-gauge galvanized steel C-studs with 1-5/8-inch flanges and ancillary items.
   3. Sizes as shown on Drawings.
   4. Furnished curved tracks where required for curved wall surfaces.

C. Carrying Channels: Cold-rolled steel, 16-gauge, free of rust, coated with factory-applied rust-inhibitive paint, 1-1/2 inches deep, weighing not less than 475 pounds per 1,000 linear feet.

D. Furring Channels: Roll-formed hat shaped section of 25-gauge galvanized steel with a face width of 1-3/8 inches and a depth of 7/8 inch. Provide 16-gauge channels at Treatment building perimeter.


F. Resilient Furring Channels:
   1. Roll-formed section of 25-gauge galvanized steel with face width of 1-1/2 inches designed for resilient attachment of gypsum board to framing.
   2. Manufacturers and Products:
      a. United States Gypsum; RC-1 channel.
      b. Gold Bond; resilient channels.

G. Z Furring Channels: U.S. Gypsum or Gold Bond.

PART 3 EXECUTION

3.01 ERECTION

A. Preparation: Provide, install, and maintain necessary scaffold, staging, trestles, planking, and temporary heating, lighting, and ventilation as necessary for the duration of the gypsum board work.

B. Field Measurements: Take and record measurements before fabrication of assemblies.
C. Layout: Align partitions as shown on the Drawings.

D. Tracks:
   1. Attach metal runner tracks to floor slabs with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC.
   2. Attach tracks to suspended ceiling with toggle or molly bolts spaced 24 inches OC.

E. Studs and Other Framing:
   1. ASTM C754.
   2. Following manufacturer’s printed instructions, position studs vertically, engaging floor and ceiling tracks and spaced as noted on Drawings.
   4. Place in direct contact with doorframe jambs, abutting partitions, and partition corners. Provide for anchorage of doorframes to studs.
   5. Anchor all studs for shelf-walls and those adjacent to window and doorframes, partition intersections, and corners to ceiling and floor runner flanges. Securely anchor studs to jamb and head anchor clips of door or borrowed-light frames by bolt or screw attachment.
   6. Over metal door and borrowed-light frames, place horizontally a cut-to-length section of runner, with a web-flanged bend at each end, and secure with one positive attachment per flange. Position a cut-to-length stud (extending to ceiling runner) at vertical panel joints over doorframe header.
   7. Locate studs at abutting construction, partition intersections, and partition corners.
   8. Spacing: 16 inches OC, unless otherwise required by manufacturer.
   9. Doorframes and Cased Openings:
      a. Full height double studs, No. 20-gauge minimum, secured to jamb anchors by bolts, screws, or welds.
      b. Header Track: Secure to frame head anchors and double studs.
      c. Provide double channel stiffeners through studs above frame and extend at least one stud space beyond each jamb.
   10. Windows: Similar framing to door openings with stiffeners both above and below.
   11. Wall Mounting Accessories: Provide channels, horizontal studding, No. 16-gauge sheet 8 inches by 2 inches greater than stud spacing, or other members within walls as required to provide secure and adequate support.
F.  Furring:

1.  Space furring channels the same as studs or as shown.
2.  Around columns and beams construct furring as shown using metal studs and furring channels securely tied together and anchored in-place.
3.  Attach resilient furring channels to wood framing with screws.

G.  Leave framing, plumb, aligned, securely anchored, braced, and ready to receive gypsum board.

END OF SECTION
Quality Control

W. Laird Ellis, Jr.
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Document Review & Approval:

Originator: Mark Sharp, Lead Architect

Design Verification Complete: Stephen J. Silkworth - Quality Control

Approved: W. Laird Ellis, Jr.
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   i. C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
   m. C1396/C1396M, Standard Specification for Gypsum Board.


s. E413, Classification for Rating Sound Insulation.


2. Gypsum Association (GA):

   a. 214, Recommended Levels of Gypsum Board Finish.

   b. 216, Application and Finishing of Gypsum Panel Products.


1.02 SUBMITTALS

A. Action Submittals:

   1. Control joint pattern proposed for gypsum board.

   2. Manufacturer’s list of items and materials proposed for use, with descriptive literature for each system used.

1.03 QUALITY ASSURANCE

A. General: Regardless of the minimum specifications herein, utilize materials and applications recommended by manufacturer.

B. Applicator’s Qualifications: Use only workers regularly employed in this type of work who can show experience in application of similar materials and specific systems specified.

C. Single Source Responsibility: Use gypsum board and related joint treatment materials from a single manufacturer for each type used.

D. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested in the assembly indicated or scheduled on Drawings, according to UL Fire Resistance Directory or in listing of other testing agencies acceptable under local building code.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver fire-rated materials bearing testing agency label and required fire classification numbers.

B. Storage:

   1. Store materials inside, under cover, stacked flat, off floor.

   2. Stack gypsum board so that long lengths are not over short lengths.

   3. Avoid overloading floor system of storage area.
4. Store adhesives and finishing compounds in dry areas; protect against freezing at all times.

1.05 ENVIRONMENTAL CONDITIONS

A. Temperature: In areas receiving gypsum board installation, maintain minimum temperature of 40 degrees F for 48 hours before, during, and after gypsum board application. Maintain minimum temperature of 50 degrees F for 48 hours before, during, and after application of adhesive methods of attachment and finishing compounds until drying is complete.

B. Ventilation:
   1. Provide ventilation during and following adhesives and joint treatment applications.
   2. Use temporary air circulators in enclosed areas lacking natural ventilation.
   3. Under slow drying conditions, allow additional drying time between coats of joint treatment.
   4. Protect installed materials from drafts of ambient air during hot, dry weather.
   5. Protect materials from drying too rapidly during hot and dry weather.

PART 2 PRODUCTS

2.01 GYPSUM BOARD

A. Fire-Rated Board (GWBX): ASTM C1396/C1396M, Type X, moisture resistive 5/8-inch thick with tapered edges.

B. Glass-Mat Gypsum Sheathing Board (GMSB):
   1. ASTM C1177/C1177M.
   3. 1/2-inch thick as base material for roof insulation. 5/8-inch thick for wall application.

C. Abuse Resistant Board (ARWB): ASTM C1396/C1396M, Type X, 5/8-inch thick as manufactured by:
   1. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.
   3. Up to 8 feet 0 inches above slab as shown on Drawings.
2.02 FASTENERS

A. Gypsum Board:

   a. Type S, 1 inch long for gypsum board to sheet metal.

2.03 JOINT TREATMENT MATERIALS

A. Tape:

2. Soffit Board, Glass Mesh Mortar Units, and Cementitious Backer Board: 2-inch wide 10 by 10 open weave glass mesh tape as recommended by manufacturer.

B. Compound:

2. Water-Resistant GWB and Soffit Boards: Chemically curing, polyindurate type material as recommended by manufacturer.

2.04 ANCILLARY MATERIALS

A. Adhesives: As recommended by gypsum board manufacturer for intended use. Use adhesives that have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 TRIM ACCESSORIES

A. ASTM C1047, Zinc-Coated Metal.

B. Manufacturers and Products:

1. Corner Bead:
   a. 1-1/4 inches by 1-1/4 inches:
      1) United States Gypsum; Dur-A-Bead.
      2) Gold Bond; standard corner beads.

2. Edge Trim:
   a. United States Gypsum; 200B metal trim.
   b. Gold Bond; No. 200 casing bead.

3. Metal Control Joint:
   a. United States Gypsum; No. 093.
   b. Gold Bond; E-Z strip control joint.
2.06 LIGHT-GAUGE METAL FRAMING ACCESSORIES

A. Cold-Rolled Carrying Channel: Cold-rolled steel, 16-gauge metal with minimum 1/2-inch wide flange, free of rust and coated with factory-applied rust-inhibitive paint, 1-1/2 inches deep.

B. Cold-Rolled Bridging Channel: Cold-rolled steel, 16-gauge metal with minimum 1/2 inch wide flange free of rust and coated with factory-applied rust-inhibitive paint, galvanized 1-1/2 inches deep.

C. Cold-Rolled Furring Channel: Cold-rolled steel, 25-gauge metal with minimum 1/2-inch wide flange, free of rust and coated with factory-applied rust-inhibitive paint, 3/4 inches deep.

D. Resilient Furring Channels: Roll-formed section of 25-gauge galvanized steel with face width of 1-1/2 inches designed for resilient attachment of gypsum board to framing.

2.07 SPRAY TEXTURE

A. Manufacturers and Products:
   1. Aggregate Finish:
      a. National Gypsum Company; ProForm Spray Quick.
      b. United States Gypsum Company; Ceiling Spray Texture.

B. Manufacturers and Products:
   1. Nonaggregate Finish:
      a. National Gypsum Company; ProForm Perfect Spray EM/HF.
      b. United States Gypsum Co.; SHEETROCK Wall and Ceiling Spray Texture (unaggregated).

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect surfaces to receive gypsum board and related materials before beginning work and report to Engineer any defects in such work which will adversely affect the quality of work specified herein.

3.02 PREPARATION

A. General: Provide, install, and maintain necessary scaffold, staging, trestles, planking, and temporary heating, lighting, and ventilation as necessary for duration of gypsum board work.

B. Protection: Protect work of other trades.
C. Coordination:
   1. Coordinate work with that of other trades. Check specifications and drawings of other trades to determine parts of work requiring coordination.
   2. Cut and repair gypsum board systems for installation of omitted work.

D. Surface Preparation: Repair defective surfaces prior to starting work. Prepare as specified for application of specific materials.

3.03 ERECTION OF LIGHT-GAUGE NONSTRUCTURAL METAL FRAMING

A. Layout: Align partitions as shown on Drawings.

B. Tracks:
   1. Attach metal runner tracks to floor slabs with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC.
   2. Where partitions terminate at suspended or framed ceilings attach top tracks to suspended ceiling with toggle or molly bolts spaced 24 inches OC.
   3. Where partitions terminate at underside of concrete or metal decking attach deflection channels to substrate with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC. Locate partition top tracks within deflection channels with a minimum top clearance of 1 inch. Do not attach track to channel.

C. Studs:
   1. ASTM C754.
   2. Following manufacturer’s printed instructions, position studs vertically, engaging floor and ceiling tracks and spaced as noted on Drawings.
   3. Splice: When necessary, use 8-inch nested lap and one positive attachment per stud flange.
   4. Place in direct contact with doorframe jambs, abutting partitions, and partition corners. Provide for anchorage of doorframes to studs.
   5. Anchor studs for shelf-walls and those adjacent to window and doorframes, partition intersections, and corners to ceiling and floor runner flanges. Securely anchor studs to jamb and head anchor clips of door or borrowed-light frames by bolt or screw attachment.
   6. Over metal door and borrowed-light frames, place horizontally a cut-to-length section of runner, with a web-flanged bend at each end, and secure with one positive attachment per flange. Position a cut-to-length stud (extending to ceiling runner) at vertical panel joints over doorframe header.
   7. Locate studs at abutting construction, partition intersections, and partition corners.
   8. Spacing: At 16 inches OC, unless otherwise required by manufacturer.
9. At Doorframes and Cased Openings:
   a. Full height double studs, No. 20 gauge minimum, secured to jamb anchors by bolts, screws, or welds.
   b. Header Track: Secure to frame head anchors and double studs.
   c. Provide double channel stiffeners through studs above frame and extend at least one stud space beyond each jamb.
10. Windows: Similar framing to door openings with stiffeners both above and below.
11. Wall Mounting Accessories: Provide channels, horizontal studding, No. 16 gauge sheet 8 inches by 2 inches greater than stud spacing, or other members within walls as required to provide secure and adequate support.

D. Furring:

   1. Space furring channels the same as studs or as shown.
   2. Around columns and beams construct furring as shown using metal studs and furring channels securely tied together and anchored in-place.
   3. Attach resilient furring channels to wood framing with screws.

3.04 APPLICATION OF GYPSUM BOARD

A. Inspection and Preparation:

   1. Check framing for accurate spacing and alignment.
   2. Verify spacing of installed framing does not exceed maximum allowable for thickness of gypsum board to be used.
   3. Verify frames are set for thickness of gypsum board to be used.
   4. Do not proceed with installation of gypsum board until deficiencies are corrected and surfaces to receive gypsum board are acceptable.
   5. Repair protrusions of framing, twisted framing members, or unaligned members before installation of gypsum board is started.

B. General:

   1. Meet requirements of ASTM C840 and GA 216.
   2. Joints: Use gypsum board of maximum lengths to minimize end joints. Stagger end joints when they occur. Locate end joints as far as possible from center of wall or ceiling. Abut gypsum board without forcing. Neatly fit ends and edges of gypsum board. Do not place butt ends against tapered edges.
   3. Support ends and edges of gypsum board panels on framing or furring members except for face layer of double layer and where ends are back blocked and floated.
   4. Use metal edge trim where gypsum board abuts another material, at corners, and where shown or noted on Drawings.
   5. Follow manufacturer’s recommendation of good practice.
C. Over Framing:

1. Apply gypsum board first to ceiling and then to walls for single layer horizontal application.
2. Use vertical application for fire-rated walls.
3. Fasten gypsum board securely to framing using double nailing, screw, or adhesive method.

3.05 JOINT SYSTEM FOR GYPSUM WALLBOARD

A. Interior Gypsum Board: Conform to ASTM C840.

B. Required: On exposed gypsum board, under ceramic tile and wall covering, and behind casework.

C. Prefill: Fill V-grooves formed by abutting rounded edges of gypsum board with prefill joint compound. Fill V-joint flush and remove excess compound beyond groove. Leave clear depression to receive tape. Permit prefill joint compound to harden prior to application of tape.

D. Taping and Finishing Joints:

1. Taping or Embedding Coat: Apply compound in thin, uniform layer to joints and angles to be reinforced. Apply reinforcing tape immediately. Center tape over joint and seat tape into compound. Leave approximately 1/64-inch to 1/32-inch compound under tape to provide bond. Apply skim coat immediately following tape embedment but not to function as fill or second coat. Fold tape and embed in angles to provide true angle. Dry embedding coat prior to application of fill coat.

2. Filling Coat: Apply joint compound over embedding coat. Fill taper flush with surface. Apply fill coat to cover tape. Feather out fill coat beyond tape and previous joint compound line. For joints with no taper, feather out at least 4 inches on either side of tape. Do not apply fill coat on interior angles. Allow fill coat to dry prior to application of finish coat.

3. Finishing Coat: Spread joint compound evenly over and beyond fill coat on joints. Feather to smooth uniform finish. Apply finish coat to taped angles to cover tape and taping compound. Sand final application of compound to provide surface ready for decoration.

4. Filling and Finishing Depressions: Apply joint compound as first coat to fastener depressions. Apply at least two additional coats of compound after first coat is dry. Leave filled and finished depressions level with plane of surface.
E. Finishing Beads and Trim:

1. First Fill Coat: Apply joint compound to bead and trim. Feather out from ground to plane of the surface. Dry compound prior to application of second fill coat.
2. Second Fill Coat: Apply joint compound in same manner as first fill coat. Extend beyond first coat onto face of gypsum board. Dry compound prior to application of finish coat.
3. Finish Coat: Apply joint compound to bead and trim. Extend beyond second fill coat. Feather finish coat from ground to plane of surface. Sand finish coat to provide flat surface ready for decoration.

3.06 FINAL FINISHES FOR GYPSUM WALLBOARD

A. Levels of Finish: Conform to GA 214.

B. Level 1:

1. Taping or embedding coat only.
2. Use in concealed areas, and where indicated, unless a higher level is required for fire-resistive or sound-rated assemblies.

C. Level 2:

1. Taping, filling, and finishing coats.
2. Use on water-resistant gypsum backing board.

D. Level 3:

1. Taping, filling, and finishing coats.
2. Use on surfaces indicated to have spray texture or ceramic tile.

E. Level 4:

1. Taping, filling, and finishing coats plus two separate coats applied over joints, angles, fastener heads, and trim accessories.
2. Sand between coats and after last coat.
3. Use on surfaces indicated to receive wall coverings.

3.07 SPRAY TEXTURE

A. Application:

1. Apply on gypsum board wall surfaces, except behind ceramic tile and wall covering, following manufacturer’s printed directions for a medium build orange peel texture.
2. Before texture application, finish gypsum board as specified for Level 3.
3. When surfaces are prepared and dry, apply sealer and allow to dry. Mix texture finish material as directed by manufacturer.
4. Use spray equipment of a size and type to assure acceptable results.
5. Apply by spray only at a coverage rate as recommended by manufacturer and in accordance with directions printed on container. Apply material to blend uniformly and cover fully without starved spots or other evidence of thin application. Provide uniform texture without application patterns.

3.08 ADJUST AND CLEAN

A. Clean: Remove droppings or texture overspray from walls, windows, and floor, leaving room clean for following trades.

B. Nail Pop: Repair nail pop by driving new nail approximately 1-1/2 inches from nail pop and reseat nail. When face paper is punctured, drive new nail or screw approximately 1-1/2 inches from defective fastening and remove defective fastening. Fill damaged surface with compound.

C. Ridging:

1. Do not repair ridging until condition has fully developed, approximately 6 months after installation or one heating season.
   a. Sand ridges to reinforcing tape without cutting through tape.
   b. Fill concave areas on both sides of ridge with topping compound.
   c. After fill is dry, blend in topping compound over repaired area.

2. Fill cracks with compound and finish smooth and flush.

END OF SECTION
**Quality Control**

W. Laird Ellis, Jr.  
Digitally signed by W. Laird Ellis, Jr.  
Date: 2017.06.23 10:38:44 -06'00'

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**Revision History:**

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**Document Review & Approval:**

**Originator:**

Mark Sharp, Lead Architect  

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control  

**Approved:**

W. Laird Ellis, Jr.  
Digitally signed by W. Laird Ellis, Jr.  
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SECTION 09 51 23
ACOUSTICAL TILE CEILINGS

PART 1   GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
   d. E1264, Standard Classification for Acoustical Ceiling Products.


1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Detailed layout of grid indicating hanger spacing, fastening and splicing details, change in level details, and access location.
   b. Seismic anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer’s recommendation for installation of system.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials with manufacturer’s labels indicating brand name, pattern, size, thickness, and fire rating.

B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Where acoustical materials are to be installed, maintain humidity of 65 percent to 75 percent in area for 25 hours before, during, and 25 hours after installation.
B. Maintain a uniform temperature of 55 degrees F to 70 degrees F during installation of materials.

1.05 EXTRA MATERIAL
A. Provide acoustical units from same production run as installed equal to 1 percent of area.

PART 2 PRODUCTS

2.01 SUSPENSION SYSTEMS
A. Components, Materials, and Accessories: Product of a single manufacturer.
B. ASTM C635/C635M, Intermediate Duty:
   1. Main and Cross Members:
      a. DX or DXL type.
      b. Single web design, cold-rolled steel, minimum thickness of 0.020 inch, electrozinc-coated and factory-painted low-sheen satin white finish.
      c. Exposed Flange Width: 15/16 inch.
   2. Edge Molding:
      a. Minimum 0.020-inch steel, channel- or angle-shaped.
      b. Flange Width: 15/16 inch, minimum.
      c. Finish to match main members.
   5. Furnish manufacturer’s hold down clips and accessories required for a complete system incorporating seismic loads indicated in General Structural Notes on Drawings.

2.02 ACOUSTICAL UNITS
A. Flat Lay-In Panels:
   1. Material: Fire-resistive mineral fiber, Class A.
   2. In accordance with ASTM E1264, Type III, Form 2.
   4. Noise Reduction Coefficient (NRC): 0.55 to 0.65.
   5. Ceiling Attenuation Class (CAC): 35 minimum.
   6. Light Reflectance: LR 0.75 or over.
10. Manufacturers and Products:
   a. Armstrong; Item 704, Cortega beveled tegular.
   b. U.S.G.; Item 8223, Astro for DX/DXL grid.

PART 3 EXECUTION

3.01 SEQUENCING

A. Lay out grid.

B. Coordinate with mechanical and electrical equipment in framing and cutting material around ceiling penetrations.

C. Install suspension systems after mechanical work above is complete.

D. Install acoustical units.

3.02 INSTALLATION OF SUSPENDED GRID SYSTEM

A. Hang level and in straight alignment directly from structure following ASTM C636/C636M and manufacturer’s current printed instructions.

B. Hanger Wires:
   1. Space maximum 4 feet on center each direction and securely attach to structure above.
   2. Install additional hangers at ends of each suspension member and at light fixtures, 6 inches from vertical surfaces.
   3. Do not splay wires more than 5 inches in a 4-foot vertical drop.
   4. Provide four-way wire splays at 45 degrees from main runner to support structure for every 144 square feet of ceiling area.
   5. Wrap wire minimum three times horizontally, turning ends upward.
   6. Where hanger wires cannot be hung vertically from structure above because of ducts, pipes, cable trays, or other interferences, provide steel channel trapezes (minimum 2-inch deep, 16-gauge cold-rolled carrying channels) hung on steel rods or 8-gauge wire from structural members above. Hang ceiling wires from these trapezes or similar members supporting ducts or pipes. Do not hang directly from ducts or pipes.
   7. Follow suspension system manufacturer’s instructions for modified installation required for seismic loads indicated in General Structural Notes on Drawings.
   8. Support lay in light fixtures with two wires to structure.

C. Edge Molding:
   1. Install at intersection of suspended ceiling and vertical surfaces.
   2. Miter corners where moldings intersect or install corner caps.
   3. Attach to vertical surface with mechanical fasteners.
D. Provide additional channels, hangers, and trapezes as required to support edges of ceiling around and under mechanical and electrical work.

3.03 INSTALLATION OF ACOUSTICAL UNITS

A. Upon completion of suspended grid system and other concealed work, install with pattern running in one direction.

B. Place material to bear all around on suspension members.

3.04 CLEANING

A. Clean soiled or discolored unit surfaces after installation.

B. Touch up scratches, abrasions, voids, and other defects in painted surfaces.

3.05 SCHEDULE OF CEILING TYPES

A. Areas to Receive Acoustical Ceilings: As indicated on Interior Finish Schedule and where shown on Drawings.

END OF SECTION
### Specification Title & Description:
(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Resilient Flooring

### Revision History:

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### Document Review & Approval:

**Originator:**

Mark Sharp, Lead Architect

NAME/POSITION

_SIGNATURE_ 6/22/2017 DATE

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control

NAME/POSITION

_SIGNATURE_ 6/22/2017 DATE

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

_SIGNATURE_ Digitally signed by W. Laird Ellis, Jr.

_DATE_ 2017.06.23 10:41:08 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   e. F1344, Standard Specification for Rubber Floor Tile.
   h. F1861, Standard Specification for Resilient Wall Base.

1.02 SUBMITTALS

A. Informational Submittals:

1. Operation and Maintenance Data:
   a. As specified in Section 01 78 23, Operation and Maintenance Data.
   b. List of recommended maintenance products, methods, and procedures.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Store materials in original containers at not less than 70 degrees F ambient temperature for not less than 24 hours immediately before installation.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature in space to receive flooring between 70 and 90 degrees F for not less than 24 hours before and 48 hours after installation.

B. Maintain minimum temperature of 55 degrees F after flooring is installed, except as specified above.
1.05 EXTRA MATERIALS
   A. Furnish additional floor covering materials from same production run as
      installed material at the rate of 45 square feet for each 1,000 square feet.

1.06 SEQUENCING AND SCHEDULING
   A. Do not install floor coverings until concrete slab has cured for 60 days or until
      primer material in test patches cannot be scraped or peeled from the slab after
      drying 24 hours.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Flooring products of the following manufacturers, meeting the Specifications,
      may be used on this Project:

   1. Afco Rubber Corp.
   2. Armstrong World Industries, Inc.
   3. Azrock Floor Products.
   4. Burke Flooring Products.
   5. Johnsonite, Division of Duramax, Inc.
   8. Nora Flooring,
   9. RCA Rubber Co.
   10. R. C. Musson Rubber Co.
   11. Roppe.

2.02 FLOOR COVERING MATERIALS
   A. General: Furnish materials uniform in thickness and size with edges cut
      accurately and square; uniform color with variations in variegated patterns
      kept to a minimum.

   B. Rubber Tile (RT):

   1. ASTM F1344, Class I, Type A, or ASTM F1859, smooth, homogeneous.
   2. Size: 12- by 12-inch face size by 0.125 inch thick.
   3. Manufacturers and Products:
      a. Nora; 24 by 24 Environcare, color: No. 2967 Moor Grass.
      b. Johnsonite (Tarkett); 24 by 24 Micro Tone, color: LE3 Silkworm.
C.  Sheet Rubber (SRUB):

1.  ASTM F1859, smooth, homogeneous, marbleized rubber sheet.
2.  Thickness: 2 mm minimum.
3.  Manufacturers and Products:
   a.  Nora; Environcare, color No. 2967 Moor Grass.
   b.  Johnsonite (Tarkett); Arcade, color HB8 Hopkins.

2.03 BASE MATERIALS

A.  General: ASTM F1861, uniform in 0.125-inch thickness and in as long
    lengths as practicable to suit conditions of installation.

1.  Factory premolded internal and external corners to match base when
    available. Rubber Base: Type TP, Group 2.
2.  Style: Cove.
3.  4 inches high.
4.  Colors, see Interior Finish Schedule.
5.  Manufacturers and Products:
   a.  Nora; Wall Base.
      1)  Color A: 6233 Dove Grey.
      2)  Color B: 6247 Goldenrod.
   b.  Johnsonite Rubber Wall Base.
      1)  Color A: 21 Platinum.
      2)  Color B: 19 Desert Camel.

2.04 ACCESSORIES

A.  Trim: Furnish in lengths as long as practical to suit conditions of installation.

B.  Reducers:

1.  Standard rubber or vinyl floor reducer in thickness to suit butting floor
    covering by 1-inch wide, tapered or beveled-edge strip.
2.  Manufacturers and Products:
   a.  Johnsonite; Reducer Series RRS.
   b.  Mercer; 633 Tile Reducer.

C.  Adhesive: Type and brands of adhesive as recommended by manufacturer of
    floor covering material for conditions of installation.

D.  Primer and Crack Filler: Type and brand recommended by floor covering
    manufacturer.
E. Floor Filler: Asphalt mastic as manufactured by:
   1. Armstrong, Lancaster, PA.
   2. National Floor Products Co., Florence, AL.
F. Concrete underlayment as manufactured by:
   1. Ardex Inc., Coraopolis, PA; Ardex K-55.
   2. Thoro Systems Products; Thoro Underlayment.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine substrate for excessive moisture content and unevenness preventing execution and quality of resilient flooring as specified.
   B. Correct defects before installation of resilient flooring.

3.02 PREPARATION
   A. Remove dirt, oil, grease, or other foreign matter from surfaces to receive floor covering materials.
   B. Fill cracks less than 1/16-inch wide and depression less than 1/8 inch deep with floor filler.
   C. Prime sanded wood surfaces with one brush coat of primer.
   D. Prime surfaces, other than wood, if recommended by floor covering manufacturer.

3.03 APPLICATION OF ADHESIVES
   A. Mix and apply adhesives in accordance with manufacturer’s instructions.
   B. Provide safety precautions during mixing and applications as recommended by adhesive manufacturer.
   C. Apply Uniformly Over Surfaces:
      1. Cover only amount of area that can be covered by flooring material within recommended working time of adhesive.
      2. Remove any adhesive that dries or films over.
      3. Do not soil walls, bases, or adjacent areas with adhesives.
      4. Promptly remove any spillage.
   D. Apply adhesives with notched trowel or other suitable tool.
E. Clean trowel and rework notches as necessary to ensure proper application of adhesive.

3.04 INSTALLATION OF TILE MATERIALS

A. Start tile at center of room or space; work toward perimeter.

B. Do not lay tile less than half the width of a field tile except where accepted by Engineer for irregularly shaped rooms or spaces.

C. Cut border tile neatly and accurately to fit within 1/64 inch of abutting surfaces.

D. Use reducer edge strip at exposed tile edges.

E. Fit flooring material neatly and tightly into breaks and recesses, against bases, around pipes and penetrations, under saddles or thresholds, and around permanent cabinets and equipment.

F. Lay tile parallel to room axis in straight courses with cross joints parallel. Lay tile with grain or pattern running in same direction between adjacent tile.

G. Roll flooring with 75- to 100-pound roller in both directions.

3.05 INSTALLATION OF SHEET MATERIALS

A. Cutting and Fitting:

1. Cut sheet material in lengths and sizes required for minimum number of seams and for pattern match between adjacent abutting edges. Double-cut if required.

2. Lay cut sheets flat and allow to acclimate to room temperature prior to installation.

B. Installation:

1. Apply adhesive to back of sheets and roll over floor surface.

2. Work out wrinkles and air pockets.

3. Roll material in two directions starting at center of sheet.

4. Butt edges of adjoining sheets.

5. Neatly and tightly seal joints with adhesive.

6. Weld seams where noted or scheduled.

3.06 INSTALLATION OF BASE

A. General: Remove defects in wall and floor that would prevent level and true installation of base material.
1. Install base around perimeter of room or space, where shown, and at toe spaces of casework and cabinets.
2. Unroll base material and cut into accurate lengths as desired or as required for minimum number of joints.
3. Match edges at seams or double cut adjoining lengths to give continuous appearance.
4. Install with tight butt joints with no joint widths greater than 1/64 inch.

B. Top-Set Base:

1. Apply adhesive and firmly adhere to wall surfaces.
2. Press down so bottom cove edge follows floor profile.
3. Ensure top and bottom edges of base are in firm contact with walls and floors.
4. Form internal and external corners by using premolded corners. Other methods, acceptable to Engineer, may be used if premolded corners are not available.
5. Scribe base accurately to abutting materials.

3.07 INSTALLATION OF TRIM MATERIALS

A. Provide reducers where floor covering terminates exposing edge of covering.

B. Center reducer under door, where floor covering terminates at a door opening. Fit end edges to door frames and abutting surfaces and other edges to adjoining materials.

C. Apply adhesives and bond securely to substrates in straight true lines. Meet visible and related features of building construction with a maximum deviation of 1/8 inch in 10 feet.

3.08 CLEANING AND PROTECTION

A. Upon completion of the installation of floor covering and adjacent work, and after materials have set, clean surfaces with a neutral cleaner as recommended by manufacturer for type of floor covering material installed.

B. Repair adjacent surfaces damaged by flooring installation.

C. Wax Finishing:

1. Provide wax, cleaner, or other finishing material as recommended by floor covering manufacturer for the particular type of flooring material.
2. Apply one coat of nonslip wax or other finish as recommended by floor covering manufacturer; buff to a sheen.
3. Do not wax radial rubber tile.
D. Protect completed work from traffic and damage until Substantial Completion by covering with plastic sheet, kraft paper, or plywood panels.

3.09 INSTALLATION SCHEDULE

A. Areas to receive resilient flooring, and pattern, are indicated in Interior Finish Schedule.

END OF SECTION
**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Painting and Coating

### Revision History:

<table>
<thead>
<tr>
<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Issue for Construction</td>
<td>June 23, 2017</td>
<td>All</td>
</tr>
</tbody>
</table>

### Document Review & Approval:

**Originator:**

Craig A. Van Horn, PE/Corrosion Engineer

**Design Verification Complete:**

Gerald P. Duppong/Corrosion Control Specialist

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.

Date: 2017.06.23 13:22:44 -06'00'
PART 1  GENERAL

1.01  REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. Environmental Protection Agency (EPA).
4. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
5. Occupational Safety and Health Act (OSHA).
6. The Society for Protective Coatings (SSPC):
   a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
   c. SP 1, Solvent Cleaning.
   d. SP 2, Hand Tool Cleaning.
   e. SP 3, Power Tool Cleaning.
   f. SP 5, White Metal Blast Cleaning.
   g. SP 6, Commercial Blast Cleaning.
   h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   i. SP 10, Near-White Blast Cleaning.
   j. SP 11, Power Tool Cleaning to Bare Metal.
   k. SP 12, Surface Preparation and Cleaning of Metals Waterjetting Prior to Recoating.
   l. SP 13, Surface Preparation of Concrete.
   m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.
1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
7. PDS: Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Data Sheets:
      1) For each product, furnish a Product Data Sheet (PDS), the manufacturer’s technical data sheets, and paint colors available (where applicable). The PDS form is appended to the end of this section.
      2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
      3) Technical and performance information that demonstrates compliance with Specification.
      4) Furnish copies of paint system submittals to the coating applicator.
      5) Indiscriminate submittal of only manufacturer’s literature is not acceptable.
   b. Detailed chemical and gradation analysis for each proposed abrasive material.

2. Samples:
   a. Paint:
      1) Submit three sets of 8-inch by 10-inch drawdown samples with type of paint and application specified for approval of colors.
      2) Furnish additional samples as required until colors, finishes, and textures are approved.
3) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator’s Qualification: List of references substantiating experience.
2. Coating Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
3. Factory Applied Coatings: Manufacturer’s certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer’s written verification that submitted material is suitable for the intended use.
5. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer’s written confirmation that materials are compatible.
6. Manufacturer’s written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years’ experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer’s instructions.
   b. SSPC PA 3, Guide to Safety in Paint Applications.
   c. Federal, state, and local agencies having jurisdiction.

C. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:
   1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
   2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS
A. Environmental Requirements:
   1. Do not apply paint in temperatures or moisture conditions outside of manufacturer’s recommended maximum or minimum allowable.
   2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

B. Status of Existing Coatings: The following information on existing coatings or substrate conditions is provided for information only, and is generally believed to be accurate, but is not guaranteed. Perform tests as required to verify applicability of this information to the Work.

PART 2 PRODUCTS
2.01 GENERAL
A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
   1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MANUFACTURERS
A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.
B. Minimum of 5 years’ verifiable experience in manufacture of specified product.

C. Each of the following manufacturers is capable of supplying most of the products specified herein:

1. Tnemec.
2. Sherman-Williams.
3. Carboline.
4. PPG.

2.03 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer’s recommendations for specific primer and coating system to be applied.

2.04 PAINT MATERIALS

A. General:

1. Manufacturer’s highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

<table>
<thead>
<tr>
<th>Product</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic Latex</td>
<td>Single-component, finish as required</td>
</tr>
<tr>
<td>Acrylic Latex (Flat)</td>
<td>Flat latex</td>
</tr>
<tr>
<td>Acrylic Sealer</td>
<td>Clear acrylic</td>
</tr>
<tr>
<td>Bituminous Paint</td>
<td>Single-component, coal-tar pitch based</td>
</tr>
<tr>
<td>Coal-Tar Epoxy</td>
<td>Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service</td>
</tr>
<tr>
<td>Epoxy Primer—Ferrous Metal</td>
<td>Anticorrosive, converted epoxy primer containing rust-inhibitive pigments</td>
</tr>
<tr>
<td>Fusion Bonded Coating</td>
<td>100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service</td>
</tr>
<tr>
<td>High Build Epoxy</td>
<td>Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat</td>
</tr>
<tr>
<td>Product</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Heat Resistant Epoxy</td>
<td>Phenolic novolac, micaceous iron oxide flake filled, amine cured epoxy, designed for service under insulation and temperature resistance up to 300 degrees F</td>
</tr>
<tr>
<td>Latex Primer Sealer</td>
<td>Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats</td>
</tr>
<tr>
<td>NSF Epoxy</td>
<td>Polyamidoamine epoxy, approved for potable water contact and conforming to NSF/ANSI 61</td>
</tr>
<tr>
<td>Epoxy, High Solids</td>
<td>Polyamidoamine epoxy, 80% volume solids, minimum, suitable for immersion service</td>
</tr>
<tr>
<td>Polyurethane Enamel</td>
<td>Two-component, aliphatic or acrylic based polyurethane; high gloss finish</td>
</tr>
<tr>
<td>Water Base Epoxy</td>
<td>Two-component, polyamide epoxy emulsion, finish as required</td>
</tr>
</tbody>
</table>

2.05 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.06 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days’ advance notice to start of shop surface preparation work and coating application work.
C. Shop Coating Requirements:

1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer’s standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer’s standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer’s standard coating with field coating manufacturer.

D. Pipe:

1. Ductile Iron Pipe:
   a. Use SSPC standards as a guide for desired prepared surface. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.
   b. The surface preparation and application of the primer shall be performed by pipe manufacturer.
   c. For high performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.
   d. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.

PART 3 EXECUTION

3.01 GENERAL

A. Provide Engineer minimum 7 days’ advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer’s absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas
into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.

2. Refer to coating systems for degree of abrasive blasting required.

3. Where the specified degree of surface preparation differs from manufacturer’s recommendations, the more stringent shall apply.

B. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:

   a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.

   b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.

d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.

e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.

g. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.

i. SP 12, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating: Surface preparation using high-pressure and ultrahigh-pressure water jetting to achieve specified surface cleanliness condition. Surface cleanliness conditions are defined in SSPC SP 12 and are designated WJ-1 through WJ-4 for visual surface preparation definitions and SC-1 through SC-3 for nonvisual surface preparation definitions.

2. The words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, and “blast cleaning”, or similar words of equal intent in these Specifications or in paint manufacturer’s specification refer to the applicable SSPC Specification.

3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
   a. Prepare such that there is:
      1) No undercutting or reverse ridges on weld bead.
      2) No weld spatter on or adjacent to weld or any area to be painted.
      3) No sharp peaks or ridges along weld bead.
   b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
   a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
   b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
   c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
   a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer’s recommendations.
   b. Select type and size of abrasive to produce surface profile that meets coating manufacturer’s recommendations for particular primer to be used.
   c. Use only dry blast cleaning methods.
   d. Do not reuse abrasive, except for designed recyclable systems.
   e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
10. Post-Blast Cleaning and Other Cleaning Requirements:
    a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
    b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.
C. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
2. Remove oil and grease by wiping or scrubbing surface with suitable solvent, rag, and brush. Use clean solvent and clean rag for final wiping to avoid contaminating surface.
3. Obtain and follow coating manufacturer’s recommendations for additional preparation that may be required.

D. Concrete Surface Preparation:

1. Do not begin until 30 days after concrete has been placed.
3. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed.
5. Secure coating manufacturer’s recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
6. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

E. Plastic and FRP Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.
2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

F. Gypsum Board Surface Preparation: Typically, new gypsum board surfaces need no special preparation before painting.

1. Surface Finish: Dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.

4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.

6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can: One part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.

2. Application:
   a. Rate: Approximately 2 gallons per 100 square feet.
   b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.
   c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
   d. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.
   e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.
   f. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.

3. Ensure surface is completely dry before application of coating.

4. Apply acid etching to obtain a “grit sandpaper” surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.

2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior and exterior, concrete, and metal, and submerged metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces, unless specifically indicated.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.

3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer’s written instructions for these requirements. Do not immerse coating until completion of curing cycle.

4. Apply coatings in accordance with these Specifications and paint manufacturers’ printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.

5. Sand wood lightly between coats to achieve required finish.

6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

7. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.

8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.

9. Water-Resistant Gypsum Board: Use only solvent type paints and coatings.

10. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.

11. Keep paint materials sealed when not in use.

12. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.

2. Prepare surface and apply primer in accordance with System No. 10 specification.

3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Porous Surfaces, Such As Concrete:

1. Filler/Surfacer: Use coating manufacturer’s recommended product to fill air holes, bug holes, and other surface voids or defects.

2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
   a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.

3. Surface Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.
D. Film Thickness and Coverage:

1. Number of Coats:
   a. Minimum required without regard to coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers’ products, and atmospheric conditions.

2. Application Thickness:
   a. Do not exceed coating manufacturer’s recommendations.
   b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.

3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   a. Perform with properly calibrated instruments.
   b. Reccoat and repair as necessary for compliance with Specification.
   c. Coats are subject to inspection by Engineer and coating manufacturer’s representative.

4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.

5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.

6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. As shown on the Finish Schedules in the Drawings. Additional requirements are included on the Piping Schedule in the Drawings.

C. System No. 1 Submerged Metal—Potable Water:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 5, White Metal Blast Cleaning</td>
<td>NSF Epoxy</td>
<td>3 coats, 3 MDFTPC</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Metal surfaces below a plane 1 foot above the maximum liquid surface; metal surfaces above the maximum liquid surface that are a part of the immersed equipment; surfaces of metallic items, such
as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel that are embedded in concrete; and the following specific surfaces:
1) Interior surfaces of steel piping noted in the Piping Schedule.
2) Interior surfaces for the Inclined Plate Clarifier.

D. System No. 4 Exposed Metal—Highly Corrosive:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 10, Near-White Blast Cleaning</td>
<td>Epoxy Primer—Ferrous Metal</td>
<td>1 coat, 2.5 MDFT</td>
</tr>
<tr>
<td></td>
<td>High Build Epoxy</td>
<td>1 coat, 4 MDFT</td>
</tr>
<tr>
<td></td>
<td>Polyurethane Enamel</td>
<td>1 coat, 3 MDFT</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Exposed metal surfaces, located inside or outside of structures and exposed to weather, or in a highly humid atmosphere, such as pipe galleries and similar areas and the following specific surfaces:
      1) Structural steel inside MTF filter bay.
      2) Filter Press:
         a) Raised platform.
         b) Filter frame.
         c) Filter pumps.
      3) Exterior surfaces of Inclined Plate Clarifier.
      4) Exposed ferrous metal near chemical storage and pumps.

E. System No. 5 Exposed Metal—Mildly Corrosive:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 10, Near-White Blast Cleaning</td>
<td>Epoxy Primer—Ferrous Metal</td>
<td>1 coat, 2.5 MDFT</td>
</tr>
<tr>
<td></td>
<td>Polyurethane Enamel</td>
<td>1 coat, 3 MDFT</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Exposed metal surfaces, new, located inside or outside of structures and exposed to weather and the following specific surfaces:
      1) Hollow metal doors and frames.
      2) Primary steel framing members as shown on Drawings.
      3) Miscellaneous exposed ferrous metal in corrosive environments not otherwise finished.
      4) Electric motors and gearboxes.
5) Exterior surfaces of ductile iron piping as noted the on Piping Schedule.

F. System No. 7 Concrete Encased Metal:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 6, Commercial Blast Cleaning</td>
<td>Coal-Tar Epoxy</td>
<td>2 coats, 16 MDFT</td>
</tr>
<tr>
<td></td>
<td>High Build Epoxy</td>
<td>2 coats, 16 MDFT</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Use on concrete encased ferrous metals including wall pipes, pipe sleeves, access manholes, gate guides, and trash racks.
   b. For the drain pipe on the Storm Water Tank and Equalization Tank, reference Section 09 97 13, Steel Tank Coatings.

G. System No. 8 Buried Metal—General:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 10, Near-White Blast Cleaning</td>
<td>Coal-Tar Epoxy</td>
<td>2 coats, 16 MDFT</td>
</tr>
<tr>
<td></td>
<td>-OR- High Build Epoxy</td>
<td>2 coats, 16 MDFT</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Buried, below-grade portions of steel items, except buried stainless steel or ductile iron.

H. System No. 10 Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation</td>
<td>Epoxy Primer—Other</td>
<td>As recommended by coating manufacturer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remaining coats as required for exposure</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Galvanized surfaces requiring painting.
   b. After application of System No. 10, apply finish coats as required for exposure.
I. System No. 12 Skid-Resistant—Steel:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 10, Near-White Blast Cleaning</td>
<td>Epoxy Primer—Ferrous Metal</td>
<td>1 coat, 2.5 MDFT</td>
</tr>
<tr>
<td></td>
<td>Epoxy Nonskid (Aggregated)</td>
<td>1 coat, 16 MDFT</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Exit door floor plate.
   b. Other locations where non-skid metal surface improves safety.

J. System No. 15 Heat Resistant Epoxy —300 Degrees F Maximum:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 10, Near-White Blast Cleaning</td>
<td>Heat Resistant Epoxy</td>
<td>2 coats, 5 MDFT</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Stainless steel blower pipe (BWA) under insulation.

K. System No. 19 Tank and Basin Lining—Corrosive Chemicals:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with Paragraph Concrete Surface Preparation</td>
<td>Epoxy Filler/Surfacer</td>
<td>As required to fill voids and level surface</td>
</tr>
<tr>
<td></td>
<td>Novolac Epoxy, High Solids</td>
<td>2 coats, 250 SFPGPC</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Containment areas for corrosive chemicals and the following specific surfaces:
      1) Containment basins at chemical storage shed.
      2) Walls at chemical storage shed.
      3) Roof above chemical storage tanks, vent area as shown on Drawings.
L. System No. 22 Chemical-Resistant Wall, Heavy-Duty:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with Paragraph Gypsum Board Surface Preparation</td>
<td>High Build Epoxy</td>
<td>1 coat, 160 SFPG</td>
</tr>
<tr>
<td></td>
<td>High Build Epoxy, Gloss</td>
<td>1 coat, 160 SFPG</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Filter Press Room.

M. System No. 25 Exterior Exposed FRP, PVC:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with Paragraph Plastic and FRP Surface Preparation</td>
<td>Acrylic Latex Semigloss</td>
<td>2 coats, 320 SFPGPC</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. All exposed-to-view exterior PVC and CPVC surfaces, and FRP surfaces without integral UV-resistant gel coat.

N. System No. 27 Aluminum and Dissimilar Metal Insulation:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent Clean (SP 1)</td>
<td>Prime in accordance with manufacturer’s recommendations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bituminous Paint</td>
<td>1 coat, 10 MDFT</td>
</tr>
</tbody>
</table>

1. Use on aluminum surfaces embedded or in contact with concrete
2. Dissimilar metals with differing dielectric properties.
O. System No. 29 Fusion Bonded Coating:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 10, Near-White</td>
<td>Fusion Bonded Coating 100% Solids Epoxy</td>
<td>1 or 2 coats, 10 MDFT</td>
</tr>
<tr>
<td>Blast Cleaning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Use on the following items:
   a. Plunger valve (HDWK-FCV-251).

P. System No. 29A Fusion Bonded, Steel Dowel and Anchor Coating:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 10, Near-White</td>
<td>Fusion Bonded Coating 100% Solids Epoxy</td>
<td>1 or 2 coats, 7 MDFT</td>
</tr>
<tr>
<td>Blast Cleaning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Use on steel expansion joint dowels as specified in Section 03 15 00, Concrete Joints and Accessories.
2. Use on anchor bolts for immersed equipment to dielectrically isolate anchor bolts from reinforcing bar.

3.08 ARCHITECTURAL PAINT SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. As shown in Finish Schedule on Drawings. Additional requirements are included in the Piping Schedule.

C. System No. 107 Metal Trim:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 6, Commercial</td>
<td>Rust-Inhibitive Primer</td>
<td>1 coat, 2 MDFT</td>
</tr>
<tr>
<td>Blast Cleaning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkyd Enamel (Semigloss)</td>
<td></td>
<td>2 coats, 4 MDFT</td>
</tr>
</tbody>
</table>
1. Use on the following items or areas:
   a. Metal flashing and trim not otherwise finished. Non corrosive environments such as exterior.

D. System No. 113 Concrete, Semigloss:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with Paragraph Concrete</td>
<td>Acrylic Latex (Semigloss)</td>
<td>2 coats, 240 SFPGPC</td>
</tr>
<tr>
<td>Surface Preparation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Striping and lettering as shown on Drawings.

E. System No. 115 Gypsum Board and Plaster, Semigloss:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with Paragraph Gypsum</td>
<td>Latex Primer/Sealer</td>
<td>1 coat, 350 SFPG</td>
</tr>
<tr>
<td>Board Surface Preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acrylic Latex (Semigloss) or Alkyd (Semigloss)</td>
<td>2 coats, 400 SFPGPC</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Gypsum board walls.

F. System No. 116 Gypsum Board and Plaster, Gloss Epoxy:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with Paragraph Gypsum</td>
<td>Manufacturer’s Recommended Primer</td>
<td>1 coat, 350 SFPG</td>
</tr>
<tr>
<td>Board Surface Preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Base Epoxy (Gloss)</td>
<td>1 coat, 250 SFPG</td>
</tr>
</tbody>
</table>

1. Use on the following items or areas:
   a. Restroom.
G. System No. 123 Traffic Striping:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSPC SP1</td>
<td>Acrylic with Solvent Base for Fast Drying</td>
<td>1 coat, 7.5 DFT</td>
</tr>
</tbody>
</table>

1. Sherwin Williams Setfast Acrylic Traffic Marking Paint or approved equal.

2. Color: Yellow or as approved by owner to demarcate clear zones shown on Drawings.

3.09 COLORS

A. Provide as shown for equipment and appurtenances and designated herein and shown in Piping Schedule. Architectural colors are shown on Interior and Exterior Finish Schedules on the Drawings.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.

2. Paint nonsubmerged portions of equipment the same color as the piping it serves, except as itemized below:
   a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
   c. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

D. Pipe Identification Painting:

1. Color code nonsubmerged, non-insulated metal piping, except copper, stainless steel, and electrical conduit. Paint fittings and valves the same color as pipe.

2. Pipe Colors: In accordance with Piping Schedule and as shown in table below.

3. Pipe Supports: Painted light gray, as approved by Engineer.

4. Fiberglass reinforced plastic (FRP) pipe, polyvinylidene fluoride (PVDF), and polyvinyl chloride (PVC) pipe located inside of buildings and enclosed structures will not require painting, except as noted or scheduled.
E. Pipe System Color Code:

<table>
<thead>
<tr>
<th>Pipe System</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire sprinkler water (FS)</td>
<td>Red</td>
</tr>
<tr>
<td>Influent (INF)</td>
<td>Buff</td>
</tr>
<tr>
<td>Stormwater (SW)</td>
<td>Buff</td>
</tr>
<tr>
<td>Stormwater Return (SWR)</td>
<td>Buff</td>
</tr>
<tr>
<td>Chemical feed services</td>
<td>Orange</td>
</tr>
</tbody>
</table>

3.10 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide magnetic type dry film thickness gauge to test coating thickness specified in mils, as manufactured by Nordson Corp., Anaheim, CA, Mikrotest.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
   a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
   b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
   c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
   d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.
D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.11 MANUFACTURER’S SERVICES

A. In accordance with Section 01 43 33, Manufacturers’ Field Services, coating manufacturer’s representative shall be present at Site as follows:

1. On first day of application of any coating system.
2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer’s Certificate of Proper Installation.
3. As required to resolve field problems attributable to or associated with manufacturer’s product.
4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.12 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.
3.13 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification:

1. Paint System Data Sheet (PSDS).
2. Product Data Sheet (PDS).

END OF SECTION
PAINT SYSTEM DATA SHEET

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

<table>
<thead>
<tr>
<th>Paint System Number (from Spec.):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint System Title (from Spec.):</td>
<td></td>
</tr>
<tr>
<td>Coating Supplier:</td>
<td></td>
</tr>
<tr>
<td>Representative:</td>
<td></td>
</tr>
<tr>
<td>Surface Preparation:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Paint Material (Generic)</th>
<th>Product Name/Number (Proprietary)</th>
<th>Min. Coats, Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
PAINT PRODUCT DATA SHEET

Complete and attach manufacturer’s Technical Data Sheet to this PDS for each product submitted. Provide manufacturer’s recommendations for the following parameters at temperature (F)/relative humidity:

<table>
<thead>
<tr>
<th>Temperature/RH</th>
<th>50/50</th>
<th>70/30</th>
<th>90/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Induction Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pot Life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelf Life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drying Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curing Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Recoat Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Recoat Time</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Provide manufacturer’s recommendations for the following:

Mixing Ratio: __________________________________________

Maximum Permissible Thinning: __________________________________________

Ambient Temperature Limitations: min.: __________ max.: __________

Surface Temperature Limitations: min.: __________ max.: __________

Surface Profile Requirements: min.: __________ max.: __________

Attach additional sheets detailing manufacturer’s recommended storage requirements and holiday testing procedures.
Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Chemical-Resistant Coatings

<table>
<thead>
<tr>
<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Issue for Construction</td>
<td>June 23, 2017</td>
<td>All</td>
</tr>
</tbody>
</table>

Document Review & Approval:

Originator:
Craig A. Van Horn, PE/Corrosion Engineer

Design Verification Complete:
Gerald P. Duppong/Corrosion Control Specialist

Approved:
W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 13:24:52 -06'00'
PART 1  GENERAL

1.01  REFERENCES

A. The following is a list of standards which may be referenced in this section:

1.  ASTM International (ASTM):
   c. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.


3.  The Society for Protective Coatings (SSPC):
   b. SP13/NACE 6, Surface Preparation of Concrete.

1.02  ABBREVIATIONS

A. CRC: Chemical-Resistant Coating.

B. MDFT: Minimum Dry Film Thickness.

C. Mil: One thousandth of an inch.

D. SDS: Safety Data Sheet.

E. SSPC SP: Surface Preparation Standard for Protective Coatings.
1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Furnish a CRC Data Sheet (CRCDS) and a CRC Product Data Sheet (CRCPDS) for each CRC system. The CRCDS and CRCPDS forms are appended to the end of this section.
   b. Indiscriminate submittal of manufacturer’s literature only is not acceptable.
   c. The following information shall be appended to each CRCDS:
      1) Manufacturer’s technical data sheets.
      2) Manufacturer’s application specification.
      3) Chemical-resistance test results for exposure to service conditions.
      4) Configuration details for the following:
         a) Expansion joints and structural isolation joints.
         b) Construction joints.
         c) Cracks.
         d) Wall base details.
         e) Gate frames.
         f) Equipment bolts (when installed before or after CRC application).
         g) Metal angle frames at trenches, gratings, or hatches.
         h) Transition and termination detail at edge of CRC system.
         i) Pipe penetrations (vertical and horizontal).
         j) Termination and sealing at base of existing fiberglass tanks.
         k) Other details specific to the structure being coated.

2. Coordinate submittal for painting metal surfaces with Section 09 90 00, Painting and Coating.

3. Samples: 4-inch square complete system proposed for use showing thickness and finish.

B. Informational Submittals:

1. Letter from manufacturer stating that:
   a. Applicator has notified manufacturer of proposed installation.
   b. Manufacturer is in agreement with the intended application.
   c. Applicator is qualified to do the Work and meets the quality assurance minimum experience requirements.

2. Applicator Qualifications:
   a. List of references substantiating experience. Include projects with at least 3 years of successful service history, including project name and location, names of Owner and Engineer, and description of product used, substrates coated, and application procedures.
b. Certification from coating manufacturer showing current status as an approved applicator.

3. Manufacturer’s Product Qualifications:
   a. List of projects substantiating successful application and performance of the proposed products to the specific exposure and process conditions. Include project name and location, application dates, and names of Owner, Engineer, and Applicator.

4. Field inspection and test reports.

5. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.

6. Safety Data Sheets (SDS).

1.04 QUALITY ASSURANCE

A. Manufacturer’s Experience: Minimum 5 years manufacturing proposed products.

B. Applicator’s Experience: Minimum 3 years applying proposed products.

C. Subcontractor is solely responsible for quality control inspection and testing. Subcontractor shall monitor and be responsible for all environmental, surface preparation, application and quality control testing compliance at the locations where coating work is undertaken.

D. Applicator Quality Control Plan: Applicator shall maintain an in-house quality assurance program that monitors surface preparation, coating application, and quality control testing for coating and lining operations. Level of experience, quality assurance program, and quality control testing by the applicator shall meet the minimum requirements specified herein, the coating manufacturer's instructions, and related government regulations.

1.05 PREINSTALLATION MEETING

A. Prior to beginning painting Work, schedule a meeting and be prepared to discuss the following subjects, as a minimum:

   1. Required schedule.
   2. Sequence of critical path work items.
   3. Use of Site, access, office and storage areas, security, and temporary facilities.
   5. Safety plan.

B. Attendees shall include:

   1. Owner’s representatives.
   2. Contractor’s office representative.
   3. Contractor’s resident superintendent.
4. Contractor’s quality control representative.
5. Subcontractors’ representatives whom Contractor may desire or Engineer may request to attend.
6. Engineer’s representative.
7. Paint manufacturer’s technical representative.
8. Others as appropriate.

1.06 REGULATORY REQUIREMENTS

A. Meet applicable federal, state, and local requirements for coating product selection, surface preparation and painting activities.

1.07 SURFACE PREPARATION AND COATING APPLICATION

A. Perform surface preparation and painting in accordance with recommendations of the following:

1. These Specifications.
2. Coating manufacturer’s instructions.
3. SSPC PA 10.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer’s original, unopened containers.

B. Storage:

1. Maintain materials in clean and dry condition.
2. Maintain storage temperatures within the manufacturer’s requirements.
3. Follow manufacturer’s instructions.

C. Shelf Life: Do not apply coating materials that have exceeded the manufacturer’s recommended shelf life.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Temporary Facilities: Provide temporary facilities that may be required for proper installation of the complete chemical resistant coating system, such as covers, enclosures, air heating or cooling, and dehumidification.

B. Temperature: Apply surfacing materials and protective coating only when substrate, ambient air, and coating material are within the manufacturer’s recommended range.

C. Substrate: Moisture content shall be within manufacturer’s recommended range for product application.

D. Ventilation: Provide during and after application to meet all applicable safety and health regulations.
1.10 SPECIAL GUARANTEE

A. Furnish extended guarantee or warranty. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of Work specified in this specification section found defective during a period of 2 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

1. 23-Month Warranty Period Inspection: Owner will conduct inspection of interior and exterior coated surfaces prior to the end of warranty period. Owner will notify Contractor in advance of inspection and Contractor may attend at its option. Owner will prepare list of coating defects and failures identified during inspection and transmit to Contractor. List shall serve as notice of repairs required under warranty.

2. Repairs:
   a. If repairs are required, requirements of Contract shall apply including, but not limited to, requirements to remove standing water and perform repair work.
   b. Repair defective coatings using coating materials, equipment, and methods similar to those used in original work. Materials shall be of fresh manufacture and within manufacturer’s stated shelf life at time of application.
   c. Provide extended warranty of 1 year for repairs. Complete repairs within 30 calendar days of Warranty Period Inspection.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. CRC-1:
   2. PPG.
   3. Carboline.
   4. Tnemec.
   5. International.

B. CRC-2:
   2. PPG.
   3. Carboline.
   4. Tnemec.
2.02 INTERNATIONAL MATERIALS

A. Chemical-Resistant Coatings:
   1. A mixture of liquid resin-based material, setting agent, and filler designed to be troweled or sprayed into place to cure to a hard state.
   2. As described in Coating Systems. Provide manufacturer’s highest quality products suitable for the intended service.

B. Product Service Experience: Minimum 3 years of verifiable successful product performance in the listed exposure and process condition.

C. Only compatible materials from a single manufacturer shall be used within any system.

D. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.

E. Materials shall not contain lead or lead compounds.

F. Joints:
   1. Provide joint filler material of type, size and composition as recommended by the CRC manufacturer for the particular joint condition.
   2. Joint materials shall maintain a liquid tight joint for the life of the coating system.
   3. Chemical resistance of the joint material shall be the same or better than the coating system.
   4. Provide joint backing material per CRC manufacturer’s recommendation.

G. Lining Reinforcement: Fiberglass chopped-strand or woven-mat.

H. Slip-Resistant Aggregate: Type and quantity as recommended by coating manufacturer for the specific application.

2.03 COATING SYSTEMS

A. CRC-1—Epoxy liner system intended for chemical containment and chemical exposure:
   1. Description:
      a. Non-skid chemical-resistant coating, suitable for secondary structures exposed to containment of the following chemicals:
         1) Ferric Chloride, at 40 percent concentration.
         2) Sodium Bisulfite, at 38 percent concentration.
         3) Organosulfide.
4) Sodium Hydroxide, at 50 percent concentration.
5) Sulfuric Acid, at 93 percent concentration.

2. Service Conditions:
   a. Location:
      1) Secondary containment for Ferric Chloride and Sulfuric Acid; outdoors, under canopy.
      2) Secondary containment for Sulfuric Acid at headworks storage shed, indoors, protected from weather.
      3) Immersion service, inside influent channels beneath sulfuric acid chemical addition port, from the flume inset to the end of the coanda ramp downstream.
   b. Surfaces: Concrete floors, walls, and, trenches for chemical containment, storage and handling.
   c. Traffic: Foot.
   d. Temperature: Ambient.

3. CRC System 1:
   a. Walls and Non-foot Traffic Areas, Such as Influent Channel Floors:
      1) Primer: One coat of manufacturer’s recommended low viscosity, high solids, penetrating epoxy primer/sealer, 4 mils MDFT. As required by CRC manufacturer.
      2) Repair/Patching and Resurfacing Compound: One layer of manufacturer’s recommended 100 percent solids epoxy surfacing compound for concrete, as needed.
      3) Finish Coat: One coat of manufacturer’s recommended high build, 100 percent solids novolac epoxy coating, 30 mils MDFT.
   b. Floors-Foot Traffic:
      1) Primer: One coat of manufacturer’s recommended low viscosity, high solids, penetrating epoxy primer/sealer, 4 mils MDFT. As required by CRC manufacturer.
      2) Repair/Patching and Resurfacing Compound: One layer of manufacturer’s recommended 100 percent solids novolac epoxy surfacing compound for concrete, as needed.
      3) Base Coat: One coat of manufacturer’s recommended high build, 100 percent solids novolac epoxy coating, 15 mils MDFT.
      4) Broadcasting/Slip Resistant Aggregate: Manufacturer’s recommendation, 20/40 mesh aggregate.
      5) Finish Coat: One coat of manufacturer’s recommended high build, 100 percent solids novolac epoxy coating, 15 mils MDFT.
   c. Trenches:
      1) Primer: One coat of manufacturer’s recommended moisture-resistant epoxy primer, 4 mils MDFT. As required by CRC manufacturer.
2) Base Coat: One coat, trowel-applied, 100 percent solids novolac epoxy, 60 MDFT.
3) Lining Reinforcement: One layer of resin-saturated fiberglass mat reinforcement.
4) Intermediate Coat: One coat of liquid-applied, novolac epoxy, 30 mils MDFT.

B. CRC-2, Epoxy Liner System Intended for Concrete Surfaces Immersed in Low pH Water:

1. Description: Epoxy coating for immersed concrete services for the Filters at the MTF:
2. Service Conditions:
   a. Location: Immersed concrete surfaces for the Filters in the MTF.
   b. Surfaces: Concrete floors, and walls.
   c. Temperature: Ambient.
3. CRC-System No. 2:
   a. Walls and Floors in Influent Channels:
      1) Primer: One coat of manufacturer’s recommended low viscosity, high solids, penetrating epoxy primer/sealer, 4 mils MDFT. As required by CRC manufacturer.
      2) Repair/Patching and Resurfacing Compound: One layer of manufacturer’s recommended 100 percent solids epoxy surfacing compound for concrete, as needed.
      3) Finish Coat: One coat of manufacturer’s recommended high build, 100 percent solids epoxy coating, 25 mils MDFT.

PART 3 EXECUTION

3.01 EXAMINATION

A. Surface Preparation:
   1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of the system manufacturer whose product is to be applied.
   2. Provide Engineer minimum 3 days’ advance notice of start of surface preparation and system application Work.
   3. Perform Work only in presence of Engineer, unless Engineer grants prior approval to perform Work in Engineer’s absence.

B. Schedule inspection with Engineer in advance for cleaned surfaces and system application Work.

3.02 PREPARATION

A. As specified herein and in accordance with the manufacturer’s written directions and recommendations.
B. Concrete Surfaces:

1. Do not begin surface preparation activities until 30 days after new concrete has been placed, or longer if required to meet coating manufacturer’s limit for moisture in the concrete.
2. Remove grease, oil, dirt, salts, chemicals, and other foreign matter by solvent, detergent, or other cleaning methods.
3. Prepare surfaces and provide a concrete profile by abrasive blasting, SSPC SP-13, or by high-pressure water blasting, 4,000 psi minimum. Minimum surface profile shall meet ICRI CSP 3 to 5, or higher if required by coating manufacturer.
4. Secure coating manufacturer’s recommendations for additional preparation if required by the coating manufacturer.
5. Ensure that concrete surfaces are sufficiently dry prior to coating.
   a. Test for moisture using plastic sheets in accordance with ASTM D4263.
   b. If the test indicates moisture is present, conduct tests to determine moisture content in accordance with ASTM F1869. If the moisture content exceeds 3 pounds per 1,000 square feet in a 24-hour period, provide the manufacturer’s recommendations for mitigation of moisture effect on lining application and long term lining performance.
   c. All tests using electronic moisture meters shall conform to ASTM F2170.

C. Concrete Defects: Fill holes and cracks with manufacturer’s recommended materials. Secure the manufacturer’s recommendations for additional preparation if required for excessive bug holes exposed after blasting.

3.03 APPLICATION

A. General:

1. This specification section is intended for coating and lining concrete with special chemical resistant coatings. See Section 09 90 00, Painting and Coating, for ferrous metal painting requirements.
2. Surfacer/Filler: Apply surfacer/filler to concrete with methods recommended by the coating manufacturer as required to provide a surface that is continuous, smooth, void-free surface. Force material into voids and irregularities, and remove excess filter before the material sets.
3. Spray or trowel apply coating system components in accordance with manufacturer’s written instructions.
4. Cove corners at vertical and horizontal intersections, and reinforce as specified in paragraph Joints, this section.
5. Apply saturant/intermediate coat to wet out and embed fiberglass reinforcement.
6. Broadcast slip-resistant aggregate to rejection in saturant/intermediate coat. Remove excess material before application of finish coat.
7. Lightly backroll finish coat as recommended by CRC manufacturer to eliminate pinholes.
8. Provide minimum number of coats required for each coating system, regardless of application method. Do not apply succeeding coats until previous coat has cured in accordance with coating manufacturer’s recommendations.
9. Observe manufacturer’s published recoat windows. If recoat window is exceeded, mechanically abrade before recoating in accordance with manufacturer’s directions and as approved by Engineer.

B. Priming and Holiday Prevention on Concrete and Substrates: Follow manufacturer’s written instructions related to application during decreasing substrate temperature conditions, adequate surface preparation and other application techniques that may be necessary to reduce the potential for outgassing and formation of pinholes during coating application and cure. If required by the coating manufacturer, apply manufacturer’s recommended epoxy penetrating primer to minimize the effects of vapor transmission from the concrete.

C. Product Mixing:

1. Thoroughly mix until homogeneous following manufacturer’s instructions.
2. Mix only components furnished by coating manufacturer.

D. Film Thickness: Provide specified thickness of material. Use screeds or wet film gauges to monitor thickness during application.

E. Joints:

1. Provide continuous sealant, backing material, and joint-lining treatment recommended by the coating manufacturer at all expansion, isolation, and construction joints.
2. Provide continuous sealant bead at joints between different coating systems.
3. Provide fiberglass or synthetic fabric reinforcement at construction joints and large substrate cracks to maintain liquid-tight requirements under the specified service conditions.

F. Penetrations: Coat over or around equipment anchors, base plates, pipes, and similar items installed in areas receiving CRC to maintain continuous liquid tight seal.
G. Terminations:

1. Confirm to manufacturer’s details.
2. For coatings exposed to wastewater or vapor space above wastewater liquid levels, terminate leading edges in beveled saw cuts 1/4-inch-wide by 1/4-inch-deep, or as required by manufacturer. Prime and extend coating into the saw cut. Do not fill saw cut with epoxy surfacer. Saw cut shall be provided by CRC subcontractors.

3.04 SECONDARY CONTAINMENT STRUCTURES

A. Install coating systems on vertical and horizontal surfaces, including caps, within containment wall for storage tanks, pumps, and piping, and as shown on Drawings.

B. Extend surfacing completely under structures and equipment located within the containment area. Install at construction joints in substrate and floor drains, trenches, and other components within the containment area.

3.05 UNSATISFACTORY APPLICATION

A. If an item has an improper appearance or insufficient film thickness, the surface shall be cleaned, prepared, and top-coated as required to achieve proper appearance and/or thickness. Provide specific procedures in writing from manufacturer prior to cleaning and preparation.

3.06 DAMAGED COATINGS

A. Damaged coatings, pinholes, and holidays shall have the edges feathered and repaired in accordance with the recommendations of the manufacturer.

B. All finish coats, including touchup and damage-repair coats, shall be applied in a manner that will present a uniform texture and color-matched appearance.

C. All visible areas of chipped, peeled, or abraded coatings shall be hand or power sanded. Prime and finish coat these in accordance with these Specifications and the manufacturer's recommendations.

3.07 FIELD QUALITY CONTROL

A. Inspection: Inspect finished system for complete, uniform coverage of specified area. Evidence of defects include improper thickness, hardness, and appearance.

B. Holiday Testing:

1. All surfaces provided with a barrier lining shall be electrically checked with high-voltage holiday test equipment to determine location of discontinuities:
a. Provide suitable electrical contact to reinforcing steel. Verify conductivity of electrical contact by touching the second, ungrounded, electrode to another metallic ground connected to the concrete structure.
   1) Do not perform electrical inspection until the barrier lining is sufficiently cured, as determined by the manufacturer.

b. All electrical inspection testing shall be performed in accordance with NACE SP0188.

c. Perform all electrical tests at 100 volts/mil for the minimum approved thickness of the lining material.

2. Repair all lining defects in accordance with the manufacturer’s written instructions.

3. After repaired and recoated areas have dried sufficiently, retest each.

C. Film Thickness:

1. Perform destructive dry film thickness measurements in accordance with ASTM D4138.

2. Perform one film thickness measurement per 500 square feet of lined surface.

3. Perform additional testing if any one measurement does not meet specified thickness requirement.
   a. Perform an additional four measurements in the area where inadequate thickness is found. No single measurement shall be less than specified dry film thickness.

4. Provide additional coats of barrier lining as required to meet specified film thickness. Abrade surface by brush blasting if manufacturer’s recommended recoat window is exceeded.

D. Repair all damaged coatings associated with film thickness testing in accordance with manufacturer’s written instructions.

3.08 MANUFACTURER’S SERVICES

A. Provide manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for installation assistance, inspection, and Manufacturer’s Certificate of Proper Installation.

B. Manufacturer’s representative shall visit the Project Site at the following intervals:

1. At preconstruction conference.

2. On first day of application of any system.

3. As necessary during surface preparation and application to ensure installations are made in accordance with the manufacturer's recommendations.

4. As required to resolve field problems attributed to or associated with manufacturer's product.
5. Minimum Number of Site Visits:
   a. Two site visits, each for a minimum of 6 hours.
      Travel time is not included as part of duration listed above.

3.09 APPLICATION SCHEDULE

A. Unless otherwise shown or specified, apply coatings in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting Work in question.

B. Coating System CRC-1:
   1. Use in the following areas:
      a. Secondary containment for Ferric Chloride and Sulfuric Acid.
      b. Secondary containment for headworks, sulfuric acid storage shed.
      c. Secondary containment for room with pumps and totes.
      d. Inside influent channels beneath sulfuric acid chemical addition port. Extend coating from the flume inset to the end of the coanda ramp downstream on floors and walls.

C. Coating System CRC-2:
   1. Use in the following areas:
      a. All immersed concrete in the filter area.

3.10 SUPPLEMENTS

A. The supplements listed below, following “End of Section”, are part of this specification.
   1. Chemical-Resistant Coating Data Sheet (CRCDS).
   2. Chemical-Resistant Coating Product Data Sheet (CRCPDS).

END OF SECTION
CHEMICAL-RESISTANT COATING DATA SHEET (CRCDS)

Complete this CRCDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single CRCDS.

<table>
<thead>
<tr>
<th>CRC Number (from Spec.):</th>
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<tbody>
<tr>
<td>CRC System Title (from Spec.):</td>
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<tr>
<td>Coating Manufacturer:</td>
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<td>Representative:</td>
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<tr>
<td>Surface Preparation:</td>
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<table>
<thead>
<tr>
<th>CRC Material (Generic)</th>
<th>Product Name/Number (Proprietary)</th>
<th>Min. Coats, Coverage</th>
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</table>
CHEMICAL-RESISTANT COATING PRODUCT DATA SHEET (CRCPDS)

Complete and attach manufacturer’s Technical Data Sheet to this CRCPDS for each product submitted. Provide manufacturer’s recommendations for the following parameters at temperature (F)/relative humidity.

**PRODUCT:**

<table>
<thead>
<tr>
<th>Temperature/RH</th>
<th>50/50</th>
<th>70/30</th>
<th>90/25</th>
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<tbody>
<tr>
<td>Induction Time</td>
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<tr>
<td>Min. Recoat Time</td>
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<tr>
<td>Max. Recoat Time</td>
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</tbody>
</table>

Provide manufacturer’s recommendations for the following:

**Mixing Ratio:**

**Maximum Permissible Thinning:**

**Ambient Temperature Limitations:** min.: ___________ max.: ___________

**Surface Temperature Limitations:** min.: ___________ max.: ___________

**Surface Profile Requirements:** min.: ___________ max.: ___________
Steel Tank Coatings
SECTION 09 97 13
STEEL TANK COATINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
3. Society for Protective Coatings (SSPC):
   a. Surface Preparation Standards:
      1) SP 1, Solvent Cleaning.
      2) SP 2, Hand Tool Cleaning.
      3) SP 3, Power Tool Cleaning.
      4) SP 5, White Metal Blast Cleaning.
      5) SP 7, Brush-Off Blast Cleaning.
      6) SP 10, Near White Blast Cleaning.
      7) SP 11, Power Tool Cleaning to Bare Metal.
      8) SP 12, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating.
   b. Paint Application Guides:
      1) PA 1, Shop, Field, and Maintenance Painting of Steel.
      2) PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
      4) Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
2. MDFT: Minimum Dry Film Thickness, mils.
3. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
5. PPDS: Paint Product Data Sheet.
7. SP: Surface preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Data Sheets:
   a. For each paint system used, furnish a Paint System Data Sheet (PSDS), Paint Product Data Sheet (PPDS), and paint colors available (where applicable) for each product used in paint system. The PSDS and PPDS forms are appended to the end of this section.
   b. Submit required information on a system-by-system basis.
   c. Provide copies of paint system submittals to coating applicator.
   d. Also provide copies of paint system submittals to the coating applicator.
   e. Indiscriminate submittal of manufacturer’s literature only is not acceptable.

2. Letter from coating manufacturer stating the proposed products are suitable for the intended use.

3. Detailed chemical and gradation analysis for each proposed abrasive material.

4. Samples: For each paint system used, furnish colors available (where applicable) for each product used in paint system.

B. Informational Submittals:

1. Coating Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

2. Current NSF certification for potable water contact, where applicable.

3. Anticipated tank coating sequence.

4. Dehumidification plan, including equipment and air change rates. Submit plan based on type of equipment used, length of time required to hold blast, reservoir volume, and time of year that coating work is undertaken.

5. Applicator’s Qualification: List of references substantiating experience.

6. Shop and field applicator’s quality control program, including, but not limited to:
   a. Environmental test methods and frequency.
   b. Steel surface temperature and profile measurement procedure and frequency.
   c. Record keeping form.

7. Manufacturer’s written instructions for applying each type of coating.

8. When self-contained blast cleaning equipment using recycled abrasives is proposed. Submit the following:
a. List of at least three successful projects within past 3 years where equipment and procedures have been used on steel tank of similar size and dimensions.
b. Provide tank owner’s name and telephone numbers.
c. Description of proposed equipment, procedures, and abrasive blast mix to be used.


10. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years’ experience in application of specified products.

B. Regulatory Requirements: Meet federal, state, and local agencies having jurisdiction for Site and types of work activities included in Project, including, but not limited to:

1. Limitations on emission of volatile organic compounds, dust, and other contaminants.
2. Requirements for disturbance, handling, and disposal of paint waste and associated debris, including lead, coal tar, abrasive, and other regulated substances.

C. Industry Best Practices:

1. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer’s instructions.
   b. SSPC–PA Guide 3.
2. Do not apply paint in temperatures outside of manufacturer’s recommended maximum or minimum allowable, in dust, in smoke-laden atmosphere, in damp or humid weather.
3. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent or whenever surface temperature is less than 5 degrees F above dewpoint of ambient air.

D. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After approval, sample spaces or items shall serve as a standard for similar work throughout the Project.
1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:
   1. Protect precoated items from damage. Batten coated items to prevent abrasion.
   2. Use nonmetallic or padded slings and straps in handling.

B. Deliver materials to Site in unopened containers labeled with designated name, date of manufacture, color, and manufacturer.

C. Store paints in a protected area that is heated or cooled as required to maintain temperatures within range recommended by paint manufacturer.

1.06 SPECIAL GUARANTEE

A. Furnish manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of Work specified in this Specification section found defective during a period of 2 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

1. 24-Month Warranty Period Inspection: Owner will conduct inspection of interior and exterior coated surfaces prior to the end of warranty period. Owner will notify Contractor in advance of inspection and Contractor may attend at its option. Owner will prepare list of coating defects and failures identified during inspection and transmit to Contractor. List shall serve as notice of repairs required under warranty.

2. Repairs:
   a. If repairs are required, requirements of Contract shall apply including, but not limited to, requirements to remove standing water in tanks, perform repair work, and tank cleaning prior to disinfection.
   b. Repair defective coatings using coating materials, equipment, and methods similar to those used in original work. Materials shall be of fresh manufacture and within manufacturer’s stated shelf life at time of application.
   c. Provide extended warranty of 1 year for repairs.
   d. Complete repairs within 30 calendar days of Warranty Period Inspection.
PART 2   PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Carboline Coatings Company, St. Louis, MO.
2. International Protective Coatings, Houston, TX.
3. Sherwin-Williams, Cleveland, OH.
4. Tnemec Coatings, Kansas City, MO.
5. PPG Coatings, Pittsburgh, PA.

2.03 MATERIALS

A. Quality: Manufacturer’s highest quality products and suitable for intended use.

B. Materials Including Primer and Finish Coats: Produced by same paint manufacturer.

C. Thinners, Cleaners, Driers, and Other Additives: As recommended by paint manufacturer of the particular coating.

D. NSF Epoxy, Low VOC: 100 percent solids, two-component epoxy for water tank lining, approved for potable water contact and conforming to NSF/ANSI 61.

E. NSF Epoxy: Polyamidoamine or phenalkamine cured epoxy coatings approved for potable water contact and conforming to NSF/ANSI 61.

F. Epoxy Primer: Two-component, polyamidoamine, phenalkamine, or polyamide cured epoxy, capable of 4-mil to 6-mil dry film thickness, and compatible with specified finish.
G. High Build Epoxy: Two component epoxy, capable of 10 to 15 mils of dry film thickness, and capable with specified finish.

H. Polyurethane Enamel: Two-component, aliphatic or acrylic based polyurethane; high-gloss finish.

I. Flexible Polyurethane: Modified polyurethane flexible lining membrane, approved for potable water contact conforming to NSF/ANSI 61 and compatible with the NSF epoxy.

J. Caulking: Two-component polyurethane caulk, suitable for potable water contact conforming to NSF/ANSI 61 and compatible with the NSF Epoxy.

2.04 COLORS

A. Formulate with colorants free of lead and lead compounds.

B. Exterior coating, furnish as selected by Owner. Interior liner, furnish as designated herein.

C. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

2.05 MIXING

A. Multiple-Component Coatings:

1. Prepare using contents of container for each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Keep paint material containers sealed when not in use.

2.06 ABRASIVES

A. Select abrasive type and size to produce a surface profile that meets coating manufacturer’s recommendations for specific primer and coating system to be applied.

B. Select abrasives that conform to federal and state regulations for metals and toxicity.
2.07 SOURCE QUALITY CONTROL

A. Prime coat structural steel surfaces.

B. Notify Engineer at least 7 days prior to start of shop blast cleaning to allow for inspection of the Work during surface preparation and shop application of paints. Work shall be subject to Engineer’s approval before shipment to Site.

PART 3 EXECUTION

3.01 GENERAL

A. Surface Preparation and Coating Application: Meet or exceed requirements of these Specifications and SSPC–PA 1, whichever is more stringent.

B. Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied.

C. Paint new interior and exterior exposed metal surfaces whether specifically mentioned or not, except as modified herein.

D. Provide Engineer a minimum of 7 days’ advanced notice prior to start of surface preparation work or coating application work. Perform such work only in the presence of Engineer, unless Engineer grants prior approval to perform such work in Engineer’s absence.

E. Schedule inspection with Engineer in advance for cleaned surfaces and coats prior to succeeding coat.

F. Do not apply paint in temperatures outside of manufacturer’s recommended maximum or minimum allowable, or in dust, smoke-laden atmosphere, damp or humid weather.

G. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

H. Ventilation for Coating Cure: Provide fans to continuously ventilate tank interior, as required, to assist with coating cure.

I. Tank liner should be installed prior to cathodic protection installation. Cathodic protection installation may require welding to the interior surface, which will require coating repairs in the area in accordance with this specification.
3.02 PREPARATION

A. Items such as structural steel, metal floor doors, manways, and frames, metal louvers, and similar fabricated items may be shop prepared and primed. Centrifugal wheel blast cleaning is an acceptable alternative to shop blast cleaning.

B. Remove, mask, or otherwise protect hardware, machined surfaces, nameplates, and other surfaces not intended to be painted.

C. Protect surfaces adjacent to or downwind of Work area from overspray.

3.03 ENVIRONMENTAL CONTROLS

A. Containment System:

1. Provide full containment of blast emissions during entire blast operation for tank exterior. Meet requirements of SSPC–Guide 6 as modified below.
   b. Provide Class 1 containment structure. Completely shroud tank with opaque fabric that prevents spread of blast media, spent chips, corrosion byproducts, and dust.
   c. Exhaust air shall be filtered by appropriately sized dust collectors.

2. As an option to containment, consideration will be given to use of self-contained blast cleaning equipment using recycled abrasives.

B. Dehumidification Equipment:

1. Provide full-time dehumidification for field painting interior of reservoir. Dehumidification and heating equipment shall be provided by a supplier with at least 3 years’ experience with necessary equipment.

2. Use dehumidification and heating equipment to control environment 24-hours a day during blast cleaning and coating application. At Contractor’s option, dehumidification equipment may also be used during curing process.

3. Provide desiccant dehumidifiers as manufactured by Cargocaire Corporation, or equal. Desiccant dehumidifiers shall have a single rotary desiccant wheel capable of fully continuous operation. No liquid, granular, or loose lithium chloride drying systems will be allowed.

4. Interior space of reservoir shall be sealed and a slight positive pressure maintained as recommended by supplier of dehumidification equipment.
5. During blasting operation, dehumidification equipment shall continuously maintain a dewpoint of air inside tank at least 5 degrees F less than temperature of coldest part of tank where the Work is underway. Inside relative humidity shall not exceed 45 percent, unless specifically required by paint manufacturer for coating application and cure.

6. Auxiliary heat may be necessary to maintain surface temperature at an acceptable level for application of coating. Auxiliary equipment shall be approved for use by dehumidification equipment supplier and shall meet the following requirements:
   a. Install heaters in process air supply duct between, and blended with, dehumidifier as close to space as possible.
   b. Use electric, indirect fired combustion, or steam coil auxiliary heaters. Direct fired space heaters will not be allowed during blasting, coating, or curing cycles.
   c. Equip heaters with controls that automatically turn heater off if airflow is interrupted or internal temperature of heater exceeds its design temperature or design temperature of supply duct.

7. Measure and record ambient temperature, relative humidity, dewpoint and reservoir wall temperature a minimum of twice daily (beginning and end of work shifts) to verify proper environmental levels are achieved inside reservoir. Field-measured test results shall be made available to Engineer upon request.

C. Filtration System:

1. Designed to remove dust from air so that it does not interfere with dehumidification equipment’s ability to control dewpoint and relative humidity inside reservoir.

2. Air from reservoir or dust filtration equipment shall not be recirculated through dehumidifier during coating application or when solvent vapors are present.

3.04 PREPARATION OF SURFACES

A. Metal Surfaces:

1. Meet requirements of the following SSPC Specifications:
   c. Power Tool Cleaning: SP 3.
   d. White Metal Blast Cleaning: SP 5.
   e. Brush-Off Blast Cleaning: SP 7.
   g. Power Tool Cleaning to Bare Metal: SP 11.
   h. High Pressure Water Jetting: SP 12.
2. Wherever the words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, or “blast cleaning”, or similar words of equal intent are used in these Specifications or in paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.

3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.

4. Preblast Cleaning Requirements:
   a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
   b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
   c. Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.
   d. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
   e. Welds and Adjacent Areas:
      1) Prepare such that there is:
         a) No undercutting or reverse ridges on weld bead.
         b) No weld spatter on or adjacent to weld or other area to be painted.
         c) No sharp peaks or ridges along weld bead.
      2) Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

5. Blast Cleaning Requirements:
   a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer’s recommendations.
   b. Select type and size of abrasive to produce a surface profile that meets coating manufacturer’s recommendations for particular primer to be used.
   c. Use only dry blast cleaning methods.
   d. Do not reuse abrasive, except for designed recyclable systems.
   e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning and disposition of spent aggregate and debris.
6. Post-blast Cleaning and Other Cleaning Requirements:
   a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
   b. Paint surfaces the same day they are blast cleaned. Reblast surfaces that have started to rust before they are coated.

7. Surface Contamination Testing:
   a. A surface contamination analysis test shall be performed every 500 square feet by means of a Chlor Test CSN Salts or approved equivalent.
   b. Surface with chloride levels exceeding 3 μg/square centimeter for submerged surfaces and 5 μg/square centimeter for exposed surfaces shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International, Chandler, AZ).
   c. Follow manufacturer’s recommendations and procedures for the use of this product to remove the surface contamination.

3.05 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior and exterior metal and submerged metal surfaces to be painted, whether specifically mentioned or not, except as modified herein.

2. Coatings Subject to Immersion:
   a. Apply coatings to internal vessel, pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals unless otherwise specified.
   b. Curing:
      1) Obtain full cure for completed system.
      2) Consult coatings manufacturer’s written instructions.
      3) Do not immerse coating until completion of curing cycle.

3. Apply coatings in accordance with paint manufacturer’s recommendations. Allow sufficient time between coats to ensure thorough drying of previously applied coat.

4. Prior to assembly or installation, paint units to be bolted together and to structures.

5. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that required number of coats have been applied.

6. With brush, work coating into and behind anchor bolts, anchor chairs, and other areas that are difficult to paint by spray.
B. Shop Primed Surfaces:

1. Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer.
2. For two-package or converted coatings, consult coatings manufacturer for specific procedures as relates to manufacturer’s products.
3. Prior to application of finish coats, clean shop primed surfaces free of dirt, oil, and grease and apply one coat of specified primer.
4. After welding, prepare and prime holdback areas as required for specified paint system. Apply primer in accordance with manufacturer’s instructions.

C. Stripe Coating:

1. Consists of one coat, brush applied, to coating thickness specified.
2. Apply between intermediate and final coats.
3. Color shall contrast intermediate coat to allow visual verification of application.
4. Apply to field welds, edges, angles, fasteners, and other irregular surfaces located inside tanks.

D. Film Thickness and Coverage:

1. Number of Coats:
   a. Minimum required without regard to coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers’ products, and atmospheric conditions.
2. Maximum film build per coat shall not exceed coating manufacturer’s recommendations.

3.06 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. System No. 1A Submerged Metal—Potable Water:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop: Solvent clean and abrasive blast or centrifugal wheel blast (SP-5)</td>
<td>NSF Epoxy (Shop Applied, White)</td>
<td>1 coat, 4 MDFT</td>
</tr>
<tr>
<td>Field: Detergent wash and fresh water rinse. Brush-off blast shop primer, abrasive blast areas of damaged</td>
<td>NSF Epoxy (white), Spot Repairs and Welds</td>
<td>1 coat, 4 MDFT</td>
</tr>
<tr>
<td></td>
<td>NSF Epoxy Intermediate Coat (grey or beige)</td>
<td>1 coat, 4 MDFT</td>
</tr>
<tr>
<td>Surface Prep.</td>
<td>Paint Material</td>
<td>Min. Coats, Cover</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Primer, and field weld holdback areas to white metal (SP-5)</td>
<td>Stripe Coat with NSF Epoxy</td>
<td>1 coat, 3 MDFT</td>
</tr>
<tr>
<td></td>
<td>NSF Epoxy Finish Coat (white)</td>
<td>1 coat, 4 MDFT</td>
</tr>
</tbody>
</table>

1. Minimum Dry Film Thickness, Total System:
   a. Nonstripe Coated Areas: 12 MDFT.
   b. Stripe Coated Areas: 15 MDFT.

2. Application Schedule:
   a. Use on submerged metal surfaces inside tank, including, but not limited to, steel plates and structural steel, exposed surfaces of inlet, outlet, and overflow piping, hatches, covers, ladders, landings, and couplings.
   b. Coat exposed stainless steel surfaces inside tank. Coat interior surfaces of stainless steel pipe for a distance of 24 inches where stainless steel pipe is connected to coated carbon steel pipe.
   c. Use on exterior surfaces of direct buried and concrete encased steel pipe.
   d. Field coating is not required for bottom side of floor plates. Shop primer is required for bottom side of floor plates.
   e. Provide full coating thickness to structural steel surfaces that will be covered by roof plates or otherwise shielded from full coating thickness, before structural members are installed. Not required for surfaces located behind members that are fully seal welded.

B. System No. 1B Special Coating under Column Baseplate:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop: Solvent clean and abrasive blast or centrifugal wheel blast (SP-5)</td>
<td>NSF Epoxy (Shop Applied)</td>
<td>1 coat, 4 MDFT</td>
</tr>
<tr>
<td>Field: Detergent wash and fresh water rinse. Brush-off blast shop primer, and as required by paint manufacturer</td>
<td>NSF Epoxy</td>
<td>Field applied, as required by paint manufacturer</td>
</tr>
<tr>
<td></td>
<td>Flexible Polyurethane</td>
<td>1 coat, 50 MDFT</td>
</tr>
</tbody>
</table>
1. Minimum Dry Film Thickness, Total System: 54 mils.
2. Application Schedule:
   a. Use on bottom of column baseplate and top of steel floor surface under baseplate.
   b. Prepare surfaces and apply coating prior to installation of columns.
   c. Extend flexible polyurethane coating on floor 2 inches beyond outside perimeter of column baseplate.

C. System No. 5 Exposed Metal:

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop: Abrasive blast, or centrifugal wheel blast (SP 10)</td>
<td>Polyamide, Anticorrosive Epoxy Primer</td>
<td>1 coat, 2.5 MDFT</td>
</tr>
<tr>
<td>Field: Detergent wash and fresh water rinse. Brush-off blast shop primer, abrasive blast areas of damaged primer and field weld holdback areas to white metal (SP-10)</td>
<td>Polyamide, Anticorrosive Epoxy Primer</td>
<td>1 coat, 3 MDFT</td>
</tr>
<tr>
<td></td>
<td>Polyurethane Enamel</td>
<td>1 coat, 3 MDFT</td>
</tr>
</tbody>
</table>

1. Minimum Dry Film Thickness, Total System: 8.5 mils.
2. Application Schedule:
   a. Use on the following:
      1) Exposed exterior metal surfaces of tank.

D. System No. 6 Skid Resistant Roof Coating

<table>
<thead>
<tr>
<th>Surface Prep.</th>
<th>Paint Material</th>
<th>Min. Coats, Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop: Abrasive blast, or centrifugal wheel blast (SP 10)</td>
<td>Polyamide, Anticorrosive Epoxy Primer</td>
<td>1 coat, 2.5 MDFT</td>
</tr>
<tr>
<td>Field: Detergent wash and fresh water rinse. Brush-off blast shop primer, abrasive blast areas of damaged primer and field weld holdback areas to white metal (SP-10)</td>
<td>High Build Epoxy</td>
<td>1 coat, 8 MDFT</td>
</tr>
<tr>
<td></td>
<td>Broadcast 40/60 mesh sand into wet coat of epoxy until rejection. After resin is cured, remove excess aggregate.</td>
<td>1 coat, 8 MDFT</td>
</tr>
</tbody>
</table>
Surface Prep. | Paint Material | Min. Coats, Cover
--- | --- | ---
 | Polyurethane Enamel | 1 coat, 4 MDFT |

1. Minimum Dry Film Thickness, Total System: 25.5 mils.

2. Application Schedule:
   a. Use on the following:
      1) Vent access way on roof of tank.

3.07 FIELD QUALITY CONTROL

A. Test Equipment:
   1. Provide a dry film thickness gauge to test coating thickness as specified in mils. Use magnetic type dry film thickness gauge as manufactured by Nordson Corp., Anaheim, CA, Milrotest, an electronic dry film thickness, as manufactured by DeFelsko, Ogdensburg, NY, Positester approved equal.
   2. Provide electrical holiday detector, low voltage, wet sponge type to test finish coat, except zinc primer, high-build elastomeric coatings, and galvanizing as manufactured by Tinker and Rasor, San Gabriel, CA; Model M-1.

B. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   1. Perform with properly calibrated instruments.
   2. Repair or recoat defective areas as necessary for compliance with Specifications.
   3. All coats are subject to inspection by Engineer and coating manufacturer’s representative.
   4. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.

C. Thickness Testing:
   1. Measure coating thickness specified in mils with magnetic or electronic type dry film thickness gauge in accordance with SSPC–PA 2.
   2. Check each coat for correct thickness. Do not make measurement before a minimum of 8 hours after application of coating.
   3. After repaired and recoated areas have dried sufficiently, tests will be conducted by Engineer.
D. Holiday (Pinhole) Testing: Test finish coat on 100 percent submerged surfaces for holidays and discontinuities with electrical holiday detector in accordance with NACE SP0188.

E. Unsatisfactory Application:

1. If improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections are causes for rejection.
3. Repair defects in coating systems in accordance with written recommendations of coating manufacturer.
4. Leave staging up until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer.

F. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat in accordance with Specifications. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.08 MANUFACTURER’S SERVICES

A. Coating manufacturer’s technical representative shall be present at Site as follows:

1. On the first day of application of coating.
2. A minimum of three additional Site inspection visits, each for a minimum of 3 hours.
3. As required for application quality assurance, and to determine compliance with manufacturer’s instructions and these Specifications.
4. As necessary to resolve field problems attributable to or associated with manufacturer’s products furnished under this Contract.
5. To verify full cure of coating prior to placing coated surfaces into immersion service.
3.09 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave Site clean.

3.10 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification:

1. Data Sheet: Example Paint System Data Sheet (PSDS).
2. Data Sheet: Example Paint Product Data Sheet (PPDS).

END OF SECTION
**PAINT SYSTEM DATA SHEET**

Complete and attach manufacturer’s Technical Data Sheet to this PSDS for each coating system.

<table>
<thead>
<tr>
<th>Paint System Number (from Spec.):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint System Title (from Spec.):</td>
<td></td>
</tr>
<tr>
<td>Coating Supplier:</td>
<td></td>
</tr>
<tr>
<td>Representative:</td>
<td></td>
</tr>
<tr>
<td>Surface Preparation:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Paint Material (Generic)</th>
<th>Product Name/Number (Proprietary)</th>
<th>Min. Coats, Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Provide manufacturer’s recommendations for the following parameters at temperature (F)/relative humidity:

<table>
<thead>
<tr>
<th>Temperature/RH</th>
<th>50/50</th>
<th>70/30</th>
<th>90/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Induction Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pot Life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelf Life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drying Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curing Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Recoat Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Recoat Time</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Provide manufacturer’s recommendations for the following:

Mixing Ratio: ________________________________________________

Maximum Permissible Thinning: ________________________________

Ambient Temperature Limitations: min.: ___________ max.: ___________

Surface Temperature Limitations: min.: ___________ max.: ___________

Surface Profile Requirements: min.: ___________ max.: ___________

Attach additional sheets detailing manufacturer’s recommended storage requirements and holiday testing procedures.
**PAINT PRODUCT DATA SHEET**

Complete and attach manufacturer’s Technical Data Sheet to this PDS for each product submitted. Provide manufacturer’s recommendations for the following parameters at temperature (F)/relative humidity:

<table>
<thead>
<tr>
<th>Temperature/RH</th>
<th>50/50</th>
<th>70/30</th>
<th>90/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Induction Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pot Life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelf Life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drying Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curing Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Recoat Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Recoat Time</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Provide manufacturer’s recommendations for the following:

- Mixing Ratio: ________________________________
- Maximum Permissible Thinning: ________________________________
- Ambient Temperature Limitations: min.: __________ max.: __________
- Surface Temperature Limitations: min.: __________ max.: __________
- Surface Profile Requirements: min.: __________ max.: __________

Attach additional sheets detailing manufacturer’s recommended storage requirements and holiday testing procedures.
**Quality Control**

W. Laird Ellis, Jr.

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 10:44:38 -06'00'

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**Revision History:**

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<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>Issue for Construction</td>
<td>June 23, 2017</td>
<td>All</td>
</tr>
</tbody>
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**Document Review & Approval:**

**Originator:**

Mark Sharp, Lead Architect

NAME/POSITION

SIGNATURE

6/22/2017

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control

NAME/POSITION

SIGNATURE

6/22/2017

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

W. Laird Ellis, Jr.

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 10:44:38 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

2. ASTM International (ASTM):
3. The Chlorine Institute, Inc.: WC-1, Wall Chart: Handling Chlorine Cylinders and Ton Containers.
4. International Code Council (ICC):
5. National Fire Protection Association (NFPA):
6. Occupational Safety and Health Act (OSHA).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Drawings showing layouts, actual letter sizes and styles, and Project-specific mounting details.
   b. Manufacturer’s literature showing letter sizes and styles, sign materials, and standard mounting details.
2. Samples: One full size for each type of nameplate, sign, and label specified.

B. Informational Submittals:

1. Manufacturer’s installation instructions.
PART 2 PRODUCTS

2.01 DOOR NAMEPLATES

A. Material: Plastic with square corners.

B. Thickness: 1/8-inch.

C. Height: 2 inches.

D. Finish: Nondirectional matte.

E. Background: Black.

F. Letters: Engraved.

1. Size: 1 inch high.
4. Message Text: As shown on Door and Hardware Schedule.

G. Manufacturers and Products:


2.02 SIGNS

A. Plastic Sign (Type A):

1. Exterior: Laminated plastic subsurface image type, 3/16 inch thick with high-gloss finish.
2. Interior: Plastic, 1/8 inch thick with nondirectional matte finish and engraved letters.
3. Rounded corners.

B. Metal Sign (Type B):

1. Material: Baked enamel finished 20-gauge (minimum) steel or 18-gauge (minimum) aluminum signs.
2. Manufacturers:
   a. Seton Identification Products.
   b. Nutheme Illustrated Safety Co.
C. Fiberglass Sign (Type C):

1. Material: Three-ply laminated fiberglass, minimum 1/8 inch thick, with contrasting color core message layer between two clear weather-resistant surface layers.
2. Manufacturers:
   a. Best Manufacturing Co.
   b. Brady Signmark.

D. Traffic Sign (Type D):


E. Exit Sign: Refer to Electrical Drawings.

F. Hazardous Material Sign (Type H):

1. Conform to OSHA Globally Harmonized System.
4. Manufacturers:
   a. Brady Signmark.
   b. Emed Co., Inc.

2.03 IDENTIFICATION LABELS

A. Pipe Labels: See Section 40 27 00, Process Piping—General.

B. Equipment Labels:

1. Applies to equipment with assigned tag numbers, where specified.
2. Label to include process description along with equipment number.
5. Materials:
   a. Aluminum or stainless steel with a baked-on finish suitable for use on wet, oily, exposed, abrasive, and corrosive areas.
   b. Fiberglass with encased lettering.
6. Furnish 1-inch margin with holes at each end of label, for mounting. On fiberglass labels, furnish grommets at each hole.
7. **Size:**
   a. 2 inches minimum and 3 inches maximum high, by 14 inches minimum and 18 inches maximum long.
   b. Furnish same size base dimensions for all labels.
8. **Message:** Equipment names and tag numbers as used in sections where equipment is specified.
9. **Manufacturers:**
   a. Brady Signmark.
   b. Seton Identification Products.

### 2.04 ANCILLARY MATERIALS

A. **Fasteners:** Stainless steel screws or bolts of appropriate sizes.

B. **Wood Posts:** Preservative treated 4 by 4 wood as specified in Section 06 10 00, Rough Carpentry.

C. **Pipe Posts:** 2-1/2-inch galvanized steel pipe meeting ASTM A53/A53M, Type S, Grade B.

D. **Chain:** Type 304 stainless steel, No. 16 single jack chain or No. 2 double loop coil chain.

E. Manufacturer’s standard brackets for wall mounting of two-sided exit signs.

### PART 3 EXECUTION

#### 3.01 INSTALLATION—GENERAL

A. In accordance with manufacturer’s recommendations.

B. Mount securely, plumb, and level.

#### 3.02 DOOR NAMEPLATES AND PICTORIAL SYMBOLS

A. Attach to doors or walls adjacent to doors with self-sticking removable adhesive. See Door and Hardware Schedule for locations and messages.

B. Mount with bottom of nameplate at 5 feet 6 inches above floor.

#### 3.03 SIGNS

A. **General:**
   1. Fasten to walls or posts, or hang as scheduled.
   2. Anchor in place for easy removal and reinstallation with ordinary hand tools.
B. Information and Safety Signs: Install facing traffic. Locate for high visibility with minimum restriction of working area around walkways and equipment and as scheduled.

C. Traffic Signs: Mount each sign on scheduled support using two 1/4-inch stainless steel bolts through sign and post. Install facing traffic at locations and in manner shown in U.S. Department of Transportation, Federal Highway Administration Manual on Uniform Traffic Control Devices for Streets and Highways.

D. Hazardous Material Sign:

1. Install where required by OSHA, NFPA No. 704 and IFC, Chapter 27.
2. Provide signs with information required by OSHA Globally Harmonized System. See A941002-F-0021.
3. Install at entrances to spaces where hazardous materials are stored, dispensed, used, or handled, and on sides of stationary tanks.
4. Specific Materials:

<table>
<thead>
<tr>
<th>Mark</th>
<th>Material</th>
<th>Signal Word</th>
<th>Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-6</td>
<td>Ferric Chloride (35-40% solution)</td>
<td>Danger</td>
<td>CORROSIVE</td>
</tr>
<tr>
<td>H-13</td>
<td>Sodium Bisulfite (25-40% solution)</td>
<td>Danger</td>
<td>IRRITANT</td>
</tr>
<tr>
<td>H-14</td>
<td>Sodium Hydroxide (10-30% solution)</td>
<td>Danger</td>
<td>CORROSIVE</td>
</tr>
<tr>
<td>H-19</td>
<td>Sulfuric Acid (92-98% solution)</td>
<td>Danger</td>
<td>CORROSIVE WATER REACTIVE</td>
</tr>
</tbody>
</table>

3.04 IDENTIFICATION LABELS

A. Pipe Labels:

1. Locate at connections to equipment, valves, or branching fittings at wall boundaries.
2. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
3. At exposed piping not normally in view, such as above suspended ceilings and in closets and cabinets.
4. Supplementary Labels: Provide to Owner those listed on Piping Schedule that do not receive arrows.
5. Apply to pipe after painting in vicinity is complete, or as approved by Engineer.
6. Install in accordance with manufacturer’s instructions.

B. Equipment Labels:

1. Locate and install on equipment or concrete equipment base as shown on Drawings.
2. Anchor to equipment or base for easy removal and replacement with ordinary hand tools.

3.05 SUPPLEMENTS

A. The supplement listed below, following “End of Section,” is a part of this specification.

1. Sign Schedule: Tabulation of characteristics and mounting information for each sign numbered on Drawings. Provide items as scheduled. Meet requirements of Occupational Safety and Health Act (OSHA).

END OF SECTION
<table>
<thead>
<tr>
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<td>20&quot;</td>
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<td>Yellow</td>
<td>Hanging</td>
<td>Chain</td>
<td>5'-6&quot;</td>
<td>1&quot; min.</td>
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<td>Black</td>
<td>CAUTION Equipment Starts Automatically</td>
<td>2</td>
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<td>Chain</td>
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<td>1&quot; min.</td>
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<td>Black</td>
<td>CAUTION Loud Equipment Wear proper Hearing Protection nearby</td>
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<td>14&quot;</td>
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<td>Wall</td>
<td>Bolts</td>
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<td>Black</td>
<td>CAUTION Sudden Discharge of Water Possible</td>
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<td>CAUTION Remove Handrails Only When Cleaning Rack</td>
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<td>Bolts</td>
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<td>Black</td>
<td>CAUTION NO SMOKING</td>
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<td>D-1</td>
<td>C</td>
<td>1014-001</td>
<td>20&quot;</td>
<td>14&quot;</td>
<td>White</td>
<td>Door</td>
<td>Screws or Bolts</td>
<td>5'-6&quot;</td>
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<td>Helvetica</td>
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<td>DANGER High Voltage</td>
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<td>White</td>
<td>Door</td>
<td>Screws</td>
<td>5'-6&quot;</td>
<td>1&quot; min.</td>
<td>Helvetica</td>
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<td>Bolts</td>
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<td>1&quot;</td>
<td>Helvetica</td>
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<td><strong>DANGER RESTRICTED ACCESS, AUTHORIZED PERSONNEL ONLY. DO NOT ENTER FILTER OR CHANNEL WHILE IN OPERATION</strong></td>
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<td>Bolts</td>
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<td><strong>DANGER SULFURIC ACID FEED POINT. EQUIPMENT STARTS AUTOMATICALLY</strong></td>
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<td>Pipe Post</td>
<td>Bolts</td>
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<td>Black</td>
<td><strong>DANGER SULFURIC ACID</strong></td>
<td>2</td>
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<td>D-8</td>
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<td>14&quot;</td>
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<td>Door</td>
<td>Screws</td>
<td>5'-6&quot;</td>
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<td>D-9</td>
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<td>N/A</td>
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<td>White</td>
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**DANGER**
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<td>Bolts</td>
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<td>Black NO SWIMMING OR DIVING ALLOWED</td>
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<td>Screws</td>
<td>5'-6&quot;</td>
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<td>min.</td>
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<td>Black NOTICE SOLID BEARING MATERIAL ONLY, NO LIQUIDS</td>
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<td>Screws</td>
<td>5'-6&quot;</td>
<td>1&quot;</td>
<td>min.</td>
<td>Helvetica</td>
<td>Black NOTICE LIQUID ONLY, NO SOLID BEARING MATERIAL</td>
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<td>White</td>
<td>Wall or Pipe Post</td>
<td>Screws</td>
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<td>Screws</td>
<td>5'-6&quot;</td>
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<td>min.</td>
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<td>Screws</td>
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<td>Wall or Pipe Post</td>
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<td>30&quot;</td>
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<td>Message</td>
<td>Faces</td>
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<td>Orange</td>
<td>Wall</td>
<td>Bolts</td>
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<td>1&quot; min.</td>
<td>Helvetica</td>
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<td>WARNING HEALTH HAZARD, PROCESS SOLIDS AND LIQUIDS CONTAIN MERCURY. WEAR PROPER PPE WHEN HANDLING</td>
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<td>W-3</td>
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<td>1014-003</td>
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<td>14&quot;</td>
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<td>Bolts</td>
<td>5'6&quot;</td>
<td>1&quot; min.</td>
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<td>Black</td>
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<td>14&quot;</td>
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<td>Wall</td>
<td>Bolts</td>
<td>5'6&quot;</td>
<td>1&quot; min.</td>
<td>Helvetica</td>
<td>Black</td>
<td>WARNING DO NOT EXCEED MAX LOAD CAPACITY 2 TONS</td>
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<tr>
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<td>Wall</td>
<td>Bolts</td>
<td>5'6&quot;</td>
<td>1&quot; min.</td>
<td>Helvetica</td>
<td>Black</td>
<td>WARNING SLIP HAZARD, FLOOR SLIPPERY WHEN WET</td>
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<tr>
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<td>C</td>
<td>1014-003</td>
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<td>14&quot;</td>
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<td>Wall</td>
<td>Bolts</td>
<td>5'6&quot;</td>
<td>1&quot; min.</td>
<td>Helvetica</td>
<td>Black</td>
<td>WARNING FALL HAZARD. FALL PROTECTION EQUIPMENT MUST BE WORN BEYOND THIS POINT</td>
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<td>Other Requirements</td>
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</table>
| W-7 | C    | 1014-003| 20"   | 14"    | Orange | Wall     | Bolts        | 5'-6"  | Helvetica| Black | WARNING NOISE HAZARD. EAR PROTECTION MUST BE WORN WHEN WORKING IN THIS AREA FOR MORE THAN 20 MINUTES | 2     | 1Numbers refer to a particular sign type with a particular message.  
2Letters refer to sign types specified in this section.  
3Numbers refer to Design Details that show sign layout. See A941002-F-0021.  
4Verify requirements for this sign with Laws and Regulations in state where Project is located. |
# UCOR-FM-001, REV. 0 - SPECIFICATION COVER SHEET

**Specification Document Control No.:** 10 28 00  
**Revision No.:** 0  
**Project:** Outfall 200 Mercury Treatment Facility  
**Engineering Discipline:** Architectural  
**Specification Division:** 10 – Specialties  
**Date:** 6/23/2017

### Specification Title & Description:
(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Toilet Accessories

<table>
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<th>Description</th>
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<th>Affected Pages</th>
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<td>Issue for Construction</td>
<td>June 23, 2017</td>
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### Document Review & Approval:

**Originator:**  
Mark Sharp, Lead Architect  
**NAME/POSITION**  
**SIGNATURE**  
6/22/2017

**Design Verification Complete:**  
Stephen J. Silkworth - Quality Control  
**NAME/POSITION**  
**SIGNATURE**  
6/22/2017

**Approved:**  
W. Laird Ellis, Jr. PE/Design Manager  
**NAME/POSITION**  
**SIGNATURE**  
Digitally signed by W. Laird Ellis, Jr.  
Date: 2017.06.23 10:47:29 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:


1.02 DESIGN REQUIREMENTS

A. Design grab bars, and attachments to resist minimum 250-pound concentrated load applied at any point in any direction.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Manufacturer’s literature clearly indicating:
      1) Engineer’s identification mark, size, and description of components.
      2) Base material with surface finish inside and out.
      3) Hardware and attachment devices.
      4) Description of rough-in framing.
      5) Details of blocking and anchorage required.

B. Informational Submittals:

1. Distributor’s List: List of local distributors for supplies required for accessories installed.
2. Cleaning instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials and products specified in this section shall be products of:

1. Bobrick Washroom Equipment, Inc.
2. Bradley Corp.
3. Accessory Specialties, Inc.
2.02 TOILET AND BATH ACCESSORIES

A. Furnish accessory items listed where indicated by mark or note on Drawings.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mark</th>
<th>Bobrick</th>
<th>Bradley</th>
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<tbody>
<tr>
<td>Surf. Mounted Shelf, Dual Roll Paper Dispenser</td>
<td>TPD-S</td>
<td>No. B-2840</td>
<td>No. 5263</td>
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<tr>
<td>Wall Mounted Liquid Soap Dispenser</td>
<td>SD-2</td>
<td>No. B-4112</td>
<td>No. 6542</td>
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<tr>
<td>Tilt Mirror-Adjustable, Size on Dwgs</td>
<td>MIR-T</td>
<td>No. B-293</td>
<td>No. 782</td>
</tr>
<tr>
<td>Surf Mounted Roll Paper Towel Dispenser and Receptacle</td>
<td>PTD/R-2</td>
<td>No. B-39619</td>
<td>No. 236-11</td>
</tr>
<tr>
<td>Surf. Mounted Seat Cover dispenser</td>
<td>SCD-2</td>
<td>No. B-221</td>
<td>No. 5831</td>
</tr>
<tr>
<td>Mop and Broom Holder (24&quot;)</td>
<td>M&amp;BH</td>
<td>No. B-223 x 24</td>
<td>No. 9953</td>
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<tr>
<td>Robe Hook</td>
<td>RH</td>
<td>No. B-6727</td>
<td>No. 9124</td>
</tr>
<tr>
<td>Grab Bars (straight), 18&quot; for Vertical Mounting</td>
<td>GB-3</td>
<td>No. B-6806-18</td>
<td>No. 812-001-18</td>
</tr>
<tr>
<td>Grab Bars (toilet, corner type)</td>
<td>GB-5</td>
<td>No. B-68137</td>
<td>No. 812-059</td>
</tr>
</tbody>
</table>

B. Finish:

1. Satin stainless steel.
2. Manufacturer’s or brand name on face of units is not acceptable.

C. Anchors: Furnish anchors, fasteners, or other devices necessary for a complete, secure installation.

D. Supplies: Furnish fill supplies, such as paper goods, soap, as recommended by accessory manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate support framing and backing as necessary for proper installation of accessories.
B. Coordinate the Work with placement of internal wall reinforcement to receive anchor attachments.

3.02 INSTALLATION

A. Mounting Heights and Locations: Locate where mark is shown on Drawings at height required by accessibility regulations and as indicated on the Drawings.

B. Follow manufacturer’s instruction and recommendations.

C. Install and securely anchor accessories in their proper locations, plumb and level, and without distortion.

D. Remove protective masking and clean surfaces, leaving them free of soil and imperfections.

E. Fill units with necessary supplies within 10 days before Substantial Completion.

F. Deliver to Owner keys and devices required to fill and service units.

3.03 CLEANING

A. Clean and repair existing toilet accessories which remain or are to be reinstalled.

END OF SECTION
**Portable Fire and Safety Equipment**

**Revision History:**

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**Document Review & Approval:**

**Originator:**

Mark Sharp, Lead Architect

NAME POSITION

Mark Sharp

SIGNATURE

6/22/2017

**Design Verification Complete:**

Stephen J. Silkworth - Quality Control

NAME POSITION

Stephen J. Silkworth

SIGNATURE

6/22/2017

**Approved:**

W. Laird Ellis, Jr. PE/Design Manager

W. Laird Ellis, Jr.

Digitally signed by W. Laird Ellis, Jr.

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PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Factory Mutual (FM).
2. National Fire Protection Association (NFPA):
   a. 10, Standard for Portable Fire Extinguishers.
   b. 30, Flammable and Combustible Liquids Code.
4. Occupational Safety and Health Act (OSHA).

1.02 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

1.03 SUBMITTALS

A. Action Submittals:

   1. Fire Extinguishers: Submit manufacturer’s product data for each item, including sizes, ratings, UL listings, or other certifications, and mounting information.

B. Informational Submittals:

   1. Manufacturer’s Installation Instructions.
   2. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Section 01 61 00, Common Product Requirements: Environmental conditions affecting products onsite.

B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.
PART 2 PRODUCTS

2.01 PORTABLE FIRE EXTINGUISHERS

A. Manufacturers and Products:

1. JL Industries.
2. Larsen’s Manufacturing Co.
3. Nystrom Products Co.
4. Potter Roemer.

B. General:

1. Conform to NFPA 10 for fire extinguishers.
2. UL listed, charged and ready for service.

C. Multipurpose Hand Extinguisher (F. Ext):

1. Tri-class dry chemical extinguishing agent.
2. Pressurized, red enameled steel shell cylinder.
3. Activated by top squeeze handle.
4. Agent propelled through hose or opening at top of unit.
5. For use on A, B, and C class fires.

2.02 FIRST-AID CABINETS AND SUPPLIES

A. Manufacturers:

1. Afassco, Inc.
2. Johnson & Johnson.
3. Zee Medical Products Co., Inc.

B. Cases:

1. Enameled metal or break-resistant plastic.
2. Carrying handles.
3. Made to hang on wall.

C. Supplies: Quantities to serve five people.

2.03 ACCESSORIES

A. Extinguisher Brackets: For hand extinguishers not located in cabinets, furnish heavy-duty brackets with clip-together strap for wall mounting formed steel, chromed, or galvanized finish.
B. Fasteners: Furnish necessary screws, bolts, brackets, and other fastenings of suitable type and size to secure items of fire and safety equipment in position.

1. Metal expansion shields for machine screws at concrete and masonry.

PART 3  EXECUTION

3.01 INSTALLATION

A. Install where indicated or directed or directed by Owner in the field, and following manufacturer’s recommendations.

B. Provide adequate backing for mounting surfaces.

C. Place extinguishers on wall brackets.

D. Top of Extinguisher: No more than 54 inches above floor.

END OF SECTION
Quality Control

W. Laird Ellis, Jr.

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PART 1  GENERAL

1.01  SUMMARY

A. Section includes:

1. Monorail crane.
2. Portable fire extinguishers.
3. Toilet room accessories.

1.02  REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International:

1.03  SUBMITTALS

A. Action Submittals:

1. Shop Drawings, showing dimensions, connection details.
2. Manufacturers’ descriptions, installation data, color charts, and cleaning and service instructions for all items proposed for use. Clearly identify each item.

PART 2  PRODUCTS

2.01  MONORAIL CRANE

A. Single girder under running crane at Grit Pump Building.

2. Lift Height: 45 feet.
3. Lift Speed: 10 feet per minute minimum.
4. Span: 12 feet.
5. 120V, single-phase motor with Class F insulation.
B. Single girder under running crane at Treatment Building.

2. Lift Height: 35 feet.
3. Lift Speed: 10 feet per minute minimum.
5. 120V, single-phase motor with Class F insulation.

C. Manufacturers and Products:

1. Wright Speedway.
2. American Crane, Yale Series.
3. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION OF SPECIALTIES

A. Follow manufacturer’s recommendations and printed instructions. Consult with Engineer so that minor adjustments in the locations can be decided if necessary.

1. Install materials plumb or level as applicable and attach securely to adjacent materials with suitable fasteners.
2. Prevent damaging adjacent materials during installation.

END OF SECTION
### Specification Title & Description:
(List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Window Treatments

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### Document Review & Approval:

**Originator:**
Mark Sharp, Lead Architect

**Design Verification Complete:**
Stephen J. Silkworth - Quality Control

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

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PART 1    GENERAL

1.01 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Details of installation indicating size, attachments, and clearances of operating hardware with other construction.

B. Informational Submittals: Manufacturer’s written instructions for the care, repair, and cleaning of all components provided in the Work. Include a detailed list of hardware parts identified by manufacturer’s catalog numbers and diagrams of installation methods. Include color selection chart.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Handle in accordance with manufacturer’s instructions.

B. Storage and Protection: Store blinds and accessories in unopened packages in manner to prevent damage from environmental and construction operations.

PART 2    PRODUCTS

2.01 MANUFACTURED UNITS

A. Horizontal Blinds: Aluminum horizontal slats 1 inch wide supported by braided ladders and hardware enclosed in a metal head.

1. Slat Supports:
   a. Braided ladders of polyester yarn, the vertical component not less than 0.045-inch diameter nor greater than 0.068-inch diameter for maximum strength and flexibility with minimum stretch.
   b. Support slats parallel and straight to assure proper tilt control and adequate overlap of slats.
   c. 15 rungs per foot of ladder equally spaced at 0.788-inch intervals.
   d. Distance between ladders, not exceeding 24 inches.
   e. The horizontal component of rungs consist of not less than two cables interbraided with the vertical components.

2. Slats: Type 6011 spring tempered aluminum alloyed for maximum strength, flexibility, and resistance to internal and external corrosion; 0.984 inch wide and 0.008 inch thick before painting; paint 1.5 mils thick.

3. Headrail: Channel-shaped steel section, 0.025 inch thick complete with tilting mechanism operated by turning wand.
4. Bottom Rail: Steel 0.031 inch thick, finished with a plastic type coating cured at high temperature and formed after coating.
5. Lift Cord: Adequate diameter braided of high strength synthetic fibers to provide minimum stretch and maximum strength and flexibility.
6. Manufacturers and Products:
   a. Levolor Lorentzen, Inc., Lyndhurst, NJ 07071; Riviera Blind.
   b. Marathon Carey-McFall, Montoursville, PA 17754; Bali Blinds

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify field measurements of openings to receive blinds, and provide systems in coordination with work of other trades. Delay installation until all other finish Work in spaces is complete.

3.02 BLIND INSTALLATION
   A. Install the hardware to manufacturer’s recommendations as approved for conditions of the installation. Install in accurate locations, make plumb, true to line, complete with accessories required for satisfactory operations, attach to building construction using approved type of fasteners so as to be rigid and secure, taking care to prevent cracking, marring, or other damage to adjacent finished surfaces.

3.03 ADJUSTING
   A. After installation, test and adjust each unit.

3.04 CLEANING
   A. Leave installation in a clean and dust-free condition.

3.05 INSTALLATION SCHEDULE
   A. Install blinds at windows as indicated in Window Schedule.

END OF SECTION
Metal Building Systems

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**Originator:**
Mark Sharp, Lead Architect

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**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

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SECTION 13 34 19
METAL BUILDING SYSTEMS

PART 1  GENERAL

1.01  REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Architectural Manufacturers’ Association (AAMA):

2. American Institute of Steel Construction (AISC):
   a. 360, Specification for Structural Steel Buildings.
   b. RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.

3. American Iron and Steel Institute (AISI): Specification for the Design of Cold-Formed Steel Structural Members.


5. ASTM International (ASTM):
   g. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
1.02 SYSTEM DESCRIPTIONS

A. Grit Pump Building:

1. Pre-engineered building framing package using manufacturer’s standard components.
   a. Primary Framing System: Clear span rigid frame.
   b. Lateral Support System in Longitudinal Direction: Cross bracing, located as shown on Drawings.

2. Pre-engineered building manufacturer to include:
   a. Secondary Framing: Girts, purlins and framing around openings and for supported equipment in coordination with GC.
   b. Insulation.

3. GC to provide roof, wall and liner panel systems, rain gutters and downspouts as described in this section and Section 07 40 00, Roofing and Siding Panels.

4. GC to provide building sheathing at corner of building adjacent to the Chemical Feed Building to provide a 1-hour fire rating as shown on Drawings.

B. Treatment Building:

1. GC to provide all parts of the building envelope, including roof, wall and liner panel systems, rain gutters and downspouts as described in this section and Section 07 40 00, Roofing and Siding Panels.
C. Storage Tank Shelter: GC to provide all parts of the shelter, including roof panel system, rain gutters and downspouts as described in this section and Section 07 40 00, Roofing and Siding Panels.

D. Dumpster Shelter: GC to provide all parts of the building envelope, including roof panel system, rain gutters and downspouts as described in this section and Section 07 40 00, Roofing and Siding Panels.

1.03 DESIGN REQUIREMENTS


B. Refer to design criteria on Drawing General Structural Notes.

C. Snow Load, Wind Load Earthquake Load and Seismic Parameters: See General Structural Notes.

D. Minimum Roof Live Load: 20 pounds per square foot.

E. Building system dead load.

F. Mechanical and Electrical Equipment Loads:
   1. Purlins and Secondary Framing: As indicated on Drawings, minimum 10 pounds per square foot collateral load.
   2. Primary Frames: As indicated on Drawings, minimum 5 pounds per square foot collateral load.

G. Special Equipment Location, as shown on Drawings:
   1. Monorail: 2-ton capacity.

H. Wind Load:
   1. Basic Wind Speed: 120 miles per hour.
   2. Exposure Category (Ce): B.
   3. Risk Category III.

I. Earthquake Load:
   1. Importance Factor (I): 1.25.
   2. Soil Site Class: D.
3. Seismic Parameters:
   a. $S_s$: 0.375.
   b. $S_l$: 0.121.
   c. $S_{DS}$: 0.375.
   d. $S_{D1}$: 0.187.
4. Seismic Design Category: C.

J. Deflection Criteria:
   1. In accordance with the applicable provisions of the AISC Design Guide 3. Conformance is required to deflection criteria as stated in the Appendix.
   2. Applies to primary and secondary framing members, bracing members, roof panels, and wall cladding.

K. Design Standards:
   1. AISC 360.
   2. AISC RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
   3. AISI Specification for the Design of Cold-Formed Steel Structural Members.
   4. AWS D1.1/D1.1M.

L. Consider prying action of bolts for bolted moment-resistant connections in primary framing.

M. Design column bases as pinned, unless specifically indicated otherwise.

1.04 CONTRACTOR/METAL BUILDING MANUFACTURER COORDINATION

A. Metal building shop drawings are to be submitted and approved prior to forming of foundation concrete or fabrication of foundation reinforcing steel. Specific attention shall be given to providing for adequate size of concrete column pilasters for steel column baseplates and its associated anchor bolt template.

B. Contractor shall verify interface of building components with foundation and coordinate required foundation revisions with Engineer.

C. Metal building supplier shall coordinate size and configuration of all rough openings with Contractor for Contractor installed doors and louvers.
1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Manufacturer’s literature and technical data.
   b. Drawings Stamped by Engineer:
      1) Drawings shall be specifically prepared for this Project.
      2) Mark out details that do not apply to Project.
      3) Show design load criteria, material specifications for
         framing members and connections, roof framing plan with
         dimensions and member sizes, baseplate details showing
         anchor bolt size and bolt layout, elevations of wall framing
         and bracing, instructions for temporary bracing, framing
         around roof and wall openings, details for joining and
         sealing of roof panels and wall cladding, and sections and
         details for all components and accessories.
   c. Painting System: Specifications; include paint manufacturer’s
      name, product trade name, and preparation for shop and field
      coats.

B. Informational Submittals:

1. Structural Calculations Stamped by Engineer:
   a. Complete analysis and design of structural components and
      connections in accordance with design requirements indicated.
   b. Summary of building column reactions to foundation level for
      load cases.
   c. Mark out calculations that do not apply to Project.
2. Manufacturer’s written instructions for shipping, handling, storage,
   protection, and erection or installation of building and components.
3. Manufacturer: IAS Quality Certification: IAS certificate showing name
   and address of manufacturer, effective date, and category of
   certification.
4. Erector:
   a. IAS Quality Certification: IAS certificate showing name and
      address of erector, effective date, and category of certification, or,
      in lieu of IAS certification, documentation of past 5 years’
      experience record to include project name, location, date of
      completion, building manufacturer, and name and phone number
      of Owner’s contact person.
   b. Certification of approval by manufacturer.
5. Manufacturer’s Certificate of Proper Installation, in accordance with
   Section 01 43 33, Manufacturers’ Field Services.
1.06 QUALITY ASSURANCE

A. Qualifications:

1. Designer: Registered professional engineer valid in same state as Project.
3. Erector:
   a. IAS Quality Certification as Certified Steel Erector (CSE), or 5 years of experience in erection of metal building systems in lieu of IAS certification.
   b. Approval by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect building components and accessories from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Deliver to Site with parts individually tagged.

C. Store on wood blocking or pallets, flat and off ground, to keep clean and to prevent damage or permanent distortion. Support bundles so there is no danger of tipping, sliding, rolling, shifting, or material damage. Cover with tarpaulins or other suitable weathertight ventilated covering.

D. Protect finish of metal panels by application of removable plastic film or other suitable material placed between panels. Do not allow panels to come in contact with other material that would result in scratching, denting, staining or other damage to panel finish.

1.08 SPECIAL GUARANTEE

A. Furnish manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of Work specified in this Specification section found defective during a minimum period of 5 years and as stated below after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

B. Conditions:

1. Finish on metal roof, wall panels, flashing, and trim will not chalk, crack, check, blister, peel, flake, chip, or lose adhesion for 5 years.
2. Roofing will remain weathertight for 20 years.
PART 2 PRODUCTS

2.01 BUILDING SYSTEM MANUFACTURERS

A. Products manufactured or supplied by the following, and meeting these Specifications, may be used on this Project:

1. American Buildings Company, Columbus, GA.
2. Behlen Manufacturing Co., Columbus, NE.
4. Butler Manufacturing Co., Kansas City, MO.
5. CBC Steel Buildings, Lathrop, CA.
6. Ceco Corp., Columbus, MS.
7. Chief Industries, Inc., Rensselaer, IN.
8. Inland Buildings, Cullman, AL.
9. Kirby Building Systems, Inc., Columbus, GA.
10. NCI Building Systems, Inc., Houston, TX.
11. Nucor Building Systems, Waterloo, IN.
12. Ruffin Building Systems, Oak Grove, LA.
13. Varco-Pruden Buildings, Memphis, TN.

B. Building layout as shown on Drawings is based on products of Varco Pruden.

2.02 COMPONENTS

A. Structural Framing and Bracing:

1. Primary Framing: ASTM A36/A36M, ASTM A529/A529M, ASTM A572/A572M, or ASTM A992 with 3/16-inch minimum thickness and factory primer compatible with finish coating.
2. Secondary Framing: Steel for cold-formed galvanized channel and z-sections shall be ASTM A653/A653M, Structural Steel (SS) Grade 33 or High-Strength Low-Alloy Steel (HSLAS) Grade 50 Type A or B, with G60 galvanized coating and minimum design thickness equal to 0.0346 inch.
3. Bracing:
   a. ASTM A36/A36M or ASTM F1554, Grade 36, for threaded rod, or ASTM A36/A36M for rolled shapes.
   b. Do not use wire rope or cable for permanent bracing.
4. Bolted Connections:
   a. Primary Framing: ASTM A325 or ASTM A490/A490M high-strength bolted connections.
   b. Secondary Framing: ASTM A307 or ASTM A325.
B. Metal Panel Requirements:

1. Roof panels, wall panels and interior liner panels to match panel manufacturer and product used at Treatment Building.

2. General Material Requirements:
   a. Structural Quality Galvanized Steel Sheet: Hot-dip zinc-coated steel sheet in accordance with ASTM A446 with G90 coating complying with ASTM A525, Grade C.
   b. Structural Quality Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip aluminum-zinc-coated steel sheet in accordance with ASTM A792 with Class AZ-50 coating; Grade 40.
   c. Finish: Polyvinylidene Fluoride: Kynar 500, two coats minimum at exterior panels. Baked polyester enamel at interior panels.

3. Roof Panel System:
   a. ASTM E1514 structural standing seam steel roof panel system.
   b. Panels shall be one piece from eave to ridge, with concealed clips and fasteners to purlins to allow for thermal movement over 120-degree ambient temperature range.

4. Refer to Section 07 40 00, Roofing and Siding Panels, for additional fabrication requirements.

5. Wall Panel System: One or two piece from eave to sill as shown on Drawings, with base trim at sill.

6. Refer to Section 07 40 00, Roofing and Siding Panels, for additional fabrication requirements.

7. Soffit Panel System (at Treatment Building):
   a. 12-inch width, interlocking panels.
   b. Minimum 26-gauge.

8. Wall Liner Panels:
   a. One piece, height as shown on Drawings.
   b. Minimum 28-gauge.
   c. Sidelaps: Overlapping major ribs with exposed color-matched fasteners.
   d. Color per Interior Finish Schedule.

C. Monorail:

1. Monorail shall be W8 by 10, 15 feet in length, located as shown on the Drawings. Bottom of monorail shall be 10 feet 0 inches above finished floor on the upper level of the building.

2. Support and brace monorail for hoist capacity of 1-1/2 tons, including allowance for seismic forces with full load on hoist.

2.03 ACCESSORIES

A. Hollow Metal Doors, Frames, and Hardware: As specified in Section 08 11 01, Steel Door Assemblies. Supplied and installed by
Contractor. Coordinate size and configuration of rough openings with Contractor. Supplied by same manufacturer as at Treatment Building.

B. Fixed Louvers: As specified in Section 08 90 00, Louvers and Vents. Supplied and installed by Contractor. Coordinate size and configuration of rough openings with Contractor. Supplied by same manufacturer as at Treatment Building.

C. Metal Building Blanket Insulation and Roof Liner System:
   1. Batt insulation specified in Section 07 21 00, Thermal Insulation, and as shown on Drawings.
   2. Rigid insulation.
   3. White vinyl vapor barrier backing with Water Vapor Permeance Rating of 0.1 maximum, ASTM E96/E96M, Procedure A.
   5. Provide at roof as indicated on Drawings at the Grit Pump Building.
   6. Manufacturer:
      a. Owens Corning, Opti Liner.
      b. Approved equal.

D. Provide vapor barrier lining, below roof purlins, white in color.

E. Trim: Factory-formed and factory-painted ridge cap, rake trim, simple eave trim, panel side trim, corner trim, door trim, and other trim as necessary.

F. Gutter Fascia and Downspouts:
   2. Gutter Fascia:
      a. Prefinish.
      b. Furnish hangers with factory-applied paint.
   3. Preformed Corner Closures: Furnish to match configuration of gable fascia.
   4. Downspouts:
      a. Configuration: Nominal 4-inch corrugated rectangular box with minimum 11 square inches of cross section area.
      b. Factory finish to match wall panels.

G. Miscellaneous: Furnish fasteners, metal-backed neoprene washers, weatherstripping, sealants, roof jacks, roof curbs, gaskets, and other items as required for a complete installation.
2.04 FABRICATION


B. Building Parts: Accurate and true to dimension to facilitate building erection without cutting, fitting, or other alterations.

C. Welded Connections: In accordance with AWS D1.1/D1.1M.

D. Shop Primer for Primary Framing: Clean and apply one coat of manufacturer’s standard primer in accordance with MBMA Metal Building Systems Manual.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting concrete foundation and anchor bolt placement for compliance with requirements for installation tolerances and other conditions affecting performance of metal building.

3.02 BUILDING ERECTION

A. Erect building system in accordance with manufacturer’s standards and instructions.

B. Provide temporary bracing in accordance with MBMA standards and as required for safe installation.

C. Structural Framing:

1. Do not field cut or alter primary or secondary framing members.
2. Installation and tolerances shall be in accordance with MBMA Metal Building Systems Manual.

D. Roof and Wall Panels:

1. Field cutting of panels by torch is not permitted.
2. Attach panels to structural supports to maintain a weathertight seal while allowing for thermal and structural movement.
   a. Install exposed fasteners in true vertical and horizontal alignment.
   b. Field seam side laps of standing seam roof panels using electrically operated seaming machine.
   c. Use proper tools to install screw fasteners to compress neoprene washer without damaging washer or stripping metal.
3. Install manufacturer’s standard joint sealants, gaskets, and closure strips as required for weathertight installation.
4. Install roof curbs for roof top equipment.
5. Field Cutting and Patching: Perform in manner not to impair appearance, weathertightness, or structural capacity of panel system.

3.03 REPAIR, CLEANING, AND PAINTING

A. Immediately following erection, remove unused material, screws, fasteners, and other debris from completed installation. Use caution in removing metal cuttings from surface of prefinished metal panels.

B. Replace damaged, dented, buckled, or discolored metal panels.

C. Repair damaged painted and galvanized surfaces as specified in Section 09 90 00, Painting and Coating.

D. Finish Painting: As specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY CONTROL

A. Special inspection will be provided by Owner.

3.05 MANUFACTURER’S SERVICES

A. Provide manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for installation assistance, inspection, and certification of proper installation.

END OF SECTION
Quality Control

W. Laird Ellis, Jr.

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.23 09:19:49 -06'00'
PART 1      GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 301, Specifications for Structural Concrete for Buildings.
3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
4. ASTM International (ASTM):
   b. A615/A615M, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   a. 10, Portable Fire Extinguishers.
   b. 13, Installation of Sprinkler Systems.
   c. 70, National Electrical Code.
   d. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
   e. 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
7. Steel Door Institute (SDI): 100, Recommended Specifications, Standard Steel Doors and Frames.
1.02 SYSTEM DESCRIPTION

A. Building Name: Headworks Chemical Feed Building.
   1. Size and roof slope as shown on Drawings.
   2. Include wall and roof paneling with integrated rigid insulation.

B. System: Design, furnish, and install complete building package using manufacturer’s standard components.

C. Structure: Pre-engineered insulated panels with wall and ceiling framing as required for panel support.

D. Design: Coordinate structure design with pump equipment, feed connections to chemical totes, and electrical and plumbing connections from external supplies, and containment area drain line.

E. Coordinate with Contractor who shall provide anchor bolt design.

F. Coordinate location of secondary framing with requirements for specified cladding and openings shown on Drawings.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Manufacturer’s Standard Details and Structural Calculations: Clearly mark those portions that apply to specific Project and those parts that do not apply.
   b. Manufacturer’s Literature and Technical Data: Drawings and Specifications for proposed building system.
   c. Painting Systems: Specifications including paint manufacturer’s name, product trade-name, and preparation for shop and field coats.
   d. Drawings stamped by Contractor’s engineer and prepared specifically for this Project:
      1) Materials and Details: Show materials, details of components:
         a) Doors and accessories.
         b) Fire suppression system.
         c) Heating/cooling system.
         d) Finishes.
         e) Fastenings.
         f) Methods of joining.
         g) Sealants.
         h) Firestopping.
i) Anchor bolt, shear angle details, including all sizes and dimensions.

j) Size and location of structural members and bracing.

k) Wall structural members, and openings, as required.
   
   1) Electrical systems.
   
   2) Mini power centers.
   
   3) Lighting and switching.
   
   4) Receptacles.
   
   5) Terminal junction boxes.

e. Analysis of dry type fire suppression system for discussions with the AHJ for approval of use as a substitute for a standard sprinkler system.

f. Calculations Stamped by Contractor’s Engineer:
  
  1) Complete structural stress and deflection analysis of structural components and connections; for bolted moment-resistant connections in main frames consider prying action of bolts.
  
  2) Electrical load calculations.
  
  3) Lighting calculations.

B. Informational Submittals:

  1. Experience records of manufacturer.
  
  2. Approval of installer by manufacturer.
  
  3. Certification that codes and referenced standards have been met.
  
  4. Description and details of electrical continuity and grounding methods.
  
  5. Test reports.

1.04 QUALITY ASSURANCE

A. Qualifications:

  1. Designers: Engineers registered in state where building is to be erected.
  
  2. Manufacturer:
     
     a. At least 5 years’ experience in work of the type required in this section.
     
     b. Production capacity to provide work required for this Project without delay.
  

B. Regulatory Requirements: Design building system to meet requirements of:

  
  
  
1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver building components in undamaged condition to Site only when ready for installation.
B. Protect products from damage and deterioration.
C. Handle products in accordance with manufacturers’ instructions.

1.06 EXTRA MATERIALS
A. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS
2.01 BUILDING SYSTEM MANUFACTURERS
A. Products of the following, meeting these Specifications, may be used on this Project:
   1. Ideal Environmental Products, Gilroy California 95021.
   2. US Chemical Storage, Wilkesboro, NC 28697.
   3. Approved equal.

2.02 SYSTEM PERFORMANCE
A. Mechanical components shall comply with IFC Chapter 50 Hazardous Materials and related chapters.
B. Structural Loading: Design structure in accordance with ASCE 7 and the following:
   1. Building: Own dead load.
   2. Special floor supported pump equipment and 330-gallon capacity chemical totes: As located on the Drawings.
   3. Chemical delivery pump cabinets as shown on Drawings.
   4. Roof Snow Load.
   5. Design Wind Loads and Earthquake Load: In accordance with applicable building code and as described in Structural General Notes.

2.03 COMPONENTS
A. The following components shall be provided by the fabricated structure manufacturer:
1. Framing and Paneling:
   a. Panel Skins: 3-inch thickness and factory primed and finished with chemical resistant coating (sulfuric acid 95 percent). Provide 2-hour fire rating at corner of building adjacent to the Grit Pump Building as shown on Drawings.
   b. Framing Materials: Steel for cold-formed galvanized channel and z-sections shall be ASTM A653/A653M, Structural Steel (SS) Grade 33 or High-Strength Low-Alloy Steel (HSLAS) Grade 50 Type A or B, with G60 galvanized coating and minimum design thickness equal to 0.0346 inch.
   c. Foundation Bolted Connections: Refer to Section 05 50 00, Metal Fabrications.

2. Man Door and Sectional Door as shown on Drawings:
   a. Manufacturer’s Standard Hardware:
      1) All materials corrosion resistant stainless steel or brass.
      2) Panic exit hardware with exterior latch handle and key entry.
   b. Door panels with factory applied chemical resistant coating (sulfuric acid 95 percent).
   c. Provide 2-hour fire rating at Man Door.

3. FRP Floor Grating and Containment as Shown on the Drawings:
   a. Manufacturers:
      1) Fibergrate Composite Structures, Inc., Addison, TX.
      2) IKG/Borden, Clark, NJ.
      3) Strongwell Corp., Bristol Division, Bristol, VA or Chatfield Division, Chatfield, MN.
      4) International Grating, Inc., Houston, TX.
   b. FRP grating of sufficient thickness to support foot traffic and pump cabinets.
      1) Maximum Deflection: 1/4 inch, unless otherwise shown.
   c. Provide corrosion resistant ball valve drain between two containment sections. Slope acid containment area to ball valve drain.
   d. Provide corrosion resistant connection to outside drain line at location shown on Drawings.

4. Safety Shower and Eyewash:
   a. OSHA compliant, Refer to Section 22 40 00, Plumbing Fixtures.
   b. Provide connection to external tepid water supply, by others.

5. Fire/smoke alarm system providing trouble and alarm signals.

6. Dry Type Fire Suppression System:
   a. Self-contained, Type ABC for use in presence of Class 2 Water Reactive chemical.
   b. System shall be capable of being either manually activated or automatically activated by fusible link or heat detector.
   c. To be reviewed and approved by Owners’ fire engineer.
   d. Subject to approval of AHJ, to be submitted as an alternate fire suppression system to typical automatic NFPA 13 system.
7. HVAC Equipment:
   a. Electric/heat pump and air conditioner capable of maintaining 60 degrees F to 85 degrees F room temperature at outdoor temperatures from 10 degrees F dry-bulb to 95 degrees F dry bulb and 74 degrees F wet-bulb.
   b. Providing continuous ventilation of outside air at a minimum rate of 1 cubic foot/square foot.
   c. Including manual break-glass shutoff switch at exterior of building.
   d. Connected to backup power supply, provided by others.
   e. Furnish with 2-inch deep MERV 8 filters.
   f. HVAC unit shall be located outside of chemical storage area.

8. Electrical Systems, Equipment and Materials:
   a. Environmental Conditions: In accordance with Section 26 05 02, Basic Electrical Requirements.
   b. Basic Electric Materials: In accordance with Section 26 05 04, Basic Electrical Materials and Methods.
      1) Provide non-fused heavy-duty safety switch for each HVAC unit.
   c. Conductors: In accordance with Section 26 05 05, Conductors.
   d. Raceways and Boxes: In accordance with Section 26 05 33, Raceway and Boxes.
      1) In the interior of the building, use materials suitable for corrosive areas.
   e. Mini Power Center:
      1) In accordance with Section 26 22 00, Low-Voltage Transformers and Section 26 24 16, Panelboards.
      2) Size the mini power center in accordance with NEC Article 220, but not smaller than 120/240V, 10kVA. Submit load calculations for approval.
      3) On the exterior of the building, provide a mini power center to the left-hand side of the personnel access door. Serve all building systems from the mini power center.
      4) Provide circuits as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimated Load VA</th>
<th>Circuit Breaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior and exterior lights</td>
<td>500</td>
<td>1P, 20A</td>
</tr>
<tr>
<td>Roll-up door opener</td>
<td>500</td>
<td>1P, 20A</td>
</tr>
<tr>
<td>Receptacles</td>
<td>1080</td>
<td>1P, 20A GFCI</td>
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<tr>
<td>HVAC unit</td>
<td>3000</td>
<td>2P, 20A</td>
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<tr>
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<td>500</td>
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<tr>
<td>CHEM-P-530-B</td>
<td>500</td>
<td>1P-20A</td>
</tr>
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</table>
### Fabricated Structures

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<th>Estimated Load VA</th>
<th>Circuit Breaker</th>
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</tr>
<tr>
<td>CHEM-WIT-530</td>
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<td>1P-20A</td>
</tr>
<tr>
<td>Spare</td>
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<td>1P-20A</td>
</tr>
<tr>
<td>Spare</td>
<td>N/A</td>
<td>1P-20A</td>
</tr>
<tr>
<td>Spare</td>
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<td>1P-20A</td>
</tr>
<tr>
<td>Spare</td>
<td>N/A</td>
<td>1P-20A</td>
</tr>
</tbody>
</table>

**f. Wiring Devices:**

1) In accordance with Section 26 27 26, Wiring Devices.
2) Light Switches: Provide light switch at the personnel access doorway.
3) Receptacles: Use weatherproof receptacle covers throughout.
   a) Exterior: Provide one receptacle on each long wall. Provide receptacles adjacent to each HVAC unit in accordance with the NEC.
   b) Interior: Provide one receptacle on each wall.

**g. Lighting:**

1) In accordance with Section 26 50 00, Lighting.
   a) Maintained Interior Illuminance: 40 footcandles, at the floor. Submit lighting calculations for approval.
   b) Interior Luminaires:
      (1) Linear, 4-foot, LED, with gasketed fiberglass enclosures and frosted lens.
      (2) 4000 deg. K LED.
      (3) Hubbell LXEM, or approved equal.
      (4) Provide one luminaire with emergency ballast.
   c) Exterior Luminaires:
      (1) Wall-mount, LED, full cutoff, with motion sensor/ambient light sensor control.
      (2) 4000 deg. K LED, Type 3 medium distribution.
      (3) Lithonia DSXW2-LED-20-350-40K-T3MVOLT-BBW-PIR1FC3V, or approved equal.
      (4) Provide one luminaire above each exterior door.

h. Provide power connections to all lighting and receptacle loads.

i. Coordinate with Instrumentation and Controls contractor to facilitate intrusion detection monitor installation at doors.

9. Gutter and leader as shown on Drawings.
   a. Manufacturer’s standard.
   b. Finished to match wall panels.
2.04 MATERIALS

A. Insulation, integral to wall and roof panels.
   1. Molded polyurethane foam or extruded polystyrene.

2.05 SOURCE QUALITY CONTROL

A. Inspections: Before shipment, inspect for complete, functional assemblies.
   1. Owner reserves the right to inspect the structure in the factory before shipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect and inventory all parts of the structure upon arrival to ensure that a complete system has been delivered.

3.02 PREPARATION

A. Verify Site conditions and make necessary field measurements.
   1. Confirm that concrete foundation is level according to concrete slab specifications.

B. Assemble components in accordance with manufacturer’s instructions. Make necessary connections to supporting services. Securely anchor to concrete foundation. Structure to be level within 1/4 inch overall, measured at each corner.

C. Install materials following manufacturers’ instructions and recommendations.

3.03 PROTECTION

A. Protect installed products from damage.

END OF SECTION
Wet-Pipe Sprinkler System, Fire Protection

Revision History:

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<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
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<tr>
<td>0</td>
<td>Issue for Construction</td>
<td>June 22, 2017</td>
<td>All</td>
</tr>
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</table>

Document Review & Approval:

**Originator:**
Ted J. Price P.E. Design Engineer

**Design Verification Complete:**
Jamin McMurren PE/QC

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

Digital signature by W. Laird Ellis, Jr.  Date: 2017.06.22 09:02:37 -06'00'
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:


2. American Water Works Association (AWWA):

3. ASME International (ASME):
4. ASTM International (ASTM):


10. Underwriters Laboratories (UL):

1.02 SYSTEM DESCRIPTION

A. Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage. Provide wet pipe sprinkler system in all areas of the building as indicated on the Drawings. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on Drawings shall be determined by hydraulic calculation. Design any portions of the sprinkler system that are not indicated on the Drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the Drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

B. Hydraulic Design: Hydraulically design the system to discharge a minimum density as indicated in the Drawing over the required hydraulically most demanding area. The minimum density shall be 0.15 gpm/square foot and the minimum design area shall be 2,500 square feet. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s.

C. In all areas of the building the system shall be designed for a minimum of 10 psi or 10 percent pressure margin throughout the entire system.
1. Hose Demand: Add an allowance for exterior hose streams of 500 gpm to the sprinkler system demand at the fire hydrant closest to the point where the water service connects to the existing system. Basis for Calculations was the information recorded from the following flow test:
   a. Test 1:
      1) Date: October 8, 2015.
      2) Static Pressure (Hydrant No. 127): 104 psi.
      3) Residual Pressure (Hydrant No. 127): 94 psi.
      4) Flow Hydrant No. 1 (Hydrant No. 110): 2110 gpm.
   b. Test 2.
      1) Date: October 8, 2015.
      2) Static Pressure (Hydrant No. 127): 104 psi.
      3) Residual Pressure (Hydrant No. 127): 89 psi.
      4) Flow Hydrant No. 1 (Hydrant No. 110): 1888 gpm.
      5) Flow Hydrant No. 2 (Hydrant No. 112): 1635 gpm.
      6) Total Flow: 3523 gpm.

D. Hydraulic Calculations: Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments and as outlined in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the Drawings. Software that uses K-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the Drawings to substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

E. Sprinkler Coverage: Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with
NFPA 13, but shall not exceed 100 square feet for extra hazard occupancies, 130 square feet for ordinary hazard occupancies.

1.03 SUBMITTALS

A. Submittals:

1. Action Submittals:
   a. Shop Drawings:
      1) Shop Drawings.
      2) As-Built Drawings.
   b. Product Data:
      1) Fire Protection Related Submittals.
      2) Materials and Equipment.
      3) Spare Parts.
      4) Preliminary Tests.
      5) Final Acceptance Test.
      6) Onsite Training; G.
      7) Fire Protection Specialist.
      8) Sprinkler System Installer.
   c. Design Data:
      1) Sway Bracing.
      2) Hydraulic Calculations.

2. Informational Submittals:
   a. Test Reports:
      1) Preliminary Test Report.
      2) Final Acceptance Test Report.
   b. Certificates: Inspection by Fire Protection Specialist.
   c. Operation and Maintenance Data: Operating and Maintenance Manuals.

1.04 QUALITY ASSURANCE

A. Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word “shall” had been substituted for the word “should” wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. The code provisions shall apply if more stringent, unless specific and appropriate relief is clearly documented. Reference to “authority having jurisdiction” within this specification shall be interpreted to mean the Contracting Officer.

B. Fire Protection Specialist: Perform work specified in this section under the supervision of and certified by the Fire Protection Specialist who is an individual registered professional engineer who has passed the fire protection engineering written examination administered by the National Council of
Examiners for Engineering and Surveys (NCEES). Submit the name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations. The Fire Protection Specialist shall prepare and submit a list of the fire protection related submittals, no later than 7 days after the approval of the Fire Protection Specialist, from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

C. Sprinkler System Installer: Work specified in this section shall be performed by the Sprinkler System Installer who is regularly engaged in the installation of the type and complexity of system specified in the Contract Documents, and who has served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Submit the name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

D. Shop Drawings: Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Submit three copies of the sprinkler system shop drawings, no later than 21 days prior to the start of sprinkler system installation. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

1. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

2. Floor plans drawn to a scale not less than 1/8-inch equals 1 foot which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

3. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross mains and branch lines to finished floor and roof or ceiling. A detail shall show the
dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.
4. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.
5. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. Submit load calculations for sizing of sway bracing, for systems that are required to be protected against damage from earthquakes.

1.05 DELIVERY, STORAGE, AND HANDLING
A. All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.06 EXTRA MATERIALS
A. Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

PART 2 PRODUCTS

2.01 STANDARD PRODUCTS
A. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.02 NAMEPLATES
A. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.03 REQUIREMENTS FOR FIRE PROTECTION SERVICE
A. Provide materials and equipment that have been tested by Underwriters Laboratories, Inc. and are listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms “listed” or “approved” appear in this Specification, such shall mean listed in UL Fire Prot
Dir or FM APP GUIDE. Submit manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

2.04 VALVES

A. Manufacturers:

1. American Cast Iron Pipe Company; Waterous Company Subsidiary.
2. American Valve, Inc.
3. Clow Valve Company; a Division of McWane, Inc.
4. Crane Co.; Crane Valve Group; Crane Valves.
5. Crane Co.; Crane Valve Group; Jenkins Valves.
6. Crane Co.; Crane Valve Group; Stockham Division.
8. Milwaukee Valve Company.
10. NIBCO INC.
11. Tyco Fire & Building Products LP.
12. United Brass Works, Inc.
13. Victaulic.
15. Substitutions: Section 01 60 00, Product Requirements.

B. Gate Valves:

1. Up to and Including 2 Inches (50 mm): Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends.
2. Over 2 Inches (50 mm): Iron body, bronze trim, rising stem pregrooved for mounting tamper switch, hand wheel, OS&Y, solid rubber covered bronze or cast iron wedge, grooved ends.
3. Over 4 Inches (100 mm): Iron body, bronze trim, nonrising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

C. Globe or Angle Valves:

1. Up to and Including 2 Inches (50 mm): Bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable rubber disc, threaded ends, with back seating capacity packable under pressure.
2. Over 2 Inches (50 mm): Iron body, bronze trim, rising stem, hand wheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.
D. Ball Valves:

1. Up to and Including 2 Inches (50 mm): Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, Teflon seats and stuffing box ring, lever handle, threaded ends with union.

2. Over 2 Inches (50 mm):
   a. Manufacturers: Cast steel body chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged.

E. Butterfly Valves:

1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amps at 115V ac.

2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends. With extended neck, hand wheel and gear drive and integral indicating device, and external tamper switch rated 10 amps at 115V ac.

F. Check Valves:

1. Up to and Including 2 Inches (50 mm): Bronze body and swing disc, rubber seat, threaded ends.

2. Over 2 Inches (50 mm): Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends.

3. 4 Inches (100 mm) and Over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

G. Drain Valves:

1. Compression Stop: Bronze with hose thread nipple and cap.

2. Ball Valve: Brass with cap and chain, 3/4-inch (20-mm) hose thread.

2.05 UNDERGROUND OR EXTERIOR PIPING COMPONENTS

A. Pipe: Piping from a point 6 inches above the floor to the point of connection to the existing water mains shall be ductile iron with a rated working pressure of 175 psi conforming to AWWA C151/A21.51, with cement mortar lining conforming to AWWA C104/A21.4. Piping more than 5 feet outside the building walls shall comply with Division 31, Earthwork.

B. Fittings and Gaskets: Fittings shall be ductile iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets shall be suitable in design and size for the pipe.
with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

C. Gate Valve and Indicator Posts:

1. Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM APP GUIDE.
2. Valve shall utilize a tamper switch to indicate if the position of the valve. Alarm shall be initiated if the valve is anything other than full open.

D. Dry Barrel Fire Hydrant:

1. Fire hydrants shall conform to the requirements of AWWA C502 for Dry Barrel Fire Hydrants.
2. Fire hydrants shall be supplied with a 5-1/4-inch main valve opening, and a main valve seat ring threaded into a bronze bushing.
3. Fire hydrants shall be furnished with a six inch ASA Class 125 standard mechanical-joint inlet with two cast-on lugs for tie backs.
4. Fire hydrants shall be provided with a weather-cap and an epoxy or bituminous-coated shoe. Connections shall be mechanical joint with “Mega-lug” fittings, unless otherwise indicated on the Drawings or required by Owner.
5. Fire hydrants shall be three-way and furnished with two 2-1/2-inch hose nozzles and one 4-1/2-inch pumper nozzle. Fire hydrants shall be left hand opening (counter clockwise). Operating and nozzle nuts shall be National Standard pentagonal with weather cap. Hose nozzle threading shall be in conformance with NFPA No. 194 for national (American) Standard Fire Hose Coupling Screw Threads.
6. Unless otherwise required by the Owner, fire hydrants shall be furnished with a barrel length that will allow a 5-foot bury.
7. The main hydrant valves shall be of the compression type where water pressure holds the main valve closed permitting easy maintenance or repair of the entire barrel assembly from above the ground without the need of a water shut-off. The main valve seat shall be either glycol urethane compound, or approved equal, that is abrasion and gravel resistant.
8. Fire hydrants shall be furnished with a breakaway traffic flange of the type which allows both barrel and stem to break clean upon impact from any angle. Traffic flange design must be such that repair and replacement can be accomplished above ground.
9. All working parts shall be bronze or non-corrosive metal in accordance with the requirements of AWWA C 502.

10. Painting and coating shall be in accordance with applicable AWWA specifications. After installation, the fire hydrant section from the traffic flange to the top of the operating nut shall be painted to match existing hydrants.

11. Manufactures and Products:
   e. Mueller; Centurian A-423.
   f. Waterous; 5-1/4-inch Pacer.
   g. Dresser; M&H Style 929.

2.06 ABOVEGROUND PIPING COMPONENTS

A. Aboveground piping shall be steel.

B. Steel Piping Components:

1. Steel Pipe: Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A795/A795M, ASTM A53/A53M Grade B or A106 Grade B, or ASTM A135/A135M. Piping shall be seamless or Electric Resistance Welded (ERW). The use of Class F or forged piping is not acceptable. Piping shall be a minimum of Schedule 40. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2. Fittings for Non-Grooved Steel Pipe: Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. The use of Steel press fittings is not acceptable. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

3. Grooved Mechanical Joints and Fittings: Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

4. Flanges: Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

5. Bolts, Nut, and Washers: Bolts shall be conform to ASTM A449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be hexagon type.
conforming to ASME B18.2.2 or ASTM A193/A193M, Grade 5. Washers shall be hardened and shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

C. Pipe Hangers: Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and of the type suitable for the application, construction, and pipe type and sized to be supported.

D. Valves:
   1. Control Valve and Gate Valve: Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM APP GUIDE.
   2. Check Valve: Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM APP GUIDE. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.
   3. Hose Valve: Valve shall comply with UL 668 and shall have a minimum rating of 300 psi. Valve shall be non-rising stem, all bronze, 90-degree angle type, with 2-1/2 inch American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 2-1/2 to 1-1/2 inch reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Valve finish shall be polished brass.

2.07 ALARM CHECK VALVE ASSEMBLY

A. Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.08 WATERFLOW ALARM

A. Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24V dc and shall be connected to the Fire Alarm Control Panel (FACP) in accordance with Section 28 31 00, Fire Detection and Alarm System.

2.09 ALARM INITIATING AND SUPERVISORY DEVICES

A. Sprinkler Waterflow Indicator Switch, Vane Type: Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the
inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

B. Valve Supervisory (Tamper) Switch: Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.10 FIRE DEPARTMENT CONNECTION

A. Fire department connection shall be free-standing type with brass body, matching lettered “Auto Spkr” with a chromium plated finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.11 SPRINKLERS

A. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be as indicated. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used. All sprinkler heads shall be UL/FM listed.

B. Recessed Sprinkler: Recessed sprinkler shall be chrome-plated standard-response type.

C. Upright Sprinkler: Upright sprinkler shall be brass or chrome plated.

D. Corrosion Resistant Sprinkler: Corrosion resistant sprinkler shall be the upright type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.12 ACCESSORIES

A. Sprinkler Cabinet: Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each
type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

B. Pendent Sprinkler Escutcheon: Escutcheon shall be one-piece metallic type with a depth of less than 3/4-inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

C. Pipe Escutcheon: Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

D. Sprinkler Guard: Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located as indicated on Drawings.

E. Identification Sign: Valve identification sign shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18-gauge steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to “main drain,” “auxiliary drain,” “inspector's test,” “alarm test,” “alarm line,” and similar wording as required to identify operational components.

2.13 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

A. Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, two-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 175 psi. The maximum pressure loss shall be 6 psi at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves as well as a pressure gauge on the test header. Valve shall be listed and approved for use in the State of Tennessee and shall be approved by Y-12/Oakridge National Labs before installation.

PART 3 EXECUTION

3.01 FIELD MEASUREMENTS

A. After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.
3.02 INSTALLATION REQUIREMENTS

A. The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 13.

3.03 INSPECTION BY FIRE PROTECTION SPECIALIST

A. Prior to ceiling installation and concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. The Fire Protection Specialist shall: 1) inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements, 2) witness the preliminary and final tests, and sign the test results, and 3) after completion of the system inspections and a successful final test, certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.04 ABOVEGROUND PIPING INSTALLATION

A. Protection of Piping Against Earthquake Damage: Seismically protect the system piping against damage from earthquakes. This requirement is not subject to determination under NFPA 13. Install the seismic protection of the system piping in accordance with, NFPA 13 and Annex A. Include the required features identified therein that are applicable to the specific piping system.

B. Piping in Exposed Areas: Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

C. Piping in Finished Areas: In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

D. Pendent Sprinklers: Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's
listed range and shall be of uniform depth throughout the finished area. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid. Sprinklers installed in suspended ceiling shall be centered in the ceiling grid.

E. Upright Sprinklers: Riser nipples or “sprigs” to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

F. Pipe Joints: Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a “go/no-go” gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the Drawings for servicing or adjusting the joint.

G. Reducers: Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

H. Pipe Penetrations: Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe
shall be firmly packed with mineral wool insulation. In penetrations that are
not fire-rated or not a floor penetration, the space between the sleeve and the
pipe shall be sealed at both ends with plastic waterproof cement that will dry
to a firm but pliable mass or with a mechanically adjustable segmented
elastomer seal.

I. Escutcheons: Escutcheons shall be provided for pipe penetration of ceilings
and walls. Escutcheons shall be securely fastened to the pipe at surfaces
through which piping passes.

J. Inspector's Test Connection: Unless otherwise indicated, test connection shall
consist of 1 inch pipe connected at the remote branch line and at the riser as a
combination test and drain valve; a test valve located approximately 7 feet
above the floor; a smooth bore brass outlet equivalent to the smallest orifice
sprinkler used in the system; and a painted metal identification sign affixed to
the valve with the words “Inspector's Test.” The discharge orifice shall be
located outside the building wall directed so as not to cause damage to
adjacent construction or landscaping during full flow discharge.

K. Drains: Main drain piping shall be provided to discharge at a safe point
outside the building. Auxiliary drains shall be provided as required by
NFPA 13.

L. Installation of Fire Department Connection: Installation shall be a free
standing unit installed where indicated in the civil site drawings. All piping
shall be hydrostatically tested before backfilling. The piping between the
connection and the check valve shall be provided with an automatic drip in
accordance with NFPA 13 and arranged to drain water from the piping.

M. Identification Signs: Signs shall be affixed to each control valve, inspector test
valve, main drain, auxiliary drain, test valve, and similar valves as appropriate
or as required by NFPA 13. Hydraulic design data nameplates shall be
permanently affixed to each sprinkler riser as specified in NFPA 13.

3.05 UNDERGROUND PIPING INSTALLATION

A. The fire protection water main shall be laid, and joints anchored, in
accordance with NFPA 24. Minimum depth of cover shall be 3 feet. The
supply line shall terminate inside the building with a flanged piece, the bottom
of which shall be set not less than 6 inches above the finished floor. A blind
flange shall be installed temporarily on top of the flanged piece to prevent the
entrance of foreign matter into the supply line. A concrete thrust block shall
be provided at the elbow where the pipe turns up toward the floor. In addition,
joints shall be anchored in accordance with NFPA 24 using pipe clamps and
steel rods from the elbow to the flange above the floor and from the elbow to a
pipe clamp in the horizontal run of pipe. Buried steel components shall be
provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Division 31, Earthwork.

3.06 ELECTRICAL WORK

A. Except as modified herein, electric equipment and wiring shall be in accordance with Section 26 05 02, Basic Electrical Requirements. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 31 00, Fire Detection and Alarm System. All wiring for supervisory and alarm circuits shall be No. 14 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

3.07 PIPE COLOR CODE MARKING

A. Color code mark piping as specified in Section 09 90 00, Painting and Coating.

3.08 PRELIMINARY TESTS

A. The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. Submit proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests and proposed date and time to begin the preliminary tests. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, submit three copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Tests. The Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

B. Underground Piping:

1. Flushing: Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

2. Hydrostatic Testing: New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.
C. Fire Hydrant and Post Indicator Valve Assemblies:

1. Install assemblies in accordance with applicable AWWA Standards, the manufacturer’s recommendations.
2. The interior components shall be cleaned of all foreign matter prior to installation.
3. Units shall be installed level and plumb. Any adjustments to the traffic flange shall be accomplished with barrel extensions, in accordance with the fire hydrant manufacturer’s recommendations.
4. Fire hydrants and Post Indicator Valves shall be opened and closed in the presence of the Fire Marshal to verify that all parts are in working condition and tamper switches alarm as required.

D. Aboveground Piping:

1. Hydrostatic Testing: Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure, whichever is greater, and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.
2. Backflow Prevention Assembly Forward Flow Test: Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. Provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5-inch diameter hoses, play pipe nozzles, calibrated pressure gauges, pitot tube gauge, plus all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. Provide a metal placard on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

E. Testing of Alarm Devices: Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

F. Main Drain Flow Test: Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.
3.09 FINAL ACCEPTANCE TEST

A. Begin the Final Acceptance Test only when the Preliminary Test Report has been approved. Submit proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests, and proposed date and time to begin the Test, submitted with the procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Submit as-built shop drawings, at least 14 days after completion of the Final Tests, updated to reflect as-built conditions after all related work is completed. Drawings shall be furnish as high resolution individual full size scans on a DVD(s). Provide six individual sets of DVDs as required. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. Submit three copies of the completed Final Acceptance Test Report no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist as specified.

3.10 ONSITE TRAINING

A. The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit proposed schedule, at least 14 days prior to the start of related training. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. Submit six Operating and Maintenance Manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. The Onsite Training shall cover all of the items contained in the approved manuals.

END OF SECTION
Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Dry-Pipe Sprinkler Systems, Fire Protection

Revision History:

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<td>Issue for Construction</td>
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Document Review & Approval:

Originator:

Ted J. Price P.E. Design Engineer

NAME/POSITION

June 21, 2017

SIGNATURE

DATE

Design Verification Complete:

Jamin McMurren PE/QC

NAME/POSITION

June 22, 2017

SIGNATURE

DATE

Approved:

W. Laird Ellis, Jr. PE/Design Manager

NAME/POSITION

W. Laird Ellis, Jr. Digitally signed by W. Laird Ellis, Jr. Date: 2017.06.22 09:05:54 -06'00'

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SECTION 21 13 18
DRY PIPE SPRINKLER SYSTEMS, FIRE PROTECTION

PART 1 GENERAL

1.01 REFERENCES

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

1. American Society Of Sanitary Engineering (ASSE):

2. American Water Works Association (AWWA):

3. ASME International (ASME):

4. ASTM International (ASTM):


5. FM Global (FM):


6. Institute of Electrical and Electronics Engineers (IEEE):


7. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):


11. Underwriters Laboratories (UL):

1.02 SYSTEM DESCRIPTION

A. Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

B. Provide dry-pipe sprinkler system(s) in areas indicated on the Drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall meet the requirements of NFPA 13 and NFPA 72. The sprinkler piping shall be filled with compressed air and a dry pipe valve shall prevent water from entering the pipe until a fire causes one or more sprinkler heads to operate.

C. Design any portions of the sprinkler system that are not indicated on the Drawings or are not specified herein, including locating sprinklers, piping, and equipment, and size piping and equipment. Determine pipe sizes which are not indicated on the Drawings by hydraulic calculations.

D. Hydraulic Design:

1. Hydraulically design the system to discharge a minimum density as indicated in the Drawing over the required hydraulically most demanding area. The minimum density shall be 0.15 gpm/square foot and the minimum design area shall be 2,500 square feet. The minimum pipe size for branch lines in gridded systems shall be 1.0 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s.
2. In all areas of the building, the system shall be designed for a minimum of 10 psi or 10 percent pressure margin throughout the entire system.

3. Hose Demand: Add an allowance for exterior hose streams of 500 gpm to the sprinkler system demand at the fire hydrant closest to the point where the water service connects to the existing system. Basis for Calculations was the information recorded from the following flow test:
   a. Test 1:
      1) Date: October 8, 2015.
      2) Static Pressure (Hydrant No. 127): 104 psi.
      3) Residual Pressure (Hydrant No. 127): 94 psi.
      4) Flow Hydrant No. 1 (Hydrant No. 110): 2110 gpm.
   b. Test 2.
      1) Date: October 8, 2015.
      2) Static Pressure (Hydrant No. 127): 104 psi.
      3) Residual Pressure (Hydrant No. 127): 89 psi.
      4) Flow Hydrant No. 1 (Hydrant No. 110): 1888 gpm.
      5) Flow Hydrant No. 2 (Hydrant No. 112): 1635 gpm.
      6) Total Flow: 3523 gpm.

E. Hydraulic Calculations: Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments and as outlined in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the Drawings. Software that uses K-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the Drawings to substantiate that the design area used in the calculations is the most demanding hydraulically.

F. Plot water supply curves and system requirements on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Indicate elevations of hydraulic reference points (nodes). Documentation shall identify each pipe individually and the nodes connected thereto. Indicate for each pipe the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient.

G. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, include a flow diagram indicating the quantity and direction of flows. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.
H. Sprinkler Coverage: Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed 100 square feet for extra hazard occupancies, 130 square feet for ordinary hazard occupancies.

I. Control System: The control system shall meet the requirements of NFPA 72 and shall conform to Section 28 31 00, Fire Detection and Alarm. Fire suppression contractor shall coordinate all fire alarm connection requirements with the fire detection and alarm contractor.

J. Power Supply: Power shall conform to Section 28 31 00, Fire Detection and Alarm. Fire suppression contractor shall coordinate all power requirements with the fire detection and alarm contractor.

K. System Actuation: The fire alarm system shall actuate the corresponding automatic water control valve. Actuation of the automatic water control valve shall cause water to fill the system piping and be discharged from fused sprinklers.

1.03 SUBMITTALS

A. Submittals:

1. Action Submittals:
   a. Shop Drawings:
      1) Shop Drawings.
      2) As-Built Drawings.
   b. Product Data:
      1) Fire Protection Related Submittals.
      2) Materials and Equipment.
      3) Spare Parts.
      4) Preliminary Tests.
      5) Final Acceptance Test.
      6) Onsite Training.
      7) Fire Protection Specialist.
      8) Sprinkler System Installer.
   c. Design Data:
      1) Sway Bracing.
      2) Hydraulic Calculations.

2. Informational Submittals:
   a. Test Reports:
      1) Preliminary Test Report.
      2) Final Acceptance Test Report.
b. Certificates: Inspection by Fire Protection Specialist.
c. Operation and Maintenance Data: Operating and Maintenance Manuals.

1.04 QUALITY ASSURANCE

A. Compliance with referenced NFPA standards is mandatory. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Incorporate all requirements that exceed the minimum requirements of NFPA 13 into the design. Interpret reference to "authority having jurisdiction" to mean the Contracting Officer.

B. Fire Protection Specialist: Perform work specified in this section under the supervision of and certified by the Fire Protection Specialist who is an individual registered professional engineer who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES). Submit the name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations. The Fire Protection Specialist shall prepare and submit a list of the fire protection related submittals, no later than 7 days after the approval of the Fire Protection Specialist, from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

C. Installer Qualifications: Work specified in this section shall be performed by the Sprinkler System Installer. Submit the name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the FPS Qualifications. The Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

D. Shop Drawings: Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Submit three copies of the sprinkler system shop drawings, no later than 21 days prior to the start of
sprinkler system installation. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

1. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

2. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot 0-inch which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Indicate each type of fitting used and the locations of bushings, reducing couplings, and welded joints.

3. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

4. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

5. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

6. Complete point-to-point wiring diagram of the detection and control system. Indicate the detailed interconnection of control panel modules to the devices, the number and size of conductors in each conduit, and size of conduit. Connection points shall be indicated and coordinated with the terminal identification marked on the devices. Provide complete internal wiring schematic of the control panel and each electrical device. Detailed description of the functions of the control panel and each module shall be provided.

1.05 DELIVERY, STORAGE, AND HANDLING

A. All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.
1.06 EXTRA MATERIALS

A. Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

PART 2 PRODUCTS

2.01 STANDARD PRODUCTS

A. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. Highlight the data to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

2.02 NAMEPLATES

A. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.03 REQUIREMENTS FOR FIRE PROTECTION SERVICE

A. Materials and equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.04 VALVES

A. Refer to Section 21 13 13, Wet Pipe Sprinkler System, Fire Protection, for additional information.

2.05 UNDERGROUND PIPING SYSTEMS

A. Pipe: Piping from a point 6 inches above the floor to outside the building wall shall be ductile iron with a rated working pressure of 250 psi conforming to Section 40 27 00, Process Piping—General.
B. Fittings and Gaskets: Fittings shall be ductile iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

C. Gate Valve and Indicator Posts: Refer to Section 21 13 13, Wet Pipe Sprinkler System, Fire Protection, for additional information.

2.06 ABOVEGROUND PIPING COMPONENTS

A. Steel Pipe: All pipe downstream of the deluge valve and all piping connecting to the deluge valve shall be hot dipped galvanized steel. Pipe shall conform to applicable provisions of ASTM A795/A795M, ASTM A53/A53M Type E or S and shall be Schedule 40.

B. Fittings for Non-Grooved Steel Pipe: Fittings shall be hot dipped galvanized grey-iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings shall be approved for fire protection systems. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

C. Grooved Mechanical Joints and Fittings: Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be hot dipped galvanized malleable iron conforming to ASTM A47/A47M, Grade 32510; galvanized ductile iron conforming to ASTM A536, Grade 65-45-12. Gaskets shall be of silicon compound and approved for dry fire protection systems. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

D. Flanges: Flanges shall be hot dipped galvanized after welding and shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

1. Bolts: Bolts shall be ASTM A449, Type 1. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2. Nuts: Nuts shall be hexagon type conforming to ASME B18.2.2.

3. Washers: Washers shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.
E. Pipe Hangers: Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and of the type suitable for the application, construction, and pipe type and size to be supported.

2.07 DRY PIPE VALVE

A. Dry pipe valve shall be an ULus or FM Approved differential type valve with single hinge pin and latch design with galvanized basic trim. Basic trim shall include a ½-inch relief valve, a 3/4-inch check valve, and a 3/4-inch control valve on the air pressure line in accordance with NFPA 13. Also include a priming chamber attachment trim and fill line attachment trim. Water to air seat area differential to be at least 6 to 1, capable of controlling air pressure ranging from 20 to 50 psi (1.4 to 3.4 bar). Dry pipe valve construction shall be cast iron. Dry pipe valve seat shall be of bronze construction with O-ring seals to prevent corrosion and leakage. Threaded-in, one piece air and water seat shall be removable for ease of maintenance. Clapper shall consist of ductile iron with sintered brass clapper bushings, and contain a one-piece clapper rubber facing. End connection styles to be flanged or grooved inlet and outlet connections. Dry pipe valve shall have a rated working pressure of 175 psi (12.1 bar) and shall be factory hydrostatic tested at 350 psi (24.1 bar).

2.08 SUPERVISORY AIR SYSTEM

A. Air Compressor: Air compressor shall be single stage oil less type, direct drive, pipe riser mounting kit, air cooled, electric-motor driven, equipped with a bubble tight check valve, stainless steel flex hose, UL listed pressure switch for automatic starting and stopping. Pressure switch shall be set to start the compressor at 35 psi and stop it at 40 psi or as required by system installer. A safety relief valve, set to operate at 65 psi, shall be provided. The compressor shall be sized to pressurize the system to 30 psi within 30 minutes. Compressor shall comply with UL 1450. Minimum size of the compressor shall be 1/2 hp.

2.09 WATERFLOW ALARM

A. Refer to Section 21 13 13, Wet Pipe Sprinkler System, Fire Protection, for additional information.

2.10 FIRE DEPARTMENT CONNECTION

A. Refer to Section 21 13 13, Wet Pipe Sprinkler System, Fire Protection, for additional information.
2.11 SPRINKLERS

A. Sprinklers for dry-pipe systems shall be automatic, fusible solder or glass bulb type; Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. All sprinkler heads shall be UL/FM listed.

B. Pendent Sprinkler: Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed standard-response type. Pendent sprinklers shall have a white polyester finish.

C. Upright Sprinkler: Upright sprinkler shall be brass or chrome-plated.

2.12 ACCESSORIES

A. Sprinkler Cabinet: Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

B. Pendent Sprinkler Escutcheon: Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

C. Pipe Escutcheon: Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

D. Sprinkler Guard: Guard shall be a chrome plated steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located as indicated in Drawings.

E. Identification Sign: Valve identification sign shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18-gauge steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.13 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

A. Refer to Section 21 13 13, Wet Pipe Sprinkler System, Fire Protection, for additional information.
PART 3 EXECUTION

3.01 EXAMINATION

A. After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.02 INSPECTION BY FIRE PROTECTION SPECIALIST

A. The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements, including signed approval of the Preliminary, Detection and Control Systems, and Final Acceptance Test Reports. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than 3 working days after the discrepancy is discovered.

3.03 ABOVEGROUND PIPING INSTALLATION

A. Protection of Piping Against Earthquake Damage: Seismically protect the system piping against damage from earthquakes. This requirement is not subject to determination under NFPA 13. Install the seismic protection of the system piping, including sway bracing as required, in accordance with UFC 3-310-04, NFPA 13 and Annex A; submit load calculations for sizing of sway bracing for systems that are required to be protected against damage from earthquakes. Include the required features identified therein that are applicable to the specific piping system.

B. Piping in Exposed Areas: Exposed piping shall be installed so as not to diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

C. Piping in Finished Areas: In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

D. Pendent Sprinklers Locations: Sprinklers installed in the pendent position shall be of the listed dry pendent type, unless otherwise indicated. Dry
Pendent sprinklers shall be of the required length to permit the sprinkler to be threaded directly into a branch line tee. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers. Dry pendent sprinkler assemblies shall be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

E. Upright Sprinklers: Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

F. Pendent Sprinklers Locations: Sprinklers installed in the pendent position shall be of the listed dry pendent type, unless otherwise indicated. Dry pendent sprinklers shall be of the required length to permit the sprinkler to be threaded directly into a branch line tee. Hangers shall be provided on arm-overs exceeding 12 inches in length. Dry pendent sprinkler assemblies shall be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area. All sprinkler installed in a finished ceiling shall be centered in the ceiling tile.

G. Pipe Joints: Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Groovedcouplings and fittings shall be from the same manufacturer. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the Drawings for servicing or adjusting the joint.

H. Reducers: Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow.
fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

I. Pipe Penetrations: Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve in accordance with NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation.

Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00, Firestopping. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

J. Escutcheons: Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

K. Inspector's Test Connection: Unless otherwise indicated, test connection shall consist of 1 inch pipe connected to the remote branch line and at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

L. Drains: Provide main drain piping to discharge at a safe point outside the building. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 3 gallons, the auxiliary drain shall consist of a valve not smaller than 1/2 inch and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 3 gallons, the auxiliary drain shall consist of two 1 inch valves and one 2- by 12-inch condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 1 inch in diameter. Tie-in drain lines shall be pitched a minimum of 1/2 inch per 10 feet.

M. Identification Signs: Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.
3.04 ELECTRICAL WORK

A. Unless otherwise specified herein, power supply equipment and wiring shall be in accordance with Section 26 05 02, Basic Electrical Requirements.

3.05 PIPE COLOR CODE MARKING

A. Color code mark piping as specified in Section 09 90 00, Painting and Coating, and Pipe Schedule in Drawings.

3.06 PRELIMINARY TESTS

A. The system, including the underground water mains, the aboveground piping, detectors and control system and system components shall be tested to assure that equipment and components function as intended. Submit proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests, proposed date and time to begin the tests, submitted with the Procedures. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, complete and submit certificates as specified, and 3 copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

B. Underground Piping: Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

C. Hydrostatic Testing: New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

D. Aboveground Piping:

1. Hydrostatic Testing: Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The
test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

2. Air Pressure Test: As specified in NFPA 13, an air pressure leakage test at 50 psi shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

E. Detection and Control System Tests: Upon completion of the installation, the detection and control system shall be subjected to functional and operational performance tests including tests of each installed initiating device, system actuation device and notification appliance. The control system tests specified in Article Final Acceptance Tests shall be conducted to ensure that the system is completely functional and that wiring has been properly connected. If deficiencies are found, corrections shall be made and the system shall be retested to assure that the systems have no deficiencies.

F. Automatic Water Control Valve Test: Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector and a manual actuation station connected to the control panel and a manual actuation device that is part of the valve trim. A full-flow main drain test shall be made. For systems with supervisory air, the air pressure shall be reduced to verify proper operation of the air supply system and associated supervisory alarm devices.

3.07 FINAL ACCEPTANCE TESTS

A. Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test; submit the proposed procedures for Final Acceptance Tests, no later than 14 days prior to the proposed start of the tests, the proposed date and time to begin Final Acceptance Tests, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material and Test Certificates and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Each system shall be completely drained after each trip test. The system air supply system shall be tested to verify that system pressure is restored in the specified time. Submit three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Report shall be signed by the Fire Protection Specialist. In addition, the Fire Protection Specialist shall have available copies of as-built drawings and certificates of
tests previously conducted. Submit as-built drawings, at least 14 days after completion of the Final Tests. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. After the system has been tested and drained, the system shall be drained periodically for at least 2 weeks until it can be assured that water from the system has been removed.

B. Control System Test: Testing shall be in accordance with NFPA 72. The test shall include the following:

1. Visual inspection of wiring connections.
2. Opening the circuit at each alarm initiating device, solenoid valve, and notification appliance to test the wiring and supervisory features.
3. Test of each function of the control panel.
4. Test of each circuit in the normal, open and ground fault modes.
5. Test of each initiating device in both normal and trouble conditions.
6. Test of each control circuit and device.
7. Test of each alarm notification appliance.
8. Test of the battery charger and batteries.
9. Operational tests under emergency power supply, including activation of connected alarm notification appliances for the specified time period.

C. Trip-tests of Automatic Water Control Valves: Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector, a manual actuation station connected to the system control panel and the manual release which is part of the valve trim. Each valve shall be returned to normal condition after each test. Prior to trip testing sprinkler deluge system, precautionary steps shall be taken to prevent water damage to the building and equipment from sprinkler discharge. Control valves on deluge systems shall be shut off immediately after automatic water control valve remain open until open sprinklers have discharged for a minimum of 10 seconds.

D. Tests of Supervisory Air System: System supervisory air pressure shall be reduced from the normal system pressure to the point at which a low-pressure alarm is sounded. Air pressure shall be restored to verify trouble signal restoration. Automatic start/stop features of air compressor shall be tested.

3.08 ONSITE TRAINING

A. The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit proposed Onsite Training schedule, at least 14 days prior to the start of related training. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete and after the
Final Acceptance Test. The Onsite Training shall cover all of the items contained in the approved Operating and Maintenance Instructions. Submit six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

END OF SECTION
Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Plumbing Piping Insulation
PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. ASTM International (ASTM):
4. Underwriters Laboratories, Inc. (UL).

1.02 SUBMITTALS

A. Action Submittals: Product description, include list of materials, thickness for each service scheduled, and locations.

B. Informational Submittals:

1. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.
2. Manufacturer’s installation instructions.

1.03 QUALITY ASSURANCE

A. Materials furnished under this Specification shall be standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.

B. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.
C. UL Listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer’s Stamp or Label:
   1. Every package or standard container of insulation, jackets, cements, adhesives and coatings delivered to Site shall have manufacturer’s stamp or label attached, giving name of manufacturer, brand, and description of material.
   2. Insulation packages and containers shall be marked “asbestos-free.”

PART 2 PRODUCTS

2.01 GENERAL

A. Insulation exterior shall be cleanable, grease-resistant, non-flaking, and non-peeling.

B. Insulation shall conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.

C. Insulation for fittings, flanges, and valves shall be pre-molded, precut, or job-fabricated insulation of same thickness and conductivity as used on adjacent piping.

D. Fire Resistance:
   1. Insulation, adhesives, vapor barrier materials and other accessories, except as specified herein, shall be noncombustible.
   2. Use no fugitive or corrosive treatments to impart flame resistance.
   3. Flame proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
   4. Materials including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with NFPA 255 methods.
   5. Materials exempt from fire-resistant rating:
      a. Nylon anchors.
      b. Treated wood inserts.
   6. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
2.01 PIPE INSULATION

a. Polyurethane insulation.
b. PVC casing.
c. Fiberglass-reinforced plastic casing.

2.02 PIPE INSULATION

A. Type P1—Fiberglass (ASTM C547, Type 1 (Minus 20 Degrees F to 500 Degrees F):

1. Fiberglass, UL-rated, preformed, sectional rigid, minimum 4 pounds per cubic foot (PCF) density, K factor 0.23 maximum at 75 degrees F mean, with factory-applied all-service jacket (ASJ) composed of reinforced kraft paper and aluminum foil laminate. Jacket shall have self-sealing lap to facilitate closing longitudinal and end joints.

2. Manufacturers and Products:
   a. CertainTeed; Preformed Pipe Insulation.
   b. Johns Manville; Micro-Lok AP-T.
   c. Owens/Corning Fiberglas Pipe Insulation.
   d. Knauf Pipe Insulation; Crown Pipe Insulation.

B. Type P3—Elastomeric (ASTM C534, Minus 40 Degrees F to 220 Degrees F):

1. Flexible, closed cell elastomeric.
2. Nominal 6 PCF density, K factor 0.27 maximum at 75 degrees F mean.
3. Water Vapor Transmission: 0.1 perm-inch, or less.
4. Manufacturers and Products:
   a. Armacell; AP Armaflex.
   b. Nomaco; K-Flex LS.
   c. Rubatex; R-180-FS.

2.03 INSULATION FINISH SYSTEMS

A. Type F3—Aluminum:

1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100 or 3105 to ASTM B209 with H-14 temper, minimum 0.016-inch thickness, with smooth mill finish.
2. Moisture Barrier: Provide factory applied moisture barrier, consisting of 40-pound kraft paper with 1-mil-thick low-density polyethylene film, heat and pressure bonded to inner surface of the aluminum jacketing.
3. Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
4. Manufacturer and Product: RPR Products; INSUL-MATE.
PART 3    EXECUTION

3.01  INSTALLATION OF INSULATION

A. Install insulation products in accordance with manufacturer’s written instructions, and in accordance with recognized industry practices.

B. Apply insulation over clean, finish painted, and dry surfaces.

C. Install insulation after piping system has been pressure tested and leaks corrected.

D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.

E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.

F. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

G. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Seal open ends of insulation with mastic.

H. Cover valves, flanges, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job-fabricated units. Finish cold pipe fittings with white vapor barrier coating and hot piping with white vinyl acrylic mastic, both reinforced with glass cloth.

I. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

J. Install protective metal shields and foamglass inserts where pipe hangers bear on outside of insulation.

K. Insulate valve bodies, flanges, and pipe couplings.

L. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.

M. Do not insulate flexible pipe couplings and expansion joints.

N. Do not allow insulation to cover nameplates or code inspection stamps.

O. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
P. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.

Q. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.

R. Placement:
   1. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
   2. Insulate valves and fittings with sleeved or cut pieces of same material.
   3. Seal and tape joints.

S. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.

T. Vapor Barrier:
   1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
   2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
   3. Do not use staples and screws to secure vapor sealed system components.

3.02 INSTALLATION OF INSULATION FINISH SYSTEMS

A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.

B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.

C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.

D. Do not use screws or rivets to fasten the fitting covers.

E. Install removable prefabricated aluminum covers on exterior flanges and unions.

F. Caulk and seal exterior joints to make watertight.
3.03 INSULATION APPLICATIONS

A. Potable Cold Water:
   1. Type P3, elastomeric.
   2. 1-inch thickness for all pipe sizes.

B. Potable Hot Water (1-1/4-Inch and Smaller):
   1. Type P1, fiberglass.
   2. 1-inch thickness.

C. Potable Hot Water (1-1/2-Inch and Larger):
   1. Type P1, fiberglass.
   2. 1.5-inch thickness.

D. Tepid Water (Outdoors):
   1. Type P3, elastomeric.
   2. 1-inch thickness for all pipe sizes.

E. Tepid Water (Indoors):
   1. Type P1, fiberglass.
   2. 1-inch thickness for all pipe sizes.

F. Refrigeration Suction:
   1. Type P3, elastomeric.
   2. 1/2-inch thickness for pipe sizes up to 1 inch.
   3. 3/4-inch thickness for pipe sizes over 1 inch.

G. Refrigeration Hot Gas Reheat:
   1. Type P3, elastomeric.
   2. 3/4-inch thickness.

H. Condensate Drain:
   1. Type P3, elastomeric.
   2. 1/2-inch thickness for pipe sizes up to 2-5/8 inches ID.
   3. 3/4-inch thickness for pipe sizes over 2-5/8 inches ID.

I. Pipe Hangers:
   1. Type P1, Fiberglass: UL-rated, preformed rigid pipe insulation inserts
      of thickness equal to adjoining insulation, 10 inches in length, with
factory-applied, vinyl-coated and embossed vapor barrier jacket with self-sealing lap.

2. Type P3, Elastomeric: Rigid insulation section with 9-inch-long, 16-gauge galvanized steel saddle.

3.04 INSULATION FINISH APPLICATIONS

A. Piping Insulation (Indoors): Factory finish.

B. Piping Insulation (Outdoors): Type F3, Aluminum wrap.

C. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.05 FIELD QUALITY CONTROL

A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION
**Specification Document Control No.:** 22 10 01  
**Revision No.:** 0

**Project:** Outfall 200 Mercury Treatment Facility

**Engineering Discipline:** Building Mechanical

**Specification Division:** 22 – Plumbing  
**Date:** 6/22/2017

**Specification Title & Description:** (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)  
Plumbing Piping and Accessories

### Revision History:

<table>
<thead>
<tr>
<th>Revision No.</th>
<th>Description</th>
<th>Date</th>
<th>Affected Pages</th>
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<tr>
<td>0</td>
<td>Issue for Construction</td>
<td>June 22, 2017</td>
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### Document Review & Approval:

**Originator:**  
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**SIGNATURE**  
June 21, 2017

**Design Verification Complete:**  
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June 22, 2017

**Approved:**  
W. Laird Ellis, Jr. PE/Design Manager  
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**SIGNATURE**  
Digitally signed by W. Laird Ellis, Jr.  
Date: 2017.06.22 09:59:45 -06'00'
PART 1    GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

2. American Society of Sanitary Engineering (ASSE):
   a. 1010, Performance Requirements for Water Hammer Arresters.
   b. 1013, Performance Requirements for Reduced Pressure Principle
      Backflow Preventers and Reduced Pressure Fire Protection
      Backflow Preventers.
3. ASTM International (ASTM):
   b. A307, Standard Specification for Carbon Steel Bolts and Studs,
      60,000 psi Tensile Strength.
   d. A888, Standard Specification for Hubless Cast Iron Soil Pipe and
      Fittings for Sanitary and Storm Drain, Waste, and Vent Piping
      Applications.
   g. B62, Standard Specification for Composition Bronze or Ounce
      Metal Castings.
   h. B75/B75M, Standard Specification for Seamless Copper Tube.
   j. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod,
      Bar, and Shapes.
   k. B127, Standard Specification for Nickel-Copper Alloy (UNS
      N04400) Plate, Sheet, and Strip.
   l. B139/B139M, Standard Specification for Phosphor Bronze Rod,
      Bar, and Shapes.
   m. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar,
      and Wire.
   n. B194, Standard Specification for Copper-Beryllium Alloy Plate,
      Sheet, Strip, and Rolled Bar.
   o. C564, Standard Specification for Rubber Gaskets for Cast Iron
      Soil Pipe and Fittings.
      Hubless Cast Iron Soil Pipe and Fittings.
   q. C1460, Standard Specification for Shielded Transition Couplings
      for use with Dissimilar DWV Pipe and Fittings Above Ground.
1.02 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

1.03 SUBMITTALS

A. Action Submittals:
   1. Product data sheets.
   2. Shop Drawings:
      a. Show Contractor recommended changes in location of fixtures or equipment.
   3. Isometric riser diagrams.

B. Informational Submittals:
   1. Changes in location of equipment or piping that affect connecting or adjacent work, before proceeding with the work.
   2. Complete list of products proposed for installation.
   3. Test records produced during testing.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption:
   Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

   1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

A. Piping Schedule: Refer to Drawing M9410001-F-0002.

B. Piping Material: Refer to Piping Data Sheet(s), Article Supplements and Section 40 27 00, Process Piping—General.

2.03 HOSE VALVES AND HYDRANTS

A. Refer to Plumbing Fixture Schedule on Drawings for additional information.

B. Non-Freeze Wall Hydrant:

   1. Nonfreeze exposed with chrome-plated face
   2. Integral vacuum breaker,
3. Manufacturers and Products:
   a. J. R. Smith; Figure 5609.
   b. Josam; 71050 Series.

C. Interior Hose Valve:
   1. Lead Free brass boiler drain.
   2. Teflon stem packing.
   3. Cast iron hand wheel.
   4. Rated 200-pound WOG.
   5. Manufacturer and Product:
      a. Watts; LFBD4F.
      b. Or equal.

D. Exterior Post Hydrant:
   1. Non-freeze free stand post hydrant.
   2. Manufacturers and Products:
      a. J. R. Smith; Figure 5910 Series.
      b. Wade, Division of Tyler Pipe; 8610 Series.
      c. Zurn; 1385 (3/4 inch) and 1396 (1 inch to 2 inch).

2.04 PIPE HANGERS AND SUPPORTS
A. Refer to Section 40 05 15, Piping Support Systems.

2.05 INSULATION
A. As specified in Section 22 07 00, Plumbing Piping Insulation.

2.06 VALVES
A. General:
   1. Furnish complete with necessary operating hand wheels, chain wheels, extension stems, floor stands, worm and gear operators, operating nuts, chains, and wrenches.
   2. Renewable Parts Including Discs, Packing, and Seats: Types as recommended by valve manufacturer for intended service.
   3. Units shall have name of manufacturer and size of valve cast on body or bonnet or shown on a permanently attached plate in raised letters.

B. Design Features:
   1. Brass and bronze components, including appurtenances in contact with water.
   2. Alloys containing less than 16 percent zinc and 2 percent aluminum.
3. Alloys are of the following ASTM designations:
   a. B61, B62, B98/B98M (Alloy A, B, or D), B139 (Alloy A), B164, B194, and B127.
   b. Stainless steel Alloy 18-8 may be substituted for bronze as an option with approval of Engineer.

C. Valve Operators:

1. Open by turning counterclockwise.
2. Worm and Gear Operators on Manually Operated Valves: Totally enclosed design, proportioned as to permit operation of valve under full operating head with maximum pull of 40 pounds on handwheel or crank.
3. Self-locking type to prevent the disc or plug from creeping.
4. Self-Locking Worm Gears:
   a. One-piece design of gear bronze material, accurately machine cut.
   b. Worm: Hardened alloy steel, with thread ground and polished.
   c. Reduction gearing shall run in a proper lubricant.
5. Galvanize handwheels.

D. Ball Valves:

1. 2 Inches and Smaller for General Water and Air Service:
   a. Three-piece body type, bronze body and end pieces, hard-chrome plated bronze or brass ball, full bore port, RTFE seats and packing, blowout-proof stem, zinc-plated steel hand lever operator with vinyl grip.
   b. Rated 600-pound WOG, 150-psi SWP.
   c. Manufacturers and Products:
      1) Soldered Ends:
         a) Milwaukee; BA-350.
         b) Nibco; S-595-Y.
         c) Conbraco Apollo; 82-200.

E. Gate Valves:

1. 4 Inches and Larger for Water and Air Services:
   a. Iron body, bronze mounted, with flanged ends, solid wedge gate with nonrising stem, and handwheel operator.
   b. Rated 125-pound SWP, 200-pound WOG.
   c. Manufacturers and Products:
      1) Crane; No. 461.
      2) Nibco; Model No. F-619.
F. Check Valves 3 Inches and Smaller:

1. Bronze body, wye pattern, threaded ends and cap, regrinding seat, and swing type disc.
2. Rated 125-pound SWP, 200-pound WOG.
3. Manufacturers and Products:
   a. Crane; No. 37.
   b. Walworth Co.; Figure 406.

G. Reduced-Pressure Principle Backflow Preventer:

1. 1/4-Inch to 3-Inch Size:
   a. Size as indicated in Plumbing Fixture Schedule on the Drawings.
   b. Two resilient seated check valves with an independent relief valve between the valves, two nonrising stem resilient-seated isolation valves, test cocks, in accordance with AWWA C511 and ASSE 1013, rated 175 psi maximum working pressure, meets requirements of USC Foundation for Cross-Connection Control and Hydraulic Research.
   c. Manufacturers and Products:
      1) Watts; Series LF009/LF909.
      2) Or approved equal.
2. 4-Inch to 10-Inch Size:
   a. Size as indicated in Plumbing Fixture Schedule on the Drawings.
   b. Two independent torsion spring check modules, a differential pressure relief valve located between and below the two modules, two drip tight shutoff valves, and required torsion spring check modules and relief valve shall be contained with a sleeve accessible single housing constructed from Type 304 (Schedule 40) stainless steel pipe with groove end connections.
   c. Torsion spring checks shall have replaceable elastomer discs and in operation produce drip tight closure against the reverse flow of liquid caused by backpressure or back-siphonage.
   d. Constructed in accordance with ASSE 1013, rated 175 psi maximum working pressure, meeting requirements of USC Foundation for Cross-Connection Control and Hydraulic Research.
   e. Manufacturers and Products:
      1) Watts; Series 957.
      2) Or approved equal.

H. Balancing Valves (Recirculating Hot Water):

1. Bronze, calibrated balancing type with provisions for connecting a portable differential pressure meter. Meter connections shall have built-in check valves.
2. An integral pointer shall register degree of valve opening.
3. Construct with internal seals to prevent leakage around rotating element.
4. Rated for 125 psig working pressure at maximum temperature of 250 degrees F.
5. Furnish one pressure gauge type readout meter in carrying case.
6. Furnish with preformed polyurethane insulation valve enclosure, suitable for use on hot water systems.
7. Manufacturers and Products:
   a. Bell & Gossett; No. CB circuit setter.
   b. TACO; Series 790.

I. Thermostatic Mixing Valve Assembly:

1. 2 GPM to 26 GPM Flow:
   a. Thermostatic water mixing valve, solid bimetal thermostat directly linked to valve porting to control the intake of hot and cold water and compensate for supply temperature or pressure fluctuations. 3/4-inch sweat inlets and outlet, 1 gpm minimum flow capacity. Integral combination check stops, Internal parts of lead free bronze, lead free brass, and stainless steel, integral wall support, color-coded dial, HOT-COLD with directional indicators, maximum operating pressure 125 psi, adjustable high temperature limit stop set for 120 degrees F, locking temperature adjustment knob.
   b. Inlets: See Plumbing Schedule on Design Drawings.
   c. Outlets: See Plumbing Schedule on Design Drawings.
   d. Self-contained; no electrical requirements.
   e. Manufacturers and Products:
      1) Leonard; Model TM-26-LF.
      2) Or approved equal.

2. 3 GPM to 126 GPM:
   a. Unit shall be self-contained and include a thermostatic water mixing valve, a dial thermometer on the outlet, union angle check stops, wall mounting bracket, piping and fittings factory assembled and tested, top or bottom inlets and top outlet, unit set for 85 degrees F and a maximum temperature of 90 degrees F. The redundant valve remains fully closed until outlet temperature reaches 90 degrees F, and will keep the maximum temperature at 90 degrees F should the primary valve allow water in excess of this temperature. Unit must be able to be set to the correct temperature for the specific contaminant but must be locked in place to prevent changing of the temperature by accident. Unit must be checked weekly for performance in conjunction with the requirements of ANSI Z-358.1 2004. Unit shall be able to flow 40 gpm at 30 psi.
   b. Rated hot water supply temperature 180 degrees F and supply pressure 125 psig.
   c. Inlets: See Plumbing Schedule on Design Drawings.
d. Outlets: See Plumbing Schedule on Design Drawings.
e. Self-contained; no electrical requirements.
f. Manufacturers and Products:
   1) Leonard; Model TM-5125-LF.
   2) Or approved equal.

2.07 MISCELLANEOUS PIPING SPECIALTIES

A. Strainers for Water Service:

   1. Iron body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap.
   2. Screen: Heavy-gauge stainless steel or Monel, 30 mesh.
   3. Manufacturers and Products:
      a. Crane; No. 988-1/2.
      b. Mueller; No. 758.

B. Vacuum Breakers 2 Inches and Smaller:

   1. Angle type, as required.
   2. Manufacturers:
      a. Febco.
      b. Watts.

C. Water Hammer Arresters:

   1. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
   2. Manufacturers and Products:
      b. Precision Plumbing Products, Inc.

D. Sleeves:

   1. Manufacturers and Products:
      a. J. R. Smith; Figure 1720.
      b. Josam; No. 26400.

E. Flashing Sleeves for Roof Penetrations:

   1. Built-Up Bituminous Roofing: Fabriicate of lead as specified in Section 07 62 00, Sheet Metal Flashing and Trim.
   2. Single-Ply Membrane Roofing: Pipe seals as specified in Section 07 70 01, Roof Specialties and Accessories.
F. Insulating Dielectric Unions and Flanges:
   1. Galvanically compatible with piping to which attached and pressure ratings suitable for system working pressures.
   2. Unions 2 Inches and Smaller: Screwed or solder-joint type.
   3. Unions 2-1/2 Inches and Larger: Flanged type, complete with bolt insulators, dielectric gasket, bolts, and nuts.
   4. Manufacturers:
      a. Epco Sales, Inc., Cleveland, OH.
      b. Capitol Insulation Unions.

G. Joint Solder: 95-5 wire solder, ASTM B32, Grade 95 TA. Do not use cored solder.

H. Pipe Joint Sealer: Compound insoluble in water or Teflon tape; approved by NFS for use in potable water.

I. Rubber Gaskets: ASTM C564.

2.08 MEASURING DEVICES

A. Thermometers:
   1. Adjustable angle, organic spirit type, blue in color, with 9-inch case and scale range in degrees F, as shown.
   2. Furnish with 3-1/2-inch stem length and separable NPT brass thermowell.
   3. Manufacturers:
      a. Trerice Co.; Model A005.
      b. Weksler.

B. Pressure Gauges:
   1. Construction: 3-1/2-inch gauge size, 0 to 690 kPa, 0 to 160 psi range, steel case, glass crystal, brass movement, and 1/4-inch NPT lower connection.
   2. Furnish with 1/4-inch brass gauge cock.
   3. Manufacturers and Products:
      a. Ashcroft; Type 1008.
      b. Marsh; J80.
      c. Marshalltown.
PART 3  EXECUTION

3.01  GENERAL

A. Install plumbing systems to meet applicable plumbing code.

B. Field Obstructions:
   1. Drawings do not attempt to show exact details of piping. Provide offsets around obstructions.
   2. Do not modify structural components, unless approved by Engineer.

C. Sleeves:
   1. Pipe sizes shown are nominal sizes, unless shown or specified otherwise.
   2. Provide piping passing through walls, floors, or ceilings with standard-weight pipe sleeves.
   3. Provide pipes passing through finished walls with chrome-plated canopy flanges.
   4. Dry pack sleeves in existing work in-place and provide finished appearance.
   5. Pack holes left by removal of existing piping with grout and finish to match adjacent surface.

D. Provide unions in piping systems at connections to equipment.

E. Provide shielded transition couplings, insulating dielectric unions and flanges between ferrous and nonferrous piping and where otherwise required for electrically insulated connection.

F. Pipe air release valves, water-lubricated bearings, and other appurtenances having water effluent with copper tubing to nearest drain.

G. Provide isolation valves and strainers at pressure regulators.

H. Trench Excavation and Backfill: As specified in Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.

3.02  INSTALLATION

A. Steel Pipe:
   1. Ream, clean, and remove burrs and mill scale from piping before making up.
   2. Seal joints with pipe joint sealer or Teflon tape.
B. Copper Tubing:
   1. Cut tubing square and remove burrs.
   2. Clean both inside of fittings and outside of tubing with steel wool and hydrochloric acid before soldering.
   4. Do not use mitered joints for elbows or notching of straight runs of pipe for tees.

C. Rigid PVC or CPVC:
   1. Cut, make up, and install in accordance with pipe manufacturer’s recommendations.
   2. Ream, clean, and remove burrs from cut ends before joining pipe.
   3. Lay in trench by snaking pipe from one side to other.
   4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and final use.
   5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
   6. Shield ends to be joined from direct sunlight prior to and during laying operation.
   7. Use strap wrenches only for tightening threaded plastic joints. Do not over tighten fittings.

D. Water System Balancing: Provide a qualified registered engineer or firm specializing in testing and balancing to adjust domestic water system. Balance system for required water flows at each plumbing fixture, terminal device, and recirculating hot water loop.

E. Water Hammer Arresters:
   1. Install in piping systems where shown on Drawings and adjacent to pieces of equipment where quick closing valves are installed.
   2. Install at all emergency safety showers and eyewashes.
   3. Size and install in accordance with PDI-WH201.
   4. Shock arresters to have access panels or to be otherwise accessible.

F. Valves: Install in accordance with manufacturer’s recommendations.

G. Miscellaneous Piping Specialties: Install in accordance with manufacturer’s recommendations.

H. Measuring Devices: Install in accordance with manufacturer’s recommendations.
3.03 SANITARY AND WASTE DRAINS AND VENTS PIPING

A. Installation:
   1. Set piping above floor slab true and plumb.
   2. Set exposed risers as close to walls as possible.
   3. Slope drain lines at minimum 2 percent slope, unless otherwise noted. Vent lines shall be installed level or sloped, with no low spots.
   4. Where vent stacks pass through roof slab, fit with flashing sleeve secured to roof.
   5. Extend vents minimum 1 foot above roof.
   6. Provide cleanouts where shown and where required by code.

3.04 HVAC CONDENSATE PIPING

A. Set piping true and plumb.
B. Slope piping 1/8 inch per foot minimum.

3.05 WATER SUPPLY PIPING

A. Water supply piping includes potable water systems and tepid water systems.
B. Flush water piping systems clean of internal debris, clean faucet aerators, and adjust plumbing fixture valves for manufacturer’s recommended flow.
C. Do not run water piping through electrical rooms, stairwells, or immediately over or within a 3-foot horizontal clearance of electrical panels, motor starters, or environmental control panels.
D. Provide exterior water piping with minimum 3 feet of cover or install below frost line, whichever is greater.
E. Hose Valves and Hydrants: Attach handle with setscrew and provide manufacturer’s recommended gravel fill around drain hole of post hydrants.
F. Provide valve operators with position indicators, where indicated, to show position of valve disc or plug.
G. Provide bypass with isolation valve for emergency throttling around each reducing valve.
H. Protect buried copper and steel pipe and fittings with a single wrap of coal-tar saturated felt in accordance with AWWA C203.
I. Vacuum Breakers 2 Inches and Smaller: Install minimum 6 inches above flood line of equipment they serve.
J. Provide manual air vents at high points in domestic hot water system.
3.06 INSULATION

A. As specified in Section 22 07 00, Plumbing Piping Insulation.

3.07 HANGERS AND SUPPORTS

A. In accordance with Section 40 05 15, Piping Support Systems.

B. Install pre-engineered support equipment in accordance with manufacturer’s recommendations.

C. Hanger Rod Sizing and Spacing for:

1. Steel Pipe:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Max. Hanger Spacing (feet)</th>
<th>Min. Rod Size (inches)</th>
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<tbody>
<tr>
<td>1 inch and smaller</td>
<td>6</td>
<td>1/4</td>
</tr>
<tr>
<td>1-1/4 through 2-1/2 inches</td>
<td>8</td>
<td>1/4</td>
</tr>
<tr>
<td>3 and 4 inches</td>
<td>10</td>
<td>3/8</td>
</tr>
<tr>
<td>6 inches</td>
<td>12</td>
<td>3/8</td>
</tr>
<tr>
<td>8 inches</td>
<td>12</td>
<td>1/2</td>
</tr>
</tbody>
</table>

2. Copper Pipe:
   a. Rod Size: Same as for steel pipe.
   b. Spacing: 2 feet less per size than for steel pipe, except pipe 1-1/4 inches and smaller shall be supported every 6 feet.

3. Cast Iron Pipe:
   a. Rod Size: Same as for steel pipe.
   b. Spacing: Locate hanger rods at each pipe joint and change of direction, 10-foot maximum spacing.

4. Plastic Pipe:
   a. Rod Size: Same as for steel pipe.
   b. Spacing: As recommended by manufacturer and required by applicable plumbing code for flow and temperature in pipe.
   c. No metal portion of hanger shall contact pipe directly.

D. Attach Support Rods for Horizontal Piping:

1. To steel beams with I-clamps.
2. To concrete with inserts or with flanges fastened with flush shells.
3. To wood with thickness of 2-1/2 inches or more with bolts or angle clips.
E. Trapeze Hangers:
1. Trapeze hangers may be used in lieu of individual hangers where horizontal piping is arranged with two or more parallel lines.
2. Attach lines to horizontal with U-bolts or one-hole clamps.

F. Vertical Piping:
1. Support by channel type support system and pipe clamps on 10-foot maximum centers.
2. Copper, and Plastic Piping: Isolate from channels and pipe clamps with pipe isolators.

G. Insulated Piping: Furnish galvanized protection shield and oversized hangers under insulated piping.

3.08 INTERIM CLEANING
A. As specified in Section 40 27 00, Process Piping—General.
B. Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.
C. Examine piping to assure removal of foreign objects prior to assembly.
D. Shop cleaning may employ conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

3.09 TESTING
A. As specified in Section 40 80 01, Process Piping Leakage Testing.

3.10 CLEANING AND DISINFECTION
A. Prior to final acceptance, following assembly and testing, flush pipelines with water, except for plant process air lines and instrument air lines, and remove accumulated construction debris and other foreign matter.
B. Minimum Flushing Velocity: 5 feet per second.
C. Insert cone strainers in the connections to attached equipment and leave until cleaning has been accomplished.
D. Remove accumulated debris through drains 2 inches and larger or by dropping spools and valves.
E. Immediately following drainage of flushed lines, dry piping with compressed air.

F. Plant process air and instrument air piping shall be blown clean of loose debris with compressed air.

G. Disinfect pipelines intended to carry potable water before placing in service:

1. Meet the requirements of AWWA C651, unless otherwise specified.
2. Disinfecting Mixture:
   a. A chlorine-water solution having a free chlorine residual of 40 ppm to 50 ppm.
   b. Prepare by injecting one of the following:
      1) Liquid chlorine gas-water mixture.
      2) Dry chlorine gas.
      3) Calcium or sodium hypochlorite and water mixture.
   c. Inject mixture into pipeline at a measured rate while freshwater is allowed to flow through the pipeline at a measured rate so the combined mixture of freshwater and chlorine solution or gas is of the specified strength.
   d. Apply liquid chlorine gas-water mixture by means of a chlorinating device.
   e. Feed dry chlorine gas through proper devices for regulating the rate of flow and providing effective diffusion of gas into water within pipe being treated.
   f. Chlorinating devices for feeding solutions of chlorine gas or gas itself must prevent backflow of water into chlorine cylinder.
   g. Calcium Hypochlorite: If this procedure is used, first mix dry powder with water to make a thick paste, then thin to approximately a 1 percent solution (10,000 ppm chlorine).
   h. Sodium Hypochlorite: If this procedure is used, dilute liquid with water to obtain a 1 percent solution.
   i. The following proportions of hypochlorite to water will be required:

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium Hypochlorite(^1) (65 - 70 percent C1)</td>
<td>1 lb</td>
<td>7.5 gal</td>
</tr>
<tr>
<td>Sodium Hypochlorite(^2) (5.25 percent C1)</td>
<td>1 gal</td>
<td>4.25 gal</td>
</tr>
</tbody>
</table>

\(^1\)Comparable to commercial products known as HTH, Perchloron, and Pittchlor.
\(^2\)Known as liquid laundry bleach, Clorox, and Purex.
H. Point of Application:

1. Inject chlorine mixture into pipeline to be treated at the beginning of the line through a corporation stop or suitable tap in the top of pipeline.
2. Control clean water from existing system or another source so it flows slowly into newly installed piping during chlorine application.
3. Manipulate valves so the strong chlorine solution in the line being treated will not flow back into line supplying the water. Use check valves, if necessary.

I. Retention Period:

1. Retain treated water in pipeline for a minimum of 24 hours or long enough to destroy nonspore-forming bacteria.
2. At the end of the retention period, the disinfecting mixture shall have strength of at least 10 ppm of chlorine.
3. Operate valves, hydrants, and other appurtenances during disinfection to assure disinfecting mixture is dispersed into all parts of the pipeline including dead ends, new services, and similar areas that otherwise may not receive the disinfecting solution.
4. Do not place concentrated quantities of commercial disinfectants in pipeline before filling with water.
5. After chlorination, flush water from permanent source of supply until water through pipeline is equal chemically and bacteriologically to permanent source of supply.

J. Disposal of Disinfecting Water:

1. Dispose of disinfecting water in an acceptable manner that will protect the public and receiving waters from harmful or toxic concentrations of chlorine.
2. Do not allow disinfecting water to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine concentrations to a safe level.

3.11 CORROSION PROTECTION

A. As specified in Section 40 27 00, Process Piping—General.

3.12 PROTECTION OF INSTALLED WORK

A. Protective Covers:

1. Provide over floor and shower drains during construction, to prevent damage to drain strainers and keep foreign material from entering drainage system.
2. Cover roof drains and emergency overflow drains during roofing process so roofing material and gravel do not enter drain piping.
3. Remove at time of Substantial Completion.

3.13 FIELD FINISHING
A. In accordance with Section 40 27 00, Processing Piping—General.

3.14 PIPING IDENTIFICATION
A. Refer to Section 40 27 00, Process Piping—General, and Pipe Schedule.

3.15 SUPPLEMENTS
A. The supplements listed below, following “End of Section,” are part of this specification.

1. Plumbing Piping Data Sheets.

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 10 01.02</td>
<td>Polyvinyl Chloride Drain Waste and Vent (PVC-DWV) Pipe and Fittings</td>
</tr>
<tr>
<td>22 10 01.03</td>
<td>Cast Iron Soil Pipe (CISP) and Fittings</td>
</tr>
</tbody>
</table>

END OF SECTION
### SECTION 22 10 01.02
### POLYVINYL CHLORIDE
### DRAIN WASTE AND VENT (PVC-DWV)
### PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>Item</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe and Fittings</td>
<td>All</td>
<td>PVC-DWV Schedule 40 nonpressure application, Class 12454B conforming to ASTM D2665 and ANSI/NSF Standard 14 system.</td>
</tr>
<tr>
<td>Joints</td>
<td>All</td>
<td>Solvent cemented conforming to ASTM D2855 except where connection to equipment may require future removal.</td>
</tr>
<tr>
<td>Solvent Cement</td>
<td>All</td>
<td>As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.</td>
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</table>

END OF SECTION
## SECTION 22 10 01.03
CAST IRON SOIL PIPE (CISP) AND FITTINGS

<table>
<thead>
<tr>
<th>Item</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe</td>
<td>6” and smaller</td>
<td>Hubless, CISPI 301, service weight, no-hub ends.</td>
</tr>
<tr>
<td></td>
<td>8” and larger</td>
<td>Hub and spigot, ASTM A74, service weight, single hub and spigot.</td>
</tr>
<tr>
<td>Joints</td>
<td>6” and smaller</td>
<td>Coupling: Conform to ASTM C564, ASTM C1277, and CISPI 310.</td>
</tr>
<tr>
<td></td>
<td>8” and larger</td>
<td>Compression: Neoprene sealing sleeve with 24-gauge Type 304 stainless steel shield and clamp assembly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joints to dissimilar material shall comply with ASTM C1460.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rubber gaskets, ASTM C564.</td>
</tr>
<tr>
<td>Fittings</td>
<td>6” and smaller</td>
<td>Conform to ASTM A888 and CISPI 301</td>
</tr>
<tr>
<td></td>
<td>8” and larger</td>
<td>Conform to ASTM A74</td>
</tr>
<tr>
<td>Coating</td>
<td>All</td>
<td>Bituminous-coated inside and out; marked with manufacturer’s name or trademark and CISPI symbol.</td>
</tr>
</tbody>
</table>

END OF SECTION
Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)

Plumbing Equipment

### Revision History:

<table>
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<tbody>
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<td>June 22, 2017</td>
<td>All</td>
</tr>
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</table>

### Document Review & Approval:

**Originator:**
Ted J. Price P.E. Design Engineer

**Design Verification Complete:**
Jamin McMurren PE/QC

**Approved:**
W. Laird Ellis, Jr. PE/Design Manager

Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.22 09:19:24 -06'00'
PART 1   GENERAL

1.01 REFERENCES

   A. The following is a list of standards which may be referenced in this section:

   2. American Society of Mechanical Engineer’s (ASME).
   5. ASTM International (ASTM).
   6. FM Global (FM).
   7. Food and Drug Administration (FDA).
   12. NSF International (NSF):
       a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
       b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
   13. Underwriters Laboratories Inc. (UL).

1.02 SUBMITTALS

   A. Action Submittals:

   1. Manufacturer’s product data.

   B. Informational Submittals:

   1. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection Observation, and Testing.
1.03 SPECIAL GUARANTEE

A. Where noted below, provide manufacturer’s extended guarantee in writing with Owner named as beneficiary. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of products found defective during the stated period after date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER HEATERS

A. Electric Water Heater (Commercial) (WH-1):

1. Description:
   a. Automatic, vertical, electric storage type.
   b. Regulatory Compliance: UL listed, ASME, ASHRAE 90.1, and NSF.
   c. Tank: Steel, glass-lined, 150 psig working pressure, and ASME rated.
   d. Insulation: Foam or fiberglass type with minimum R value per ASHRAE 90.1.
   e. Dip Tube: Required on inlet connection down to bottom section of tank.
   g. Pressure/Temperature Relief Valve: ASME rated.
   h. Connections: Inlet and outlet with factory-installed dielectric unions and brass drain valve with hose thread.
   i. Heating Element: Watt-density (maximum of 75 watts per square inch) incoloy sheath; immersion type.
   j. Controls: Fully automatic, housed in control panel, and including the following:
1) Terminal block.
2) Close differential immersion-type thermostat.
3) Control transformer for 120-volt circuit and fusing.
4) Magnetic contactors for each stage, as applicable.
6) Adjustable temperature range, 95 degrees F to 180 degrees F.
7) Power circuit fusing as required by NEC and UL.

k. Guarantee: 3 years.

2. Capacity: See Plumbing Schedule in Drawings.

3. Manufacturers:
   a. AO Smith.
   c. Lochinvar Corporation.

2.03 DOMESTIC WATER STORAGE TANK

A. Glass-Lined Steel (ST-1):

1. Description:
   a. Regulatory Compliance: ASHRAE 90.1 ASME, and NSF.
   b. Tank: Steel, glass-lined, 150 psig working pressure.
   c. Jacket: 16-gauge steel, galvanized, acrylic finish, with sealed drain pan.
   d. Insulation: Foam or fiberglass type with minimum R value per ASHRAE 90.1.
   e. Pressure/Temperature Relief Valve: ASME rated.
   f. Connections: Inlet and outlet with factory-installed dielectric unions and brass drain valve with hose thread.
   g. Guarantee: 5 years.

2. Capacity: See Plumbing Schedule in Drawings.

3. Manufacturers:
   a. AO Smith.
   c. Lochinvar Corporation.
   d. State Industries, Inc.

2.04 DOMESTIC WATER EXPANSION TANK

A. Description (ET-1):

1. Type: Prepressurized diaphragm type, configuration as scheduled on the Drawings.
3. Diaphragm: FDA-approved, heavy-duty butyl with polypropylene liner.
5. Maximum Operating Pressure: 150 psig.
6. Maximum Operating Temperature: 200 degrees F.
7. Finish: Manufacturer’s standard air-dry enamel.

B. Capacity: See Drawings.

C. Manufacturer: AMTROL, Inc.; Model AST.

2.05 DOMESTIC HOT WATER CIRCULATING PUMP (PUMP-1)

A. Description:
   1. Type: In-line, direct-drive, close-coupled centrifugal pump.
   2. Construction: Bronze body, stainless steel face plate, glass-filled noryl impeller, carbon steel shaft, mechanical carbon on ceramic seals, and bronze oil lubricated motor bearings.
   4. Connections Type and Size: Manufacturer’s standard.
   5. Accessories: Aquastat and automatic timer kit.

B. Capacity: See Plumbing Schedule in Drawings.

C. Manufacturers:
   1. Bell & Gossett.
   2. Taco, Inc.

2.06 WATER PRESSURE REDUCING VALVES 1/2 INCH THROUGH 2-1/2 INCHES

A. Description:
   1. Spring controlled, with a neoprene diaphragm.
   2. All brass or bronze construction with lead free construction.
   3. Sizes and Ratings:
      a. Refer to Drawings for capacity information.
   4. Manufacturers and Products:
      a. Fisher; Type 75.
      b. Watts; No. LF223.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, arrange, and connect equipment as shown on Drawings and in accordance with manufacturer’s recommendations.
3.02  FIELD QUALITY CONTROL

A.  Pumps: Do not hydrostatic test pumps with mechanical seals.

B.  Startup:

1.  In accordance with UCOR-4931, Outfall 200 Mercury Treatment Facility Startup Test Plan, and Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

2.  Piping Systems: Verify that flushing, cleaning, and testing has been completed prior to startup.

END OF SECTION
Specification Document Control No.: 22 40 00
Revision No.: 0
Project: Outfall 200 Mercury Treatment Facility
Engineering Discipline: Building Mechanical
Specification Division: 22 – Plumbing
Date: 6/22/2017

Specification Title & Description: (List attached Specifications by Section number, revision, date, and number of pages for each Section Specification compiled under this cover page. Attached Specifications are to have sequentially numbered pages.)
Plumbing Fixtures

Revised History:

<table>
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Digitally signed by W. Laird Ellis, Jr.
Date: 2017.06.22 09:21:13 -06'00'
PART 1   GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Americans with Disabilities Act (ADA).
2. American Society of Mechanical Engineers (ASME).
5. Food and Drug Administration (FDA).
6. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
7. Plumbing and Drainage Institute (PDI):
8. Underwriters Laboratories Inc. (UL).

1.02 SUBMITTALS

A. Action Submittals: Catalog information and rough-in dimensions for plumbing fixtures, products, and specialties.

1.03 REGULATORY REQUIREMENTS

A. Comply with the Americans with Disabilities Act (ADA), and local and state requirements.

PART 2   PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MANUFACTURERS

A. Fixture Trim:

1. Supply Stops and Traps:
   a. McGuire.
   c. Kohler.
2. Flush Valves: Sloan.
3. Water Closet Seats:
   a. Bemis.
   b. Church.
   c. Olsonite.
4. Lavatory Supply, Tailpiece, and Trap Insulation:
   a. McGuire.
   b. Trap Wrap.
   c. Truebro.

B. Plumbing Fixtures:

1. Water Closets, Lavatories, and Urinals:
   b. Kohler.
   c. Eljer.
2. Service Sinks:
   a. Kohler.
   b. Eljer.
3. Faucet Fittings:
   a. Sinks:
      1) Chicago.
      2) T&S Brass.
   b. Lavatories:
      1) Chicago.
      2) Symmons.
4. Shower Trim:
   a. Symmons.
   b. Powers.
5. Shower Stalls:
   a. Aqua Glass.
   b. Fixture Manufacturers.
6. Stainless Steel Sinks:
   a. Elkay.
   b. Just.
7. Mop Sinks:
   a. Stern-Williams.
   b. Fiat Products, Inc.
   c. Fixture Manufacturers.

C. Emergency Showers and Eyewashes:
   1. Haws.
   2. Bradley.
   3. Guardian.

D. Drainage Products:
   1. General:
      a. Smith.
      b. Wade.
      c. Zurn.

E. Plumbing Specialties:
   1. Shock Arresters:
      a. Smith.
      b. Sioux Chief.
      c. Precision Plumbing Products.
   2. Trap Primers:
      a. Precision Plumbing Products.
      b. Smith.
      c. Wade.
   3. Pressure/Temperature Relief Valves:
      a. Cash-Acme.
      b. Kunkle Valve.
      c. Watts.
   4. Pressure Gauges:
      a. Ashcroft.
      b. Marsh.
      c. Marshalltown.
   5. Thermometers:
      a. Trerice.
      b. Weksler.

2.03 GENERAL

A. Fixture Trim: Provide plumbing fixture trim where applicable on fixtures.

B. Plumbing Fixtures: Indicated by fixture number as shown on Drawings.

C. Drainage Products: Indicated by fixture number as shown on Drawings.
D. Plumbing Specialties: Indicated by fixture number as shown on Drawings.

E. Exposed fixture connections and piping shall be polished chrome-plated.

2.04 MATERIALS

A. Fixture Trim:

1. Supply Stop:
   a. Flexible supply with heavy cast brass, loose key, 1/2-inch IPS by 3/8-inch outside diameter tubing angle stop to wall with escutcheon plate; chrome-plated finish.
   b. Provide stop with stuffing box.

2. Trap:
   a. Chrome-plated, 17-gauge, semicast P-trap with compression ring cast brass waste and vent connection and cleanout.
   b. 1-1/2 inches for lavatories and drinking fountains.
   c. 1-1/2 inches for sinks.


B. Plumbing Fixtures: Refer to Drawings for Plumbing Fixture Schedule.

C. Drainage Products:

1. YCO, Cleanout (Exterior):

2. CO, Cleanout:

3. WCO, Wall Cleanout:
   a. Material: Stainless steel cover and screw.

D. Hose Valves: Refer to Section 22 10 01, Plumbing Piping and Accessories.

E. Plumbing Specialties:

1. Water Hammer Arresters:
   a. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.

2. Pressure Gauge:
   a. Materials: 3-1/2-inch gauge size, 0 to 160 psi range, steel case, glass crystal, brass movement, and 1/3-inch NPT lower connection.
   b. Manufacturer and Product: Ashcroft Dresser Instrument Division, Dresser Industries, Inc.; Type 1008.

3. Thermometer:
   a. Materials: Adjustable angle, red reading mercury type with 9-inch case and 30 degrees F to 180 degrees F range, 3-1/2-inch aluminum stem, and separate NPT brass thermowell.
   b. Manufacturer and Product: H.O. Trerice Co.; Model A005.

4. Trap Primer:
   a. Electronic trap primer with integral vacuum breaker with 24-hour adjustable timer with manual over ride.
   b. Electric solenoid valve and a manifold sized to accommodate the priming of all floor drains simultaneously.
   c. Provide with a stainless steel door with pull ring and a flush mounted cabinet. Power shall be a 110 volts with wall plug.
   d. Manufacturer:
      1) Precision Plumbing Products; pt-1320.
      2) Or equal.

F. Sealant: In accordance with Section 07 92 00, Joint Sealants.

PART 3 EXECUTION

3.01 PREPARATION

A. Drawings do not attempt to show exact details of fixtures. Changes in locations of fixtures, advisable in opinion of Contractor, shall be submitted to Engineer for review before proceeding with the Work.

3.02 INSTALLATION

A. Fixture Trim: Install fixture trim where applicable on fixtures.

B. Plumbing Fixtures, Mounting Heights:

   1. Standard rough-in catalogued heights, unless shown otherwise on Drawings.
   2. Caulk fixtures in contact with finished walls with waterproof, white, nonhardening sealant which will not crack, shrink, or change color with age. See Section 07 92 00, Joint Sealants.
C. Exact fixture location and mounting arrangement shall be as indicated on toilet room elevations and details as shown on Drawings.

D. Unless noted otherwise and as a minimum, fixtures shall be supported as indicated in PDI Code Guide 302.

E. Safety Equipment:

1. System Shutoff Valves:
   a. Shutoff valves shall give visual indication of position (open or closed).
   b. Shutoff valves shall be lockable valves and locked in open position.

2. Each safety shower/eyewash shall have red safety signoff tag. After completing requirements listed below, Contractor and Owner shall sign red safety signoff tag. Requirements are as follows:
   a. Visually check safety shower/eyewash piping for leaks.
   b. Verify that upon operation, stay-open valves remain open.
   c. Showerheads to be between 82 inches and 96 inches above standing surface.
   d. Shower spray pattern, when valve is full open, shall be a minimum 20 inches in diameter at 60 inches above standing surface.
   e. Water arcs from eyewash spray heads must cross. Test with eyewash gauge; Haws Drinking Faucet Co., Model 9015.
   f. Minimum flow rates for safety showers shall be 20 gpm.
   g. Minimum flow rates for eyewashes shall be 3 gpm.
   h. Tempered water shall be temperature indicated on Drawings.

F. Drainage Products:

1. Floor Drains: Set top flush with floor. Provide membrane clamps where required.
2. Cleanouts: Install where shown or required for purposes intended. Set cover flush with finished floor.
3. Hub Drains: Set top of hub 2 inches above finished floor.

G. Plumbing Specialties:

1. Shock Arresters:
   a. Install PDI-certified and rated shock arresters, sized and located in accordance with PDI WH-201 and as shown on Drawings.
   b. Install adjacent to equipment wherein quick closing valves are installed.
   c. Install at each emergency safety shower.
   d. Shock arresters to have access panels or to be otherwise accessible.
2. **Drain P-Trap Priming:**
   a. **Pipe:** Type K, soft copper.
   b. **Trap and prime floor drains and hub drains**, unless shown otherwise on the Drawings. No attempt has been made to show trap primer valve locations or trap primer pipe routing.
   c. **Field route trap primer piping** during installation of floor drains and hub drains, and install trap primer valves in mechanical rooms, janitor rooms, or other locations acceptable to Engineer.
   d. **Priming System:** Complete with connection to serving W2 cold water system.

3. **Thermometers and Pressure Gauges:**
   a. Arrange devices to facilitate use and observation.
   b. Install in orientation that will allow clear observation from ground level.
   c. Provide pressure gauges with block valves.
   d. Install thermometers in thermowells.

H. Caulk penetrations of exterior walls with weatherproof sealant in accordance with Section 07 92 00, Joint Sealants.

I. Adjust water flows in domestic water systems for reasonable water flows at each plumbing fixture, terminal device, and recirculation loop.

### 3.03 FIELD QUALITY CONTROL

A. Perform visual inspection for physical damage, blocked access, cleanliness, and missing items.

B. Notify Owner and Engineer 48 hours prior to shower testing. Owner and Engineer reserve the right to witness all tempered water and safety shower testing.

C. Test safety shower and eyewash units. Water flow must be tested at both showerhead and eyewash/face ring.

1. **Shower Flow:**
   a. Test with tube-type water gauge (Haws Drinking Faucet Co., Model 9010) and 5-gallon container.
   b. Container shall fill in 15 seconds or less, with a minimum 20-gpm flow.

2. **Eyewash Flow:**
   a. Test with tube-type water gauge (Haws Drinking Faucet Co., Model 9010) and 1-gallon container.
   b. Container shall fill in 20 seconds or less.

3. Contractor shall log, date, and initial inspection upon passing flow tests.
D. Verify alarm operation both locally and system wide. Notify security prior to test if alarm is connected system wide.

END OF SECTION