

Spec No.:	4973
Revision Date:	03/01/17
Revision No.:	1.0

SPECIFICATION NUMBER 4973

MASTER SPECIFICATIONS FOR

CIVIL/STRUCTURAL/ARCHITECTURAL WORK PACKAGES

FOR

Hemlock Semiconductor Operations LLC

4973

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END OF SECTION

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SUMMARY OF REVISIONS

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PART 1– GENERAL

1.1 INSTRUCTIONS

- A. Future revisions to the master specification 4973 will be referenced in this Section.
- B. Changes will correspond to items listed below.

1.2 SUMMARY OF CHANGES

<u>Section</u>	<u>Para</u>	<u>Description</u>
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All		Complete update of 4970 renamed 4973.
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END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Selection and payment
- B. Field Survey Agency responsibilities
- C. Field Survey reports
- D. Limits on field survey agency independent services authority
- E. Land (boundary) survey requirements
- F. Topographical survey requirements.

1.2 REFERENCES

- A. Drawing HY161157 - Survey Benchmarks & Monuments Plan Layout – North
- B. Drawing HY161158 - Survey Benchmarks & Monuments Plan Layout – South

1.3 SELECTION AND PAYMENT

- A. The Owner will employ services of an independent agency to deliver field survey services.

1.4 QUALITY ASSURANCE

- A. Field Survey Agency:
 - 1. Authorized to operate in state in which the project is located.
- B. Field Survey Staff:
 - 1. Maintain a full-time registered land surveyor with a minimum of 5 years of experience in field surveying and be able to demonstrate the ability to normally perform field survey work.
 - 2. The field survey crew leader shall have at least 5 years experience performing field surveying and be able to demonstrate the ability to normally perform field survey work.
- C. Field Survey Equipment Calibration
 - 1. Unless specifically stated in the "Summary of Work" section (see section 01010 for clarification), calibration of field survey equipment for each and every job contract is not required by HSC. However HSC may request documentation showing conformance with the following requirements.
 - 2. The following field survey equipment is to be calibrated at the indicated interval:
 - a. Theodolites: Minimum of an annual check with another theodolite. If problems are detected, a calibration/repair of the instrument is to be completed by the manufacturer.
 - b. Electronic Distance Measurement Instrument: Minimum of an annual check against another electronic distance measurement instrument. If problems are detected, a calibration/repair of the instrument is to be completed by the manufacturer.
 - c. Automatic Level: Minimum of an annual check against another automatic level. If problems are detected, a calibration/repair of the instrument is to be completed by the manufacturer.

- d. Accuracy Standards: Precision of the survey shall be based upon the positional accuracy concept. The surveyor shall recommend the positional accuracy limits and error of closure limits for the property surveyed.

1.5 FIELD SURVEY AGENCY RESPONSIBILITIES

- A. Provide qualified personnel at the site. Cooperate with the Owner's Representative and Contractor in performance of services.
- B. Perform the specified field survey work as requested.
- C. Promptly notify the Owner's Representative and Contractor of observed irregularities or non-conformance of work or products.
- D. Perform additional inspections and tests required by the Owner's Representative.

1.6 SURVEY REPORTS

- A. After each field survey, submit one copy of the field survey data to the Owner's Representative.
- B. Include:
 - 1. Date issued
 - 2. Project title and number
 - 3. Names of survey crew members
 - 4. Date and time of field survey
 - 5. Location of the field survey

1.7 LIMITS ON FIELD SURVEY AGENCY AUTHORITY

- A. May not release, revoke, alter, or enlarge on requirements of the contract documents.
- B. May not approve or accept any portion of the work.
- C. May not assume any duties of the Contractor.
- D. Has no authority to stop the work.

1.8 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with field survey personnel and provide access to the work site.
- B. Provide incidental labor and facilities required for the field survey personnel to complete their items of work.
- C. Notify the Owner's Representative 48 hours prior to the expected time for operations requiring field survey services.

1.9 DRAWING REQUIREMENTS

- A. Requirements for land survey drawings are as indicated
 - 1. Drawings shall note all dimensions and elevations in imperial units.
 - 2. Show north arrow and locate magnetic north.
 - 3. Legend of symbols and abbreviations used on the drawing.

4. Spot elevations on paving and other hard surfaces shall be to the nearest 1/8" for architectural and structural and to the nearest 0.01 foot for civil. On other surfaces to the nearest .10 foot.
5. Boundary and topographic information shall be on the same drawing.
6. State elevation datum on each drawing using National Vertical Geodetic Datum (NVGD) 1929 and give location of bench mark used.
7. Submit electronic version of survey on disc compatible with Owner's operating system.

1.10 LAND (BOUNDARY) SURVEY REQUIREMENTS

A. Survey requirements shall be as indicated as follows.

1. Show boundary lines, giving lengths and bearing on each straight line; interior angles, radius, point of tangency and length of curved lines.
2. Furnish legal description that conforms to the record title boundaries. Prior to making this survey and insofar as is possible, the Surveyor shall acquire data including but not limited to deeds, certificates or abstracts of title, section line and other boundary line locations in the vicinity.
 - a. Reconcile any differences between the survey and the recorded legal description.
3. Give area in square feet if less than one acre; in acres if over one acre.
4. Note identity, jurisdiction and width of adjoining streets and highways, width and type of pavement. Identify street monuments and show distance to nearest intersection.
5. Plot location of structures on the property. Dimension to property lines and other buildings. Describe building materials and number of stories.
6. Show encroachments across property lines.
7. Describe fences and walls and locate them with respect to property line.
8. Show recorded or otherwise known easements and right-of-way and identify owner.
9. Show building line and setback requirements.
10. Show zoning of property.

1.11 TOPOGRAPHICAL SURVEY REQUIREMENTS

A. Topographical survey requirements shall be as indicated as follows.

1. A minimum of one benchmark on site and elevation to nearest .001 foot.
2. Contours at 1 foot intervals; error shall not exceed one-half contour interval or as noted otherwise.
3. Spot elevations at each intersection of a 10 square foot grid covering the property or as noted otherwise.
4. Spot elevations at street intersections and at curb, sidewalk and edge of paving at 10 feet on center or as noted otherwise.
5. Plotted locations of structure, paving and improvements above and below ground.

6. Floor elevations and elevations at each entrance of buildings on the property.
7. Utility Information. The following information is to be shown based on record information and on surface evidence. Inadequate record data requiring the surveyor to employ techniques of subsurface exploration to locate utilities will be an additional service subject to Owner's Representative approval.
 - a. Location size, depth and pressure of water and gas mains, central steam and other utilities but not limited to buried tanks serving or on the property.
 - b. Location of fire hydrants available to the property and the size of the main serving each.
 - c. Location, elevation and characteristics of power, cable television, street lighting, traffic control facilities and communication systems above and below grade.
 - d. Location, size, depth and direction of flow of sanitary sewers, combination sewers, storm drains and culverts serving or on the property; location of catch basins and manholes and inverts of pipe at each.
8. Mean elevation of water in any excavation, well or nearby body of water.
9. Location of flood plain and flood level of streams or adjacent bodies of water.
10. Extent of watershed onto the property.
11. Location of trees over 3 feet tall.
12. Perimeter outline only of thickly wooded areas.
13. Locations of confirmed soil contaminations.

PART 2 PRODUCTS – NONE

PART 3 EXECUTION – NONE

END OF SECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Submittal Procedures.

1.2 SUBMITTAL PROCEDURES

- A. Submit to the Owner's Representative information as detailed in the project "summary" specifications. (See section 01010 - Summary of Work, for the listing of required submittals for a specific project).
- B. Submittals required by this annual master specification, but not listed in the projects "summary" specifications, must also be provided to the Owner's Representative unless that individual submittal requirement has been waived by the Owner.
- C. Identify Project, Contractor, Subcontractor and supplier, pertinent drawing and detail number and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Submit electronic submittals via email as PDF electronic files to Owner's Representative and Hemlock Semiconductor Project Manager. Maximum email size limit is 5 MB.
- F. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.3 SHOP DRAWINGS

- A. Identify each drawing with Building number, name of supplier submitting the drawings, clear identity of contents, location of the work, and the date.
- B. When submitting Hemlock Semiconductor produced drawings as Erection Drawings, remove all occurrences of the names of Hemlock Semiconductor employees. Clearly state who produced the drawing in the Title Block.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit drawings via email as PDF electronic files.
- E. After review by Hemlock Semiconductor, PDF electronic files will be returned to the Contractor stamped "Proceed", "Proceed As Noted", or "Correct and Resubmit".
- F. When stamped "Correct and Resubmit", revise the original drawing. Resubmit each revised sheet for approval within one week.
- G. When stamped "Proceed As Noted", return to the Owner's Representative one (1) initialized print of each drawing for Hemlock Semiconductor's record print set.

1.4 CALCULATIONS

- A. Submit calculations for to the Owner's Representative when required.

1.5 PRODUCT DATA

- A. Submit electronic submittals via email as PDF electronic files.
- B. When specified, submit manufacturer's printed instructions for delivery, storage, assembly, installation, adjusting, and finishing to the Owner's Representative.
- C. Identify conflicts between manufacturer's instructions and this project specification.

1.6 CERTIFICATIONS

- A. When specified, submit material and performance certification by manufacturer, installation/application Subcontractor or Contractor to the Owner's Representative.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits and certifications as appropriate.
- C. Certificates may be recent or previous test results on materials and performance, but must be acceptable to the Owner's Representative.
- D. Submit certifications before the start of fabrication and/or installation.

1.7 SURVEYING RECORDS

- A. When specified, submit an electronic copy of the surveyor's field survey to the Owner's Representative.
- B. Submit field survey prior to the start of any future work that may be impacted by the accuracy of the surveyed work.

1.8 SUBSTITUTIONS/ALTERNATES

- A. Any changes, alternates or substitutions of the product materials in the provisions of this specification should be identified by the Contractor in writing and presented to the Owner's Representative and will be subject to approval by the Engineer.
- B. Substitution Submittal Procedure:
 - 1. Submit an electronic copy of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit shop drawings, product data, certified test results attesting to the proposed product equivalence.
 - 3. The Owner's Representative will notify Contractor, in writing, of decision to accept or reject request.
 - 4. Changes in the work due to the Contractor's substitutions will be the responsibility of the Contractor.

1.9 AS-BUILT INFORMATION

- A. Submit (1) complete set of drawings issued with this specification.
 - 1. Drawings with as-built information are to be marked up using the following color system.
 - a. Red Pencil: All new and revised work.
 - b. Blue Pencil: Work being deleted.
 - c. Black Pencil: Notes or comments.
 - 2. Drawings without as-built information are to indicate that no field changes were made.

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SUBMITTALS

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- B. Submit as-built drawings prior to contract close-out. (See section 01700 - Contract Closeout.)

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Selection and payment
- B. Contractor submittal
- C. Laboratory responsibilities
- D. Laboratory reports
- E. Limits on testing laboratory independent survey services authority
- F. Contractor responsibilities
- G. Schedule of inspections and tests

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals: Manufacturer's certificates
- B. Individual Specification Sections: Inspections and tests required, and standards for testing

1.3 REFERENCES

- A. ANSI/ASTM D3740 - Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- B. ANSI/ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection or Special Inspection.
- C. ASTM standards referenced in the individual specification sections

1.4 SELECTION AND PAYMENT

- A. The Owner will employ services of an independent testing laboratory to perform specified inspection and testing.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of ANSI/ASTM E329 and ANSI/ASTM D3740
- B. Laboratory:
 - 1. Authorized to operate in state in which the project is located
 - 2. The agency responsible for testing of soil and concrete shall have suitable test equipment and laboratory facilities for storing and testing samples and preparing samples for test. The agency shall have the capability of performing all laboratory testing with the listed ASTM procedure.
- C. Agency/Laboratory Staff:
 - 1. Maintain a full-time registered engineer with a minimum of 5 years of experience in the inspection and testing of soil and concrete on staff to review services.
 - 2. The supervising laboratory technician shall have at least 5 years' experience performing testing on soil and concrete and be able to demonstrate the ability to normally perform all laboratory testing listed in Section 1.3 in accordance with the listed ASTM procedures

3. The supervising field technician shall have at least 5 years' experience performing testing and inspection on soil and concrete and be able to demonstrate the ability to normally perform all laboratory testing listed in Section 1.3 in accordance with the listed ASTM procedures.

D. Testing Equipment Calibration

1. Unless specifically stated in the "Summary of Work" section (see section 01010 for clarification), records showing calibration of testing equipment for each and every job contract is not required. However HSC may request documentation showing conformance with the following requirements.
2. The following test equipment is to be calibrated at the indicated interval:
 - a. Laboratory Balances:
 1. Annual calibration with a device traceable to NIST
 - b. Field Balances:
 1. Monthly test using laboratory check weights
 - c. Nuclear Density Gage:
 1. Annual calibration by MDOT or other recognized testing agency
 - d. Concrete Compression Machine:
 1. Annual calibration to +/- 1% of indicated loads
 - e. Air Meter:
 1. Annual calibration per ASTM C 173

1.6 LABORATORY RESPONSIBILITIES

- A. Test samples submitted by the Contractor.
- B. Provide qualified personnel at the site. Cooperate with the Owner's Representative and Contractor in performance of services.
- C. Perform the specified inspection, sampling, and testing of products in accordance with specified standards.
- D. Ascertain compliance of materials and mixes with requirements of contract documents.
- E. Promptly notify the Owner's Representative and Contractor of observed irregularities or nonconformance of work or products.
- F. Perform additional inspections and tests required by the Owner's Representative.
- G. Attend preconstruction conferences and progress meetings as directed by owner.

1.7 LABORATORY REPORTS

- A. After each inspection and test, promptly submit two copies of laboratory report to the Engineer and to the Contractor.
- B. Include:
 1. Date issued
 2. Project title and number
 3. Name of inspector

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TESTING LABORATORY SERVICES

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4. Date and time of sampling or inspection
 5. Identification of product and specifications section
 6. Identification of inspection, measuring and test equipment
 7. Location in the project
 8. Type of inspection or test
 9. Date of test
 10. Results of tests
 11. Conformance with contract documents
 - C. When requested by the Engineer, provide interpretation of test results.
- 1.8 LIMITS ON TESTING LABORATORY AUTHORITY
- A. Laboratory may not release, revoke, alter, or enlarge on requirements of the contract documents.
 - B. Laboratory may not approve or accept any portion of the work.
 - C. Laboratory may not assume any duties of the contractor.
 - D. Laboratory has no authority to stop the work.
- 1.9 CONTRACTOR RESPONSIBILITIES
- A. Deliver to laboratory, at the designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix design.
 - B. Cooperate with laboratory personnel and provide access to the work.
 - C. Provide incidental labor and facilities to provide access to the work to be tested to obtain and handle samples at the site or at source of products to be tested to facilitate tests, inspections, storage and curing of test samples.
 - D. Notify the Owner's Representative and laboratory 24 hours prior to the expected time for operations requiring inspection and testing services.
- PART 2 PRODUCTS – NONE
- PART 3 EXECUTION – NONE

END OF SECTION

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MATERIAL AND EQUIPMENT

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products
- B. Transportation and handling
- C. Storage and protection
- D. Substitutions and/or alternates

1.2 PRODUCTS

- A. Products: Defined as new material, machinery, components, equipment, fixtures, and systems forming the work. It does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the work. Products may also include existing materials or components required for reuse.
- B. Do not use materials and equipment removed from existing premises, unless directed to reuse by contract documents.
- C. Provide interchangeable components of the same manufacturer for similar components.

1.3 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 STORAGE AND PROTECTION

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- B. Provide off-site storage and protection when site does not permit on-site storage or protection.
- C. Discuss and reach agreement with Owner's Representative planned location of storage areas prior to delivery of materials and products.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- E. Store loose granular materials on solid flat surfaces in a well-drained area.
- F. Provide equipment and personnel to store products by methods to prevent soiling,

disfigurement, or damage.

- G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- H. Store product off ground.
- I. Cover product to protect from wet weather.
- J. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.
- K. Prevent contact with materials during storage which may cause discoloration, staining, or damage.
- L. Protect rigid board insulation from direct sunlight exposure and moisture.

1.5 ALTERNATES/SUBSTITUTIONS

- A. Alternates or substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- B. Document each request with complete data substantiating compliance of proposed substitution with contract documents.
- C. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
- D. Substitution Submittal Procedure: see section 01300 - Submittals.

PART 2 PRODUCTS - None

PART 3 EXECUTION - None

END OF SECTION

PART 1 - GENERAL**1.1 WORK INCLUDED**

- A. Closeout procedures
- B. Final cleaning
- C. Adjusting
- D. Project record documents
- E. Warranties
- F. Spare parts and maintenance materials

1.2 CLOSEOUT PROCEDURES

- A. Submit written notification that contract documents have been reviewed, work has been inspected, and that work is complete in accordance with contract documents and ready for Owner's Representative's review.
- B. Provide submittals to Owner that are required by governing or other authorities.
- C. Submit project record documents and other similar final record data in compliance with this Section.
- D. Complete facility startup, testing, adjusting, and balancing of systems and equipment, as specified in compliance with this Section.
- E. Owner will occupy all and/or portions of the building as noted per Owners Representative's directive.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures including exposed light fixtures, ducts, pipes, and conduits to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Clean dust and debris from girts, trusses, and miscellaneous framing members at building interior.
- E. Clean debris from roofs, gutter, downspouts, and drainage systems, including interior/exterior trench drains, sumps, and pits.
- F. Clean site; sweep paved areas; rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- H. Remove temporary partitions and enclosures.

1.4 ADJUSTING

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

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the work:
 - 1. Drawings
 - 2. Specifications
 - 3. Addenda/Bulletins

4. Change orders and other modifications to the Contract
5. Reviewed Shop Drawings, Product Data, and Samples
6. Manufacturer's instruction for assembly, installation, and adjusting
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, including subcontractors.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 1. Manufacturer's name and product model and number
 2. Product substitutions or alternates utilized.
 3. Changes made by addenda and modifications.
- F. Record documents and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish floor datum.
 2. Measured horizontal elevations of finish floors and platforms.
 3. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
 5. Field changes of dimension and detail.
 6. Details not on original contract drawings.

1.6 MAINTENANCE DATA

- A. Provide maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

1.7 WARRANTIES

- A. Execute and assemble transferable warranty documents from subcontractors, suppliers, and manufacturers.
- B. For items of work delayed beyond date of substantial completion, provide updated submittal per Owner's Representative's schedule, listing date of acceptance as start of warranty period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual specification sections.
- B. Deliver to Owner's Representative; obtain receipt.

PART 2 - PRODUCTS - Not used

PART 3 - EXECUTION - Not used

END OF SECTION

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SUBSURFACE INVESTIGATION

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Laboratory responsibilities
- B. Laboratory reports
- C. Limits on testing laboratory authority
- D. Schedule of inspections and tests

1.2 REFERENCES

- A. ASTM D1586 - Standard Test Methods for Penetration Test and Split-Barrel Sampling of Soils
- B. ASTM D1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.
- C. ASTM D 2113 Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigations.
- D. ASTM D2166 - Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
- E. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes
- F. ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
- G. ASTM D2850 - Standard Test Method for Unconsolidated, Undrained Triaxial Test on Compressive Strength of Cohesive Soils
- H. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- I. ASTM D3740 - Standard Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- J. ASTM D4220 - Standard Practices for Preserving and Transporting Soils Samples
- K. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
- L. MBC - Michigan Building Code(Chapter 18)
- M. ASCE 7 - Minimum Design Loads for Buildings And Other Structures

1.3 QUALITY ASSURANCE

- A. Comply with requirements of ANSI/ASTM D3740.
- B. Laboratory: Authorized to operate in state in which the project is located.

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- C. Laboratory Staff: Maintain a full-time registered engineer on staff to review services.
- D. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards (NBS) standards or accepted values of natural physical constants.

1.4 LABORATORY RESPONSIBILITIES

- A. Provide qualified personnel at the site. Cooperate with the Owner's Representative and contractor(s) in performance of services.
- B. Obtain Plant Orientation and Safety Orientation, including Building Safety Orientation where required.
- C. Obtain appropriate Safe Work Permits and Excavation Permits from the Building Supervisor or Owner's Representative.
- D. Perform the specified inspection, sampling, and testing of products in accordance with specified standards.
- E. Perform additional inspections and test required by the Owner's Representative.
- F. Stop all work when unexpected conditions arise. Do not recommence work without approval of Owner's Representative.

1.5 LABORATORY REPORTS

- A. Seal report by a professional engineer licensed in the state in which the project is located.
- B. After each inspection and test, promptly submit two copies of laboratory report to the Owner's Representative.
- C. Include:
 - 1. Date issued
 - 2. Project title and number
 - 3. Name of inspector
 - 4. Date and time of sampling or inspection
 - 5. Identification of product and specifications section
 - 6. Location in the project
 - 7. Type of inspection or test
 - 8. Date of test
 - 9. Results of tests
 - 10. Conformance with contract documents
- D. Provide interpretation of test results when requested.
- E. If rock is encountered, perform core drilling procedures in accordance with ASTM D2113 as required to determine the rock quality designations (RQD).

1.6 LIMITS ON TESTING LABORATORY AUTHORITY

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- A. Laboratory may not release, revoke, alter, or enlarge on requirements of the contract documents.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS

All materials, equipment, services, and labor required to perform the work of this section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the site to verify accessibility requirements for borings and equipment. Report any problems to Owner's Representative.
- B. Verify information received is adequate to perform the testing and calculations required in the specification.

3.2 PREPARATION

- A. Identify known underground, above ground, and aerial utilities. Stake and flag locations.
- B. Contact the local "Miss Dig" and Plant Engineering prior to commencing any boring.
- C. Provide layout and survey services for determining locations of borings if required by the scope of this contract.
- D. Locate borings as shown on drawings.
- E. Establish locations of boring to within +/- 1 ft.
- F. Notify Owner's Representative of any potential interferences between requested borings and above/below grade utilities.
- G. Number borings in accordance with drawings.

3.3 BORINGS

- A. Sink borings to a minimum depth of 25 feet.
- B. Estimate and record ground surface elevations for each boring to +/- 1 ft. by referencing the drawing.
- C. Do not alter boring locations without approval of the Owner's Representative.
- D. Plug and abandon all borings in accordance with appropriate standards.
- E. Clean site of any residual boring materials. Dispose of materials on-site as instructed by the Owner's Representative.

3.4 SAMPLING METHODS

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- A. Retrieve sample and measure penetration resistance in accordance with ASTM D-1586.
- B. Obtain undisturbed samples with a Shelby Tube Sampler in accordance with ASTM D-1587 when consolidation of triaxial test samples is needed.
- C. Take split spoon samples at 5 ft. intervals below the existing grade and at each change in soil stratification.

3.5 SOIL PROPERTIES

- A. Determine the following soil properties for the site based on the borings:
 - 1. Angle of Internal Friction - ϕ (Estimated)
 - 2. Cohesion - C_u (Estimated)
 - 3. Soil Spring Constant - K (Estimated)
 - 4. Shear Modulus - G (Estimated)
 - 5. Young's Modulus - E (Estimated)
 - 6. Poisson's Ratio - ν (Estimated)
 - 7. Allowable Bearing Pressure - σ (Actual)
 - 8. Allowable Lateral Pressure - Active and Passive (Actual)
 - 9. Lateral Modules of Subgrade Reaction (Actual)
 - 10. Unit Weight (Actual)
- B. Determine soil properties per the appropriate ASTM Standard Test Method(s).

3.6 STORING AND TRANSPORTING SAMPLES

- A. Store soil samples in appropriate containers per ASTM D4220.
- B. Label and transport soil samples per ASTM D4220.
- C. Protect soil samples from freezing.

3.7 GEOTECHNICAL REPORT

- A. Submit a plot showing location of test borings.
- B. Record and submit a boring log for each soil boring taken from the site.
- C. Record the following information on each boring log:
 - 1. Boring number
 - 2. Boring start and completion date
 - 3. Surface elevation at the boring
 - 4. Thickness, consistency, and character of the various strata of soil encountered per ASTM D2487
 - 5. Number of blows, N , required to obtain the penetration of the sampler
 - 6. Size and penetration of sampler or referenced standard which applies
 - 7. Weight and height of fall of hammer or referenced standard which applies
 - 8. Ground water elevation at completion of sampling
 - 9. Ground water elevation 24 hours after completion of sampling if requested
 - 10. Water content
 - 11. Unconfined compressive strength
 - 12. Calibrated hand penetrometer strength.

13. Expected total and differential settlement.
- D. Summarize the required soil properties
 - E. Summarize recommendations for optimum foundation systems to be used. If deep foundation system is recommended, discuss various alternates. Include, but not limited to, followings:
 1. Recommend pier or pile types and installed capacities both for compression and uplift loads.
 2. Recommend center to center spacing of piers or piles.
 3. Driving criteria, if applicable.
 4. Installation procedures.
 5. Pier or pile load test requirements.
 6. Durability of pier or pile materials.
 7. Designation of bearing strata.
 8. Reductions for group actions, wherever necessary. Provide allowable values of soil parameters for the design of recommended deep foundation system for vertical downward, uplift and lateral loads.
 - F. Design criteria to determine depth of drilled piers to resist lateral loads.
 - G. Allowable lateral soil modulus for analyzing drilled piers using LPILE program, or similar.
 - H. Perform differential settlement calculations only when requested.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. This section includes furnishing, installing, maintaining, and removing at project completion, Soil Erosion and Sediment Control devices. Devices include silt fence, straw bales, rock check dams, filter rings, outlet protection, temporary gravel construction entrance/exits, inlet filters, ditch sediment traps, and appurtenances.

1.2 RELATED WORK

- A. Section 02110 – Site Cleaning
- B. Section 02224 – Excavating, Trenching, and Backfilling
- C. Section 02900 – Landscaping

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- A. The Owner has secured a Soil Erosion and Sedimentation Control Permit for this Project. The Owner will handle the inspections and the reporting requirements for the SWPPP & SESC Permit.
- B. Maintain existing Soil Erosion and Sediment Control (SESC) measures per Storm Water Pollution Prevention Plan (SWPPP), and install and maintain new SESC as described in these Contract Documents.

1.4 PERFORMANCE REQUIREMENTS

- A. Employ Best Management Practices (BMPs) as defined by Standard EPA 832-R-92-005.
- B. Put preventative measures in place as soon as possible after disturbance of cover and before precipitation occurs.
- C. Control increased storm water runoff due to disturbance of surface cover and construction activities for this project.
- D. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less. Anticipate runoff volumes due to the most extreme short-term and 24-hour rainfall event that may occur in 10 years.
- E. Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
- F. Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project. Prevent tracking or flowing of mud and sediment onto public or private roads, sidewalks, or pavements outside the site.
- G. Prevent sedimentation of waterways on or off the project site, including rivers, streams, lakes, ponds, open drainage ditches, storm sewers, and sanitary sewers. If sedimentation occurs, install or correct preventative measures immediately at no cost to the Owner. Comply with requirements of the agencies having jurisdiction.
- H. Maintain temporary preventative measures until permanent measures have been established. Remove temporary measures when the permanent measures have been established.
- I. If erosion or sedimentation occurs due to non-compliance with these requirements, remove deposited sediment and restore eroded areas at no cost to the Owner.

1.5 SUBMITTALS

- A. Submit a schedule of Soil Erosion and Sedimentation Control materials and activities to Owner prior to beginning work. Include events (with days and/or dates of the various activities) for review and approval.

PART 2 PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS

- A. None.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All erosion control products shall be listed on the Michigan Department of Transportation Qualified Products List

- B. Silt Fence

- 1. Polypropylene geotextile fabric, resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible meeting the following requirements:
 - a. Average Opening Size: 30 U.S. Std. Sieve 600 μ m), maximum; ASTM D4751.
 - b. Permittivity: 0.1 sec⁻¹, minimum; ASTM D4491.
 - c. Ultraviolet Resistance: Retaining at least 70% of tensile strength; ASTM D4355 after 500 hours exposure.
 - d. Tensile Strength: 100 lb-f (445 N) minimum, in cross-machine direction; 124 lb-f (551 N) minimum in machine direction; ASTM D4632.
 - e. Tear Strength: 45 lb-f (244 N) minimum; ASTM D4533.
 - 2. Attach geotextile to machine-pointed, No. 2 common grade hardwood posts with at least five staples through wood lath at least inch thick and 2.0 feet long. Space posts no greater than 6½ feet apart. Posts must be at least 36 inches long with a cross-sectional area of at least 2¼ square inches, and a smallest dimension of 1½ inches.

- C. Dewatering Discharge Filter Bag

- 1. UV stabilized, non-woven geotextile bag to filter sediment from water prior to discharging. Geotextile fabric shall meet the following minimum average roll requirements:
 - a. Tensile Strength: 180 lb-f minimum; ASTM D4632
 - b. Elongation: 50% minimum; ASTM D4632
 - c. Puncture Strength: 105 lb-f minimum; ASTM D4833
 - d. Mullen Burst: 350 psi minimum; ASTM D3786-87
 - e. Trapezoidal Tear: 70 lb-f minimum; ASTM D4533
 - f. Flow Rate: 80 gal/min/sf minimum; ASTM D4491
 - g. Permittivity: 1.4 sec⁻¹ minimum; ASTM D4491

- h. Apparent Opening Size: 100 US Std. Sieve (150 µm) maximum; ASTM D4571
- i. UV Stability: 70% retained strength; ASTM D4355 after 500 hours.

D. Erosion Control Blankets

- 1. Machine produced blanket with a consistent thickness evenly distributed straw or coconut fiber as specified. Unless otherwise specified on the Plans, the erosion control blanket shall have the following minimum properties:
 - a. Double net 100% straw blanket.
 - b. Top and bottom photodegradable polypropylene netting, 1.64 lbs/1,000 sf approximate weight.
 - c. 100% agricultural straw 0.5 lbs./syd.
 - d. Stitch spacing: 1.5 inches on center.
- 2. Secure erosion blanket with wood or other biodegradable net anchors at least 6 inches in length

E. Bonded Fiber Matrix Mulch Anchoring

- 1. Bonded fiber matrix (BFM) shall consist of long strand, residual, softwood fibers joined together by a high strength, non-toxic adhesive. The BFM shall be 100% biodegradable, and shall be non-toxic to fish, wildlife, and humans. Upon drying the matrix shall form a high strength, porous, and erosion resistance mat that shall not inhibit the germination and growth of plants. The BFM shall retain its form despite rewetting.
- 2. Bonded fiber matrix shall consist of:
 - a. Seed and fertilizer per Section 02900 – Landscaping
 - b. Wood Fiber Mulch: Thermo-mechanically defibrated long, softwood fibers manufactured from select northern softwood wood chips.
 - c. Polyacrylamide Binder: Site specific, fully biodegradable, polyacrylamides (PAMs) binders, with cross-linking long organic jute fibers.
- 3. Materials shall be mixed at the rate of 80 lbs/acres of PAM binder and 2,500 lbs/acre of wood fiber mulch.

F. Inlet Filter Fabric

- 1. The filter fabric shall be constructed of 100% continuous polyester needle-punched non-woven engineering fabric and follow the guidelines in the ASTM D1117-99; Standard Guide for Evaluating Non Woven Fabrics. The filter fabric shall be fabricated to provide a direct fit with the drainage structure cover.
- 2. Filter fabric shall have the following minimum physical properties.
 - a. Tensile Strength: 90 lb-f (.355 kN) minimum; ASTM D4632
 - b. Elongation: 50 percent minimum; ASTM D4632
 - c. Puncture Strength: 45 lb-f (200 kN) minimum; ASTM D4833
 - d. Mullen Burst: 140 psi (2413 kPa) minimum; ASTM D3786-87
 - e. Trapezoidal Tear: 45 lb-f (310 N) minimum; ASTM D4533
 - f. Permittivity: 0.5 sec ⁻¹ minimum; ASTM D4491

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- g. Apparent Opening Size: 100 U.S. Std. Sieve (150 µm) maximum; ASTM D4751
- h. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

PART 3 EXECUTION

3.1 PREPARATION

- A. Schedule work so that the soil surfaces are left exposed for the minimum amount of time. Place permanent soil and sedimentation control measures as soon as practical.

3.2 GENERAL

- A. Construction site runoff will be prevented from entering any storm drain, river, stream, etc. directly by the use of silt fences, inlet filters, or other suitable methods. The Contractor shall provide erosion protection of surrounding soils.
- B. Sedimentation control devices shall be installed prior to Contractor beginning work. All soil erosion and sedimentation control devices shall be maintained in an effective functioning condition at all times during the course of the Work.
- C. Immediately bring earthwork to final grade and protect side slopes and back slopes from erosion. Plan and conduct earthwork to minimize duration of exposure of unprotected soils.

3.3 DUST CONTROL

- A. Keep dust down at all times, including during non-working periods. Sprinkle or treat, with Owner-approved dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming is not permitted.

3.4 INSTALLATION - GENERAL

- A. Install silt fences, ditch sediment traps, check dams, inlet filters, temporary gravel construction entrance/exits, turbidity barriers, erosion control blankets, and other soil erosion control devices as detailed on the Plans. Maintain devices until permanent control measures are completed and effectively established.
- B. Remove temporary control devices after permanent measures are established. Remove and replace temporary control devices if they become ineffective at no additional cost to the Owner.
- C. Install temporary erosion and sedimentation control devices per the manufacturer's recommendations. Advise Owner's Representative of any discrepancies between the manufacturer's recommendations and the details on the Plans, and install per Owner Representative's resolution of discrepancy.

3.5 MAINTENANCE

- A. Inspect preventative measures a minimum of once a week and within a minimum of 24 hours after every rainfall. Any soil erosion control measures damaged or rendered ineffective shall be immediately repaired or removed and replaced at no additional cost.
- B. Remove all accumulated sediment and debris from catch basin insert when unit is 1/3 full. Remove all accumulated sediment and debris from vicinity of unit after each storm event.

3.6 INSTALLATION OF EROSION CONTROL BLANKETS

- A. Erosion control blankets shall be pegged at the pattern and rate as recommended by the manufacturer; however, at a minimum, blankets shall be stapled at the rate of 1.75 pegs per square yard of blanket, unless otherwise indicated on the Plans.

3.7 APPLICATION OF BONDED FIBER MATRIX

- A. The slope shall be prepared and graded prior to application of bonded fiber matrix (BFM). Mixture of wood fiber mulch and polyacrylamide binder shall be blended, with the appropriate amount of seed and fertilizer per Section 02900 – Landscaping, according to manufacturer's recommendations.
- B. The BFM shall be hydraulically applied to the soil as a viscous mixture, creating a continuous, three-dimensional blanket that adheres to the soil surface. The BFM shall be mixed and applied at the rate as specified in Article 2.2.E, unless otherwise indicated on the Plans. The resulting coverage must be a least 1/8-inch thick over the entire surface area. The BFM shall be applied in two applications from alternate directions to eliminate shadowing, and shall be applied to flow unfiltered from the construction site.

3.8 DEWATERING DISCHARGE

- A. Should it become necessary for the Contractor to do any dewatering during the course of construction, the Contractor shall filter all discharge through a discharge filter bag or other sediment control device that will filter all discharge water. Discharge filter bag shall be sized to adequately handle expected dewatering discharge flow. No dewatering discharge shall be allowed to flow unfiltered from the construction site.

3.9 PROJECT COMPLETION

- A. Remove all temporary soil erosion and sedimentation control devices as soon as the permanent measures have been established.

END OF SECTION

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DEMOLITION AND WEATHER PROTECTION

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PART 1 GENERAL

1.1 WORK INCLUDED

- A. Remove items as scheduled on the demolition drawings.
- B. Abandon-in-place below grade construction as indicated on drawings.
- C. Disconnect, cap, or seal site utilities as indicated on drawings.
- D. Salvage items for reuse by Owner as indicated.
- E. Protect items designated to remain.
- F. Disconnect utility services prior to demolition.
- G. Provide weather protection of normally heated enclosed buildings to maintain temperatures above 50° F.
- H. Remove demolition materials from site.

1.2 RELATED SECTIONS

- A. Section 02110 – Site Clearing.
- B. Section 02200 – Site Grading.
- C. Section 02224– Backfilling/Trenching/Excavating.

1.3 REFERENCES

- A. ANSI A10.6 – American National Standard for Construction and Demolition Operations.
- B. EPA – Environmental Protection Agency.

1.4 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them as directed unless indicated to be salvaged or reused.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.5 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Control dust during demolition maintaining a safe work environment and to eliminate additional cleaning or disruptions to surrounding buildings and work areas. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Clean-up the work area daily.

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DEMOLITION AND WEATHER PROTECTION

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- E. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 15 feet of fire hydrants.
- F. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of Hemlock Semiconductor. Any damaged items shall be repaired or replaced as approved by the Owner. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have Owner's Engineering approval.

1.6 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Owner.
- B. Items designated to be salvaged remain the property of the Owner.
- C. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1.7 PROJECT CONDITIONS

- A. Do not close or obstruct roadways without permits.
- B. Conduct demolition to minimize interference with building operations and adjacent structures.
- C. Underground services may exist in the work area. Review drawings for locations and meet with Owner prior to underground work beginning.
- D. Hazardous Material
 - 1. Hazardous materials will be removed by Owner before start of the Work or identified with direction of how to address.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner. Hazardous materials including universal waste will be removed by Owner under a separate contract.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Pre-demolition Conference: Conduct conference at the Project site to review surrounding conditions and the work plan.

1.9 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

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DEMOLITION AND WEATHER PROTECTION

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PART 2 - PRODUCTS

2.1 OWNER PROVIDED PRODUCTS – None

2.2 CONTRACTOR PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Notify Owner's Representative 48 hours in advance of utility shutoffs or disruptions.
- B. Obtain permits from Owner's Representative authorizing transport and disposal of debris.
- C. Prevent movement or settlement of adjacent structures, provide bracing and shoring.
- D. Protect existing appurtenances and structures which are not to be demolished.
- E. Do not close or obstruct building egress path.
- F. Erect and maintain temporary partitions.
- G. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
 - 4. Do not start demolition work until utility disconnecting and sealing have been completed.
- H. Mark the location of disconnected utilities. Identify the utilities and indicate the capping locations on project record documents and zone drawings. Provide markups to the Owner's Representative.

3.2 WEATHER PROTECTION OF ENCLOSED FACILITIES

- A. Weather protect the enclosure immediately after removals. A minimum temperature of 50° F shall be maintained during the construction period.
- B. The Contractor shall keep the interior of the enclosure dry, providing necessary drainage means as required.

3.3 SALVAGE REQUIREMENTS

- A. Coordinate with Owner
- B. Protect designated salvage items.
- C. Package small and loose parts
- D. Deliver salvaged items to Owner.

- E. Components Indicated to be Reused or Salvaged:
 - 1. Disassemble components as required to permit removal.
 - 2. Package small and loose parts.
 - 3. Mark components and packaged parts to permit reinstallation.
 - 4. Store components, protected from construction operations, until reinstalled or delivered to Owner.

3.4 DEMOLITION

- A. As required demolish and remove buildings and structures or portions of buildings and structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As shown in the project construction work package.
 - 2. As required for installation of new utility service lines.
 - 3. To full depth within an area defined by hypothetical lines located 5 feet outside building lines of new structures.
- B. Contractor shall coordinate the removal of debris from the project site with Owner's Representative. Owner will provide for disposal under existing contracts with the disposal facility designated by HSC Environmental Department.
- C. Separate and place all recyclable metals, copper and wiring in appropriate roll-off boxes supplied by Owner designated for recyclables.
- D. Any recyclables too large to fit in a roll-off box must be transported by the Contractor to the S-59 wash pad after coordination with the Owner's Representative.
- E. Provide loading and hauling of soil, concrete and asphalt debris to locations identified by Owner.
- F. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 24 inches square to permit drainage. Any concrete reinforcement shall be cut within 1 foot of the concrete edge.
- G. Cease operations and notify the Owner's Representative immediately if adjacent structures appear to be endangered. Do not resume operations until corrective measures have been taken.
- H. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.
- I. Remove and salvage materials to be reinstalled or retained in a manner to prevent damage.
- J. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Owner's Engineer. When utility lines are encountered that are not indicated on the drawings, the Owner's Representative shall be notified prior to further work in that area.
- K. Do not burn or bury materials on site.
- L. Erect partitions and temporary enclosures for the demolition work area as required to control dust and noise in existing buildings.

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- M. Provide interior and exterior barriers to isolate construction area from building traffic and plant operations.
- N. Remove demolished materials from site as work progresses per the direction of the Owner's Representative.
- O. Promptly repair damage to adjacent buildings caused by demolition operations.

3.5 CLEAN-UP

- A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Owner's Representative. Clean-up shall include disposal of all items and materials as well as all debris and rubbish resulting from demolition operations.

3.6 SITE RESTORATION

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in 02224 Excavating, trenching and backfilling.

END OF SECTION

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SITE CLEARING

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Removal of surface debris.
- B. Removal of paving, curbs and other improvements.
- C. Removal of trees, shrubs, and other plant life.
- D. Removal of abandoned utilities

1.2 REGULATORY REQUIREMENTS

- A. Conform to soil erosion and sedimentation controls detailed in the written Soil Erosion and Sedimentation Control Plan and Section 02020.
- B. Coordinate clearing Work with utility companies.

1.3 PROJECT CONDITIONS

- A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities. Do not close or obstruct street, walks or other occupied or used facilities without permission from the Owner's Representative.
- B. Protection: Provide temporary fences, barricades, coverings or other protection to preserve existing items indicated to remain and to prevent injury or damage to persons or property.
- C. Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed.
- D. Indicated locations of existing services are approximate. Field verify exact locations before commencing work.

PART 2 - PRODUCTS - (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping.
- C. Request underground utilities be located and marked within and surrounding construction areas.
- D. Protect bench marks, survey control points, and existing structures and utilities from damage or displacement.

3.2 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees, shrubs, grass and other vegetation, improvements or obstructions, as required to permit installation of new construction. Remove similar items elsewhere on site as specifically indicated. Remove stumps, main root ball and root system to a minimum depth of 18 inches.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Strip and stockpile topsoil for reuse in finish grading

3.3 REMOVAL

- A. Remove existing improvements, both above-grade and below-grade, to extent indicated or as otherwise required to permit new construction.

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- B. Partially remove paving and curbs as indicated. Neatly saw cut edges at right angles.
- C. Remove abandoned utilities as indicated. Indicate removal termination point for underground utilities on record documents.
- D. Control air pollution caused by dust and dirt; comply with governing requirements.
- E. Fill depressions and voids resulting from site-cleaning operations, using satisfactory soil materials, place in maximum 6-inch deep horizontal layers and compact each layer to density of surrounding original ground.

3.4 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's property is not permitted.
- B. Provide loading and hauling of soil, concrete and asphalt debris to location identified by Owner.
- C. All vegetation debris is to be legally disposed of offsite at the Contractor's expense.
- D. Disposal of other debris is to be as indicated in Section 02050 of this specification.

END OF SECTION

PART 1 - GENERAL**1.1 WORK INCLUDED**

- A. This section includes grading the project to the lines and grades as indicated on the Plans, complete with removing and stockpiling topsoil, excavation, placing and compacting embankment, subgrade undercutting, proof rolling, fine grading, dewatering, road, and ditch construction. Also includes underdrain, geotextile fabrics, excavation and backfill for slabs and foundations.

1.2 RELATED WORK

- A. Section 02020 – Temporary Erosion and Sediment Control
- B. Section 02110 – Site Clearing
- C. Section 02224 – Excavating, Trenching and Backfilling
- D. Section 02900 – Landscaping

1.3 REFERENCED STANDARDS

- A. ASTM – American Society of Testing Materials
- B. AASHTO - American Association of State Highways and Transportation Officials
- C. MDOT - Standard Specifications for Road and Bridge Construction

1.4 SITE COMPACTION TESTING AND SOILS INSPECTION

- A. At the Owner's discretion, an experienced certified soils technician under the direct supervision of a geotechnical engineer may be present during site grading operations to determine soil conditions and make recommendations as to whether the contract design requirements need modification. All recommendations shall be directed to the Owner's Representative.
- B. Testing will be performed to least encumber the performance of work.
- C. The Owner will pay the cost of geotechnical investigation and testing as specified in Section 01005 – General Provisions.
- D. Coordinate testing with the Owner's Representative as the work progresses. Do not proceed with additional portions of work until the Owner approves.
- E. Density testing shall be performed with the Nuclear Density Gauge and shall be provided and operated by the Owner's third party Testing Agency. All equipment and personnel necessary to perform these tests shall be properly certified.
- F. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, remove defective work, replace and retest at no cost to the Owner, as directed by the Owner.
- G. Upon excavation of the road bed and all structure areas the Testing Agency may be scheduled to inspect and determine the type of subgrade soil and the subgrade bearing capacity. The contractor shall not proceed with construction of fills until approval is given by the Owner's Representative.
- H. Verify areas for roadways are at bottom of subgrade and structure areas are at bottom of sand elevations before proof roll.
- I. Compact granular (sandy) subgrade to the density requirements for subsequent backfill materials if disturbed during clearing.
- J. Proof roll roadway subgrade.

1.5 PROTECTION

- A. Protect features remaining as part of final landscaping.
- B. Protect bench marks and existing utilities, structures, roads, grounds, paving, and curbs against damage from equipment and vehicular or foot traffic.
- C. Notify the Owner of unexpected subsurface conditions and discontinue work in the area until the Owner provides notification to resume work.
- D. Grade around excavation(s) to prevent surface water runoff into excavated areas.
- E. Provide temporary erosion and sedimentation control measures per the Soil Erosion and Sedimentation Control Plan and Section 02020 – Temporary Erosion and Sediment Control.

1.6 EXISTING UTILITIES

- A. The Owner has made efforts to identify and locate underground utilities on documents included. Before starting excavation, establish location and extent of underground utilities occurring in work area. Notify the Owner's Representative if site and documents differ. Do not proceed with this work without approval of the Owner's Representative.

PART 2 - PRODUCTS**2.1 FILL MATERIALS**

- A. Sand: Clean coarse natural river or bank sand; free from frost, silt, clay, loam, friable or soluble materials, and organic matter.
- B. Aggregates for Road Construction: 21AA, 23A Stonemix and 7A washed 100% crushed limestone. Free of clay, organics, and other foreign materials. Contractor shall order aggregate materials from Wirt Stone Dock (WSD) under HSC direct billing procedure.
- C. Pea Stone: Screened stone min. 3/8 inch and 5/8 inch, free from silt, clay, loam, friable or soluble materials, and organic matter.
- D. Aggregates for Surfacing of Ditches and Block Interiors: Open graded 6AA and 7A crushed limestone installed as scheduled on the drawings. Contractor shall order aggregate materials from Wirt Stone Dock (WSD) under HSC direct billing procedure.
- E. Sound earth: Natural material that can be compacted to the required density and contains no organic material.

2.2 UNDERDRAIN

- A. Corrugated, perforated plastic tubing for underdrains shall meet the requirements of AASHTO M252 for polyethylene tubing. Pipe shall be wrapped in a geotextile pipe wrap. Fittings shall conform to ASTM F405 and F667. Size as indicated on drawings.

2.3 GEOTEXTILE FABRICS

- A. Geotextile Fabric for Drainage Applications shall be a non-woven fabric of polyester or polypropylene, inert to commonly encountered chemicals and hydrocarbons, mildew and rot resistant, insect and rodent resistant, and conform to the following properties:

Minimum Avg. Physical Properties	Test Method	Unit	Roll Value
Grab Tensile Strength (min)	(ASTM D 4632)	lbs	90
Trapezoid Tear Strength (min)	(ASTM D 4533)	lbs	45
Puncture Strength (min)	(ASTM D 4833)	lbs	45
Mullen Burst Strength (min)	(ASTM D 3786)	psi	140
Apparent Opening Size (max)	(ASTM D 4751)	mm	0.21
Permittivity	(ASTM D 4491)	sec ⁻¹	0.5

- B. Geotextile Fabric for Subgrade Stabilization shall be a woven fabric of polyester or polypropylene, inert to commonly encountered chemicals and hydrocarbons, mildew and rot resistant, insect and rodent resistant, and conform to the following properties:

Physical Properties	Test Method	Unit	Minimum Avg. Roll Value
Grab Tensile Strength (min)	(ASTM D 4632)	lbs	270
Trapezoid Tear Strength (min)	(ASTM D 4533)	lbs	100
Puncture Strength (min)	(ASTM D 4833)	lbs	100
Mullen burst Strength (min)	(ASTM D 3786)	psi	400
Apparent Opening Size (max)	(ASTM D 4751)	mm	0.5
Permittivity	(ASTM D 4491)	sec ⁻¹	0.05

2.4 GEOGRIDS FOR SUBGRADE STABILIZATION

- A. Geo-grids for subgrade stabilization shall be tri-axial, integrally formed polypropylene grids with a positive mechanical interlock load transfer mechanism, and shall conform to the following properties:

Properties	longitudinal	Diagonal	Transverse	General
Rib pitch ² (in.)	1.6	1.6	-	
Mid-rib depth ² (in.)	-	0.06	0.06	
Mid-rib Width ² (in.)	-	0.04	0.04	
Nodal Thickness ² (in.)	-			0.12
Rib Shape				rectangular
Aperture shape				Triangular
Junction Efficiency ³ %				98
Aperture stability ⁴ kg-cm/deg @5.0 dg-cm				3.6
Radial stiffness at low strain ⁵ lb/ft @ 0.5% strain				20,580
Resistance to chemical degradation ⁶				100%
Resistance to ultra-violet light and weathering ⁷				100%
Weight (lbs/syd)				1

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D4759-02. Brief descriptions of test procedures are given in the following notes.
2. Nominal dimensions.
3. Load transfer capability determined in accordance with GRI-GG2-87 and GRI-GG1-87 and expressed as a percentage of ultimate tensile strength.

4. In-plane torsional rigidity measured by applying a moment to the central junction of a 225mm x 225mm specimen restrained at its perimeter in accordance with U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity, (Kinney, T.C. Aperture stability Modulus ref 3, 3.1.2000).
5. Radial stiffness is determined from tensile stiffness measured in any in-plane axis from testing in accordance with ASTM D6637-01.
6. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.
7. Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultraviolet light and aggressive weathering in accordance

PART 3 - EXECUTION

3.1 PREPARATION AND LAYOUT

- A. Establish the extent of excavation by the area and elevation.
- B. Set the required lines and levels.
- C. Protect and maintain bench marks, test wells, monuments, and other reference points. Contact the Owner's Representative if disturbed or destroyed. Reestablish at no cost to the Owner.

3.2 DEWATERING

- A. Keep trenches and excavated areas dry. Provide the necessary equipment including sumps, pumps, piping, and temporary drains.
- B. Discharge drainage water lines as directed by the Owner. If required by the Soil Erosion and Sedimentation Control Plan, provide a sediment filter sock on the discharge of the pump.
- C. Direct surface drainage away from the excavated areas.
- D. Furnish and operate suitable pumps on a 24-hour basis to keep excavations free of water until services have been placed and backfilling is completed.

3.3 TOPSOIL STRIPPING

- A. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
- B. Topsoil shall be salvaged in an amount equivalent to the quantity required by the Plans. Topsoil salvaged in excess of that required by the Plans or as required by the Owner's Representative will be stockpiled by the Contractor at a place as designated by the Owner offsite.
- C. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. The topsoil stockpiles shall be located as near the original location as possible and no payment will be made for overhaul.
- D. Topsoil shall be kept separate from other excavated materials that are to be used for embankment.
- E. Excavate topsoil and subsoil in accordance with lines and levels. Stockpiles shall be located and shaped so as to avoid diversion of storm water runoff, either in or out of the limits of construction, towards buildings, creation of standing water, or interference of

controlled irrigation. The Contractor shall not place topsoil around trunks and root areas of trees to be preserved.

- F. Before removing topsoil, all vegetation shall be reduced to a height of approximately four inches and all such vegetation and all brush, stones, rocks, and any other objectionable litter or foreign material shall be removed and disposed of before the ground is broken for topsoil removal.

3.4 EXCAVATION

- A. Excavate topsoil and subsoil in accordance with lines and levels.
- B. Additional excavation below the planned lines and levels shall be allowed only by the written authorization of the Owner's Representative.
- C. Leave excavations free from loose or organic matter.
- D. Correct unauthorized excavation as directed, at no cost of the Owner.
- E. Fill over excavated areas with sand or approved subsoil to establish design grades and compact. Fill and compact as specified below for embankments.
- F. Cut roadway subgrade to proper slope as noted on drawings.
- G. Any required sheeting, shoring or bracing shall be in accordance with section 0224 – Excavating, Trenching and Backfilling.

3.5 SUBGRADE UNDERCUTTING

- A. Removing topsoil is not part of subgrade undercutting. Subgrade undercutting includes excavation below subgrade in cut sections; excavation at the transition from cut to fill sections; and excavation, other than peat excavation, as required below the topsoil in fill sections.
- B. Subgrade Undercutting shall be the operation of:
 - 1. Removing unsuitable soils as determined by the Owner's Representative, below the subgrade level of the ground after topsoil has been stripped in fill areas.
 - 2. The removal of unsuitable soils below the subgrade elevation as determined by the Owner's Representative in cut areas after the planned finished subgrade has been established and proof rolling is completed as needed.
 - 3. Subgrade undercutting and associated backfill will be paid as extra work unless otherwise noted in Section 01010 – Summary of Work or on the drawings.
- C. After the subgrade is excavated to the approximate grade, the Owner's Representative will inspect the subgrade to decide if subgrade undercutting will be required and to determine the limits of undercutting.
- D. Backfill of Subgrade Undercut
 - 1. Backfill subgrade undercutting Type I with selected clay or other approved material.
 - 2. Backfill subgrade undercutting Type II with granular material.
 - 3. Backfill subgrade undercutting Type III with Material excavated from subgrade undercut areas, after mixing the excavated material to break up the undesirable strata of soils or with other approved backfill material.
 - 4. Compact subgrade undercutting backfill to 95% as determined by ASTM D-1557 (modified Proctor compaction).
 - 5. Always drain the undercut to an underdrain, catch basin, or pipe.

6. When specified, place subgrade stabilization fabric at the bottom of the cut or at locations designated by the Owner's Representative. Place the fabric smooth and free of tension or wrinkles. Fold or cut the fabric to conform to curves. Overlap a minimum of 18 inches at the ends and sides. Hold the fabric in place with pins or staples.
 - a. End dump the suitable material on the fabric. Do not operate the equipment directly on the fabric. Unless stated otherwise, spread the end dumped material and maintain a maximum lift thickness of eight inches.

3.6 SUBGRADE STABILIZATION FABRIC AND GEOGRIDS

- A. Place Subgrade Stabilization Fabric and Geogrids in strict accordance with manufacturer's recommendations on prepared subgrade or subbase at the location as called for on the Plans or directed by the Owner's Representative.

3.7 PROOF ROLLING

- A. Notify the Owner's Representative 48 hours prior to proof rolling.
- B. After removal of topsoil or other overburden and prior to the construction of embankments, proof roll the existing subgrade.
- C. Proof roll roadway subgrade with a pneumatic tire single axle, 4 tires per axle, proof roller loaded to 30,000 lbs. Proof rolling shall only be performed in the presence of the Owner's Representative. In a systematic manner acceptable to the Owner's Representative, the equipment shall perform a minimum of three (3) passes over the designated areas(s).
- D. Operate the proof rolling equipment in a systematic manner to assure the number of passes over all areas, and at the speeds between 2.5 and 3.5 miles per hour.
- E. Proof rolling shall be done in the presence of the Owner's testing agency. Rutting or pumping shall indicate unsatisfactory material and that material shall be undercut as determined by the Owner's Representative and replaced with suitable engineered fill material. This work will be paid as extra work unless otherwise noted in Section 01010 – Summary of Work or on the drawings.
- F. Perform proof rolling only when weather conditions permit. Do not proof roll wet or saturated subgrades.

3.8 EMBANKMENT

- A. All areas to receive fill shall be proof rolled prior to fill placement to delineate any soft or yielding areas. Do not place fill over existing subgrade surfaces which are porous, wet, or spongy. Do not use frozen fill material. Do not place fill material over subgrade that is frozen or that is covered with ice, snow, or water. Contact the Owner's Representative for approval to undercut. Verify approved proof roll for all virgin subgrades.
- B. Do not start fill placement operations until the excavated areas are inspected by the Owner's Representative.
- C. Original ground shall be scarified and benched or otherwise treated to provide adequate bond and to prevent slippage of fill. Embankments shall be so constructed that adequate surface drainage will be provided at all times.
- D. Embankments shall be constructed with sound earth. The materials shall be deposited and compacted in accordance with the General Notes shown on the Plans and these Specifications.
- E. Fill shall not contain rock or rock fragments larger than four inches in any dimension.

- F. Fill material shall be free of debris, organic materials, brush, hedge, roots, stumps, parts of trees, or other deleterious material and shall have a moisture content within two percent of optimum moisture. The use of a sheep foot roller is recommended for cohesive soils and a vibratory roller for cohesionless soils.
- G. Roadway embankment materials that consist of soil shall be placed in horizontal layers not to exceed eight inches in depth before compaction. Place and compact fill materials for site grading in continuous layers not exceeding twelve inches loose depth.
- H. Place fill systematically and as early as possible to reduce water problems and allow maximum time for natural settlement and compaction.
- I. Slope grade away from buildings a minimum of 2% slope for minimum distance of 10 feet unless noted otherwise. Make grade changes gradual. Blend slope into level areas.

3.9 COMPACTION

- A. Road/Pavement subgrade: Compact subgrade to a depth of twelve inches, 95 percent for cohesive soils and 98 percent for cohesionless soils as determined by ASTM D-1557 (modified Proctor compaction).
- B. Aggregate road, shoulders, and base courses: Road and shoulder base courses: Compact to a minimum of 98 percent as determined by ASTM D-1557 (modified proctor compaction).
- C. Roadway embankments shall be placed in horizontal layers not to exceed 8 inches in depth and each layer shall be compacted to a minimum of 95% as determined by ASTM D1557 (Modified Proctor). The moisture content of the material being compacted shall meet both the following conditions:
 - 1. The moisture content shall be within the range of values at which 95% of the maximum density can be obtained as indicated by the moisture-density relationship curve; and,
 - 2. The moisture content shall not exceed the optimum moisture content to the extent that the material pumps under loads applied by the construction equipment. Even if the required density is achieved and the moisture content is in range, if pumping occurs, these sections will be removed and replaced at no additional cost to the Owner.
- D. All fill placed beneath proposed grade supported slabs (buildings, concrete pads, etc.) shall be compacted to 98% modified proctor compaction and shall extend a minimum of 10 feet beyond the outside edge of the proposed slab.
- E. In confined areas where portable equipment is used to achieve compaction, thin lifts of three to four inches may be required to achieve the specified compaction.
- F. All other areas: Compact all subgrade areas to receive fill to a minimum of 95 percent as determined by ASTM D-1557 (modified Proctor compaction).

3.10 BACKFILLING SLABS AND FOUNDATIONS

- A. Backfill under soil-supported slabs or against foundations beneath soil-supported slabs:
 - 1. Backfill material shall conform to MDOT Class II material unless otherwise noted, free of frozen chunks, organics, debris or other deleterious material.
 - 2. Do not place backfill against concrete structures until completion of the required curing and surface finishing.
 - 3. Place backfill evenly around structures to equalize horizontal loadings.

4. Fill material shall be placed in uniform layers not exceeding 12 inches in loose thickness and compacted to at least 95% of the maximum dry density determined in accordance with ASTM D-1557 (Modified Proctor)
5. The Contractor shall, by whatever means are necessary, achieve the specified moisture content at the time of placement. Moisture conditioning and/or treatment of the backfill soil to achieve the specified moisture content shall be considered incidental to the Work of backfilling and shall include all the work required to obtain the specified moisture content and density. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.11 TOLERANCES

- A. The finish subgrade surface shall be shaped to conform to a plan grade and cross section within a tolerance of one-inch in ten feet.
- B. Finish grading shall be done when the ground is frost-free and weather is favorable.

3.12 STOCKPILING OF MATERIAL

- A. Stockpile topsoil and backfill materials separately on the site away from construction operations, in Owner-approved locations. Shape piles to drain surface water and to minimize erosion from wind and rain.

3.13 UNSUITABLE SOILS OR EXCESSIVE SOIL DISPOSAL

- A. Excess excavated material shall be used to raise, widen, or flatten the slopes of embankments; to fade embankments into cuts; or be placed in such other locations and for such purposes as the Owner's Representative may direct. Specific instructions will be given by the Owner's Representative regarding the disposal of surplus material. Excess or unsuitable material placed within the project limits shall be placed and compacted in accordance with the requirements of this section.
- B. Waste material (earth and rock) not required for the construction of the project will be disposed of offsite by the Contractor. The disposal location will be at the HSC sand pit south of Geddes Road.

3.14 UNDERDRAINS/EDGE DRAINS

- A. The pipe shall be laid in close conformity with the lines or grades shown on the Plans or established by the Engineer. All longitudinal pipes shall slope toward an outlet pipe at a minimum rate of one inch per ten feet. The upgrade ends of all underdrains/edge drains shall be closed with suitable plugs to prevent entry of soil or other foreign material.
- B. The pipe shall be laid with perforations down if the perforations are not uniformly distributed around the circumference of the pipe, unless otherwise shown on the Plans. Sections shall be jointed with approved fittings. Dead ends of pipe shall be completely closed by means of caps or plugs.
- C. Underdrains/edge drains shall be bedded in 7A Aggregate. The bedding shall have a minimum thickness beneath the pipe of 4 inches, a minimum width of 6 inches on each side of the pipe and extend to a level not less than 12 inches above the top of the pipe.
- D. The bedding shall be placed equally on both sides of the underdrain/edge drain at the same time. Staking or other methods to restrain the pipe may be necessary during the backfilling operation to maintain the line and grade of the underdrain/edge drain.
- E. Rodent screens and outlet endings are required for all underdrains/edge drain which terminate in a ditch or swale.

- F. Any underdrain trenching that results in an uneven trench bottom or exposes soft, yielding or unstable ground in the trench bottom shall be removed and backfilled with drainage aggregate material of sufficient thickness to ensure maintenance of proper alignment and gradient for all subsequent operations.

3.15 PLACING TOPSOIL

- A. Topsoil: Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, wood matter, and other objects over two inches in diameter, and without weeds, roots, and other objectionable material.
- B. The topsoil shall be spread uniformly to provide a smooth, even surface at a finish grade specified on the Plans, or acceptable to the Owner's Representative. After spreading, the topsoil shall be compacted lightly as necessary to minimize settlement. Final grades shall not vary more than one-tenth of a foot from the elevations indicated on the Plans.

3.16 FIELD QUALITY CONTROL

- A. During the course of the Work, the Owner's Representative may require testing for compaction or density of the backfill, sieve analysis, or other similar tests. The taking of samples and the testing required shall be performed by a Testing Agency provided by the Owner. The cost for testing and sampling shall be at the expense of the Owner except as otherwise provided for herein. Test results will be provided to the Contractor.
- B. The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot as determined by ASTM D1557.
- C. Allow for visual inspection of bearing surfaces by the Owner's Representative.

3.17 DEFECTIVE WORK

- A. Any portion of backfill, subbase, or subgrade which is deficient in the specified density shall be corrected by methods meeting the approval of the Owner's Representative.
- B. Any extra testing or sampling required by the Owner's Representative because of deficiencies, shall be at the Contractor's expense.

END OF SECTION

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EXCAVATING, TRENCHING, AND BACKFILLING

02224-1

Rev. 0

PART 1 GENERAL

1.1 SCOPE

- A. This Section includes open trench construction for utility installation, complete with trenching, sheeting, dewatering, bracing, bedding materials, backfilling, backfill material, and compaction.

1.2 RELATED SECTIONS

- A. Section 01410 - Testing Laboratory Services: Testing fill compaction
- B. Section 02200 - Site Grading
- C. Section 02610 - Underground Ductile Iron Water Lines
- D. Section 02685 - HDPE Natural Gas Line
- E. Section 02721 - HDPE Gravity Sewer Pipe

1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates
- B. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method
- C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop

1.4 SUBMITTALS

- A. Submit under the provisions of Section 01300.
- B. Submit samples of fill to testing laboratory in air-tight containers.

1.5 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

1.6 PROTECTION

- A. Protect features remaining as part of final landscaping.
- B. Protect bench marks and existing utilities, structures, roads, grounds, paving, and curbs against damage from equipment and vehicular or foot traffic.
- C. Notify the Owner of unexpected subsurface conditions and discontinue work in the area until the Owner provides notification to resume work.
- D. Grade around excavation(s) to prevent surface water runoff into excavated areas.
- E. Provide temporary erosion and sedimentation control measures per the Soil Erosion and Sedimentation Control Plan and Section 02020 – Temporary Erosion and Sediment Control.

1.7 EXISTING UTILITIES

- A. The Owner has made efforts to identify and locate underground utilities on documents included. Before starting excavation, establish location and extent of underground utilities occurring in work area. Notify the Owner's Representative if site and documents differ. Do not proceed with this work without approval of the Owner's Representative.

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EXCAVATING, TRENCHING, AND BACKFILLING

02224-2

Rev. 0

PART 2 PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS

- A. Contractor shall order aggregate materials from Wirt Stone Dock (WSD) under HSC direct billing procedure.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, and labor not mentioned above and required to perform the work of this section

2.3 FILL MATERIALS

- A. Coarse Stone or Gravel: 21AA washed 100% crushed limestone, open-graded 5A, 6AA, and 7A crushed limestone. Free of clay, shale, organic matter, friable material, sand, debris; graded in accordance with ANSI/ASTM C136.
- B. Pea Gravel: Natural stone; free of clay, shale, organic matter; friable material, sand, debris; graded in accordance with ANSI/ASTM C136, to the following:
 - 1. Minimum Size: 1/4 inch
 - 2. Maximum Size: 5/8 inch
- C. Utility Bedding for D.I., HDPE, PVC, and Concrete Pipe: Coarse Sand: Natural river or bank sand; free of clay, shale, organic matter, friable material, debris; graded in accordance with ANSI/ASTM C136 unless noted otherwise on drawings as required for job site conditions.
- D. 6AA Crushed Stone: Free of clay, shale, organic matter; friable material, sand, debris; graded in accordance with ANSI/ASTM C136
- E. 7A Crushed Stone: Free of clay, shale, organic matter; friable material, sand, debris; graded in accordance with ANSI/ASTM C136.
- F. Sound earth: Natural material free of organic matter, debris, gravel larger than 3 inch size that can be compacted to the required density.
- G. Non Structural Flowable Fill (Removable)
 - 1. Supply non-structural flowable fill consisting of a mixture of Portland cement, fly ash, sand (2NS) and water. All non-structural flowable fill is intended to be removable using conventional mechanical excavation methods. Use either Type I or IA Portland cement and Class F or C fly ash as specified by ASTM C 618 except that there is no limit on loss on ignition.
 - 2. Produce a mix of cement, fly ash, sand and water in the following proportions.

a.	Portand Cement	50 lb/cyd
b.	Fly Ash	500 lb/cyd
c.	Sand	2850 lb/cyd
d.	Water	approx.. 376 lb/cyd

(sufficient to produce desired flowability)
 - 3. Produce and deliver the non-structural flowable fill at a minimum temperature of 50 degrees F.

2.4 GEOTEXTILE FABRICS

- A. Stabilization Fabric shall be as specified in Section 02200 – Site Grading.

- B. Geotextile Fabric for Drainage Applications shall be as specified in Section 02200 – Site Grading.

2.5 DETECTABLE WARNING TAPE FOR NON-METALIC PIPING

- A. Polyethylene plastic tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, three inches wide, color coded as specified below for the intended utility with warning identification imprinted in bold, all capital, black letters, continuously over the entire tape length. Caution to read, “Caution Buried (Intended Service) Line Below” or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.
 - 1. Color Green: Sewer System
 - 2. Color Blue: Water System
 - 3. Color Yellow: Gas System
- B. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1,500 psi lengthwise and 1,250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to three feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

PART 3 EXECUTION

3.1 DEWATERING

- A. Keep trenches and excavated areas dry. The depth of the dewatering shall be sufficient to allow the trench excavating operation, including backfilling and compacting to proceed in a dry condition. Provide the necessary equipment including sumps, pumps, piping, and temporary drains.
- B. Discharge drainage water lines as directed by the Owner. If required by the Soil Erosion and Sedimentation Control Plan, provide a dewatering discharge filter bag on the discharge of the pump(s) as required in Section 02010 – Temporary Erosion and Sediment Control.
- C. Upon completion of dewatering Work for the Project, abandon and/or fill all holes, trenches, ditches, and other excavations created by the Work of this Section and not scheduled to remain. Do all filling, backfilling, and grading to restore excavations and earth banks to the lines and levels indicated on the Plans, and as determined by the Owner's Representative.

3.2 PREPARATION

- A. Generally, compact subgrade to the density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of insitu compaction per subgrade undercutting Section 02200 – Site Grading.
- C. Identify the required lines, levels, contours, and datum.

3.3 TRENCH EXCAVATION

- A. Excavate subsoil for utility piping, manholes and/or building foundations.
- B. The trenching operation shall commence at the downstream or outlet end of the new Work and proceed upstream, unless otherwise specified or directed by the Owner's Representative.

- C. The trench shall be excavated in reasonably close conformity with the lines and grades specified on the Plans or as established by the Owner's Representative.
- D. The excavated materials shall be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property, public property, or traffic. The excavated materials shall not be placed at such locations that will endanger the trench banks by imposing loads thereon.
- E. Excavate trenches to at least 4 inches and not more than 6 inches below the specified grade from bottom of pipe.
- F. The trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe.
 - 1. For rigid pipe, the width of the trench from below the pipe bedding to 12 inches above the top of the pipes shall not exceed the following dimensions:

6-inch thru 12-inch pipe	30 inches wide
15-inch thru 36-inch pipe	outside diameter plus 16 inches*
42-inch thru 60-inch pipe	outside diameter plus 20 inches**
over 60-inch pipe	outside diameter plus 24 inches

* For multiple pipes in one trench, 8" between O.D. and trench wall.

** For multiple pipes in one trench, 10" between O.D. and trench wall.

- a. To support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, the Contractor shall install, at his expense, concrete encasement which shall completely surround the pipe and shall have a minimum thickness at any point of 1/4 of the outside diameter of the pipe or four (4) inches, whichever is greater, or at his expense, install another type bedding, approved by the Owner's Representative.
 - b. The concrete encasement shall consist of minimum 3,500 psi strength concrete.
- 2. For flexible pipe and flexible pipe with multiple pipes in one trench, the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25, plus 12 inches. The maximum trench width for flexible pipe shall not exceed the minimum width by more than 6 inches.
 - a. To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, the Contractor shall install, at his expense, crushed stone pipe bedding to the full width between undisturbed trench walls.
- G. All trench excavations, including those for shafts and structures, shall be adequately braced and/or sheeted where necessary to prevent caving or squeezing of the soil.
- H. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- I. Machine grade banks to angle of repose or less, until shored.
- J. Hand trim excavation. Remove loose matter.
- K. Remove lumped subsoil, boulders, and rock up to 1/3 cu. yd. as measured by volume.

- L. Notify the Owner's Representative of unexpected subsurface conditions. Discontinue the work in the affected area until directed to resume work by the Owner's Representative.
- M. Correct unauthorized excavation at no extra cost to the owner.

3.4 SHEETING, SHORING, AND BRACING

- A. Shore adjacent structures which may be damaged by excavation work, including slab on grade, building foundations, utilities and pipe chases.
- B. The Contractor shall furnish, place, and maintain at all times such sheeting, shoring, and bracing of the trench and/or shaft as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipe lines, conduits next to or crossing the trench, and the protection and safety of pedestrian and vehicular traffic.
- C. The Contractor shall be responsible for the complete design of all sheeting, shoring, and bracing Work. Design shall be sealed by a Professional Engineer registered in Michigan.
- D. The design shall be appropriate for the soil conditions, and shall be of such strength, quality, dimension, and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil.
- E. Prior to installing the sheeting, shoring, or bracing, the Contractor shall submit Plans for this Work to the Owner's Representative for informational purposes only.
- F. Sheeting, shoring, bracing, and excavation shall conform to the current federal or state regulations for safety.
- G. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to Contractor for sheeting, shoring, or bracing left in place.
- H. Supports for pipes, conduits, etc. crossing the trench shall conform to the requirements of the owners of such facilities and, if necessary, shall be left in place.
- I. The furnishing, placing, bracing, maintaining, and removing of sheeting, shoring, and trenching materials shall be at the Contractor's expense.
- J. The Contractor shall not remove the trench sheeting, shoring, and bracing unless the pipe has been properly bedded, and the trench backfilled to sufficiently support the external loads. Also the sheeting, shoring, and bracing material shall not come in contact with the pipe, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

3.5 BEDDING

- A. All loose soil, water and foreign materials shall be removed prior to placement of the bedding and piping. If necessary, the subgrade shall be prepared with the use of hand tools.
- B. For pipe bedding from 4" (minimum) below bottom of pipe to top of pipe use coarse sand compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).

3.6 BACKFILLING

- A. Backfill areas/trenches to contours and elevations shown on attached drawings.
- B. Systemically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

- C. Place geotextile fabric as scheduled on drawings for stability in such areas as access drives, road crossings, etc.
- D. Granular Fill: Place and compact materials in continuous layers not exceeding 6 to 8 inches of loose depth for motorized plate compactors, 8 to 10 inches for hydraulic hoe packs.
- E. Soil Fill: Place and compact material in continuous layers not exceeding 8 to 12 inches of loose depth for motorized plate compactors, 12 to 16 inches for hydraulic hoe packs.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Leave the fill material stockpile areas completely free of excess fill materials. Replace areas to original conditions.
- H. Backfilling in roadways, access drives, shoulders and parking areas shall consist of continuous compacted coarse sand layers topped with designated finish materials, or minimum 15" stonemix. Compact to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).
- I. Backfilling in areas not scheduled for paving shall consist of approved sound earth previously excavated or coarse sand compacted in continuous layers to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).

3.7 TOLERANCES

- A. Plus/minus 0.10 feet from required elevations.

3.8 FIELD QUALITY CONTROL

- A. During the course of the Work, the Owner's Representative may require testing for compaction or density of the backfill, sieve analysis, or other similar tests. The taking of samples and the testing required shall be performed by a Testing Agency provided by the Owner. The cost for testing and sampling shall be at the expense of the Owner except as otherwise provided for herein. Test results will be provided to the Contractor.
- B. Tests and analysis of compacted fill material will be performed in accordance with ANSI/ASTM D1557 and C136. Submit samples according to Section 01410.
- C. If required, compaction testing of undisturbed in situ soil will be performed in accordance with ANSI/ASTM D1556. If testing is required by Engineer, state the number of tests and form to be used per D1556. Submit form to Engineer.
- D. If tests indicate the work does not meet specified requirements, remove the work, replace and retest at no additional cost to the Owner.
- E. Frequency of tests: Fill material should be tested and analyzed before delivery to the construction site; if determined to be necessary from the Owner's Representative's visual inspection. Fill materials will be protected as appropriate. Compaction testing should be done every third lift for engineered fills, and for the final sub-base layer before placing the foundation, slab-on-grade or pavement. The frequency of compaction testing may be altered at the discretion of the Owner's Representative.

3.9 PROTECTION OF FINISHED WORK

- A. Re-compact fills subjected to vehicular traffic.
- B. Protect bottom of excavations and soil adjacent to and beneath foundations from freezing.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation.

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- D. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Materials, labor, tools, equipment, and other required service needed to install all piles.
- B. Steel pipe, filled with concrete, with conical tip or end bearing plate, as shown on drawings
- C. Rolled steel H-section piles, used for bearing on rock or gravel hard pan, with sizes shown on the drawings
- D. Testing and inspection of materials used in piles

1.2 RELATED SECTIONS

- A. Section 01050 – Field Survey Services
- B. Section 01300 - Submittals
- C. Section 01410 – Testing Laboratory Services
- D. Section 02200 – Site Grading
- E. Section 09900 – Painting
- F. Section 03320 – Foundation Concrete
- G. Section 05120 – Structural Steel

1.3 REFERENCES

- A. ASTM A252 – Standard Specification for Welded and Seamless Steel Pipe Piles
- B. ASTM A6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
- C. ASTM A992 – Standard Specification for Structural Steel Shapes (steel H piles)
- D. ASTM A690 – Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments
- E. ASTM D1143 - Standard Test Methods for Deep Foundations Under Static Axial Compressive Loads
- F. ASTM D3689 - Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
- G. ASTM D3966 - Standard Test Methods for Deep Foundations Under Lateral Load
- H. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- I. ASTM A36 - Standard Specification for Carbon Structural Steel
- J. ASTM A27 - Standard Specification for Steel Castings, Carbon, for General Application
- K. ASTM A148 - Standard Specification for Steel Castings, High Strength, for Structural Purposes
- L. ASTM C1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
- M. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

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- N. AISC Steel Construction Manual 14th Edition
- O. AWS D1.1 - Structural Welding Code – Steel
- P. AISC 360 - American Institute of Steel Construction 2010, Specification for Structural Buildings

1.4 PROJECT SITE CONDITIONS

- A. The Contractor shall protect all active underground and overhead utilities and structures in the area. The Owner shall identify all known utilities, structures, and the condition of the subsurface soils.
- B. The Contractor shall thoroughly review all subsurface investigation data presented in Geotechnical report for the building. This information is made available to the Contractor by the Owner for his convenience and shall be used solely at Contractor's responsibility.
- C. The Contractor may perform additional test borings and other subsurface investigation operations at no cost to Owner. Additional investigation shall not damage adjacent buildings or impact the construction schedule.
- D. If subsurface conditions are found to be significantly different than indicated in the contract documents, the Contractor must immediately notify the Owner's Representative. Increases or decreases in the bid contract price will be negotiated.
- E. The Engineer will identify nearby structures that may be distressed during pile construction. The Contractor will monitor these structures for possible movement and will halt work immediately if problems develop.

1.5 QUALIFICATIONS & PERFORMANCE REQUIREMENTS

- A. Installer: Company specializing in performing the work of this section with a record of projects spread over a period of a minimum ten years of successful in-service performance construction.
 - 1. Installer's responsibility includes providing a qualified professional engineer to prepare pile driving records.
- B. Drive piles to load supporting capacities as indicated on the drawings.
- C. Job Conditions:
 - 1. Do not drive piles until excavation or filling and compaction in the area they are to occupy has been completed to design grades as shown on the drawings.
 - 2. Do not drive piles until mud-line is clear of debris or other material that may interfere with pile driving.
 - 3. When concrete is less than seven days old, do not drive piles closer to the concrete than the distance computed by the formula below
$$D = 1/7 (E)^{1/2}$$
where;
D - Distance in feet
E - Energy of the pile hammer in foot-pounds
 - 4. Protect existing structures, including overhead and buried utility lines.

1.6 SUBMITTALS

- A. Submit the following under the provisions of Section 01300.

1. Submit accurate pile driving records of the following (within two days of driving each pile):
 - a. Project name and number.
 - b. Name of Contractor.
 - c. Pile type.
 - d. Pile location in pile group and designation of pile group.
 - e. Sequence of driving in pile group.
 - f. Pile dimensions.
 - g. Ground elevation.
 - h. Elevation of tips after driving.
 - i. Final tip and cutoff elevations of piles after driving pile group.
 - j. Records of re-driving.
 - k. Elevation of splices.
 - l. Type, make, model, and rated energy of hammer.
 - m. Weight and stroke of hammer.
 - n. Type of pile-driving cap used.
 - o. Cushion material and thickness.
 - p. Actual stroke and blow rate of hammer.
 - q. Pile-driving start and finish times, and total driving time.
 - r. Time, pile-tip elevation, pile head elevation, and reason for interruptions.
 - s. Number of blows for each 12 inches of penetration, and number of blows per 1 inch for the last 6 inches of driving.
 - t. Pile deviations from location and plumb.
 - u. Pre-boring, jetting, or special procedures used.
 - v. Unusual occurrences during pile driving.
 - w. The above records shall be compiled and attested to by a qualified professional engineer.
2. Shop Drawings: Show fabrication and installation details for piles, including details of driving shoes, tips or boots, and pile butt protection.
 - a. Indicate welds by standard AWS symbols distinguishing between shop and field welds, and show size, length and type of each weld.
 - b. Include arrangement of static pile reaction frame, test and anchor piles, equipment, and instrumentation. Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. As-built drawings.
4. Manufacturer's mill certificate: Certify that steel meets or exceeds specified requirements.

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5. Static Pile Test Reports: Submit within two days of completing each test
6. Qualification data for installer, professional engineer and testing agency.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing driven piles similar in material, design, and extent indicated for this Project, whose work has resulted in construction with a record of successful in-service performance over a ten year period.
 1. Installer's responsibility includes providing a qualified professional engineer to prepare pile driving records.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
- C. Welding Standards: Qualify welding procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS (PIPE PILES)

- A. Pipe: ASTM A252, Grade 2; single length steel pipe, seamless, unless noted otherwise on the design drawings.
 1. Wall: Plain
 2. Ends: Plain, unless noted otherwise
 3. Diameter: Constant diameter, with flat plate end, unless noted otherwise on the drawings.
 4. Wall Thickness: Schedule 40, unless noted otherwise on the drawings.
- B. Concrete Materials and Mix: Using Type I Portland cement; with maximum aggregate size of $\frac{3}{4}$ inch; 4 to 5 inches of slump; and 28-day compressive strength of 4000 psi
- C. Admixtures: For concrete filled piles in cold-weather applications, use appropriate accelerator. Note: calcium chloride is not allowed without Owner Representative's consent. Discuss options with Owner's Representative before use.
- D. Reinforcement: Deformed bars in accordance with ASTM A615.
- E. Accessories: Points and driving cap to suit pile shape.

2.4 MATERIALS (H-PILES)

- A. Piles: ASTM A36, ASTM A992, ASTM A690, or ASTM A6 as noted on drawings; structural steel, rolled H-sections, minimum 36 ksi yield strength; sizes and lengths as required to achieve design loads.

- B. Accessories: Points and driving cap to suit pile shape.

2.5 SHOP PAINTING

- A. SSPC - Paint 16; self-priming, two-component, coal-tar epoxy polyamide, red.
- B. General: Shop paint steel pile surfaces except for surfaces to be encased in concrete, as follows:
 - 1. Extend painting to a depth of 60 inches (1500 mm) below finished grade to top of exposed pile.
- C. Surface Preparation: Clean surfaces to be painted. Remove loose rust and loose mill scale, spatter, slag, and flux deposits. Prepare surfaces according to NACE No. 2/SSPC-SP 10, Joint Surface Preparation Standard: Near-White Metal Blast Cleaning. Painting: Immediately after surface preparation, apply first coat of paint according to manufacturer's written instructions to provide a dry film thickness of not less than 8 mils (0.2 mm).
 - 1. Apply second coat to provide a dry film thickness of not less than 8 mils (0.2 mm), resulting in a 2-coat paint system thickness of not less than 16 mils (0.4 mm).
 - 2. Apply second and third coats with each coat having a dry film thickness of not less than 8 mils (0.2 mm), resulting in a 3-coat paint system thickness of not less than 24 mils (0.6 mm).
 - 3. Mark pile lengths after shop painting.

2.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piles to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent physical damage. Support piles with webs in vertical position.
- B. Protect pile coatings and touch up damage to coatings before driving piles.

2.7 FABRICATION

- A. Pile Lengths: After reviewing static pile test reports, Owner's Representative will verify pile lengths.
- B. Fabricate and assemble piles in shop to greatest extent possible.
- C. Identify high-strength steel piles and maintain markings until driven.
- D. Fabricate full-length piles to eliminate splicing during driving, with ends square.
- E. Fabricate full-length piles by splicing lengths of H pile together. Accurately mill meeting ends of piles and bevel for welding. Maintain axial alignment of pile lengths.
 - 1. Splice Unit: Notch web of pile, fit splice unit into position, and weld according to manufacturer's written instructions and AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 2. Welded Splices: Continuously weld pile according to AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 3. Splice piles during fabrication or field installation.
- F. Fit and weld driving points to tip of pile according to manufacturer's written instructions and AWS D1.1 for procedures, appearance and quality of welds, and methods used in

correcting welding work.

- G. Pile-Length Markings: Permanently mark each pile with horizontal lines at 12-inch intervals; mark the distance from pile tip at 60-inch intervals.

2.8 PILE ACCESSORIES

- A. Driving Points Steel H Piles: Manufacturer's standard one-piece driving point, fabricated from steel castings as follows to provide full bearing of web and flange of pile tip. Cast driving point with integral tapered cutting wedges and with top alignment curbs to encase web and flanges of pile.
 - 1. Carbon-Steel Castings: ASTM A27/A27M, Grade 65-35.
 - 2. High-Strength Steel Castings: ASTM A148/A148M, Grade 80-50.
- B. Splice Unit: Manufacturer's standard splice unit, fabricated from two connected steel plates, of same material as H pile, shaped and tapered to encase web and each flange.
- C. Driving Points Pipe Piles: Manufacturer's standard 60-degree conical driving point, with integral reinforcing ribs, to provide full bearing of pipe pile tip. Fabricate from steel castings as follows:
- D. Inside Cutting Shoes: Manufacturer's standard, inside-flanged, open-ended cutting shoe, to provide full bearing of pipe pile tip.
- E. Outside Cutting Shoes: Manufacturer's standard, outside-flanged, open-ended cutting shoe, to provide full bearing of pipe pile tip.
- F. Splice Coupling: Manufacturer's standard splice coupling, rolled from ASTM A36/A 36M, carbon-steel bar or cast from heat-treated carbon steel, ASTM A27/A 27M, Grade 65-35 (Grade 450-240), with interior stop and internally tapered for friction fit driving.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Notify the Owner's Representative, five days before proceeding with the work.
- B. Use driving method which will not cause damage to nearby structures.
- C. Protect structures, equipment, and piping near the work from damage.
- D. Prepare to place piles from excavated working elevation.
- E. The contractor shall review the geotechnical report for the soil conditions in the area and follow recommendations provided in the report. Contractor may perform additional soil investigation if required, to supplement Owner's supplied report.
- F. Size pile driving equipment to drive production and test piles without damage. Select pile driving equipment that installs piles at a rate from two blows per inch to 10 blows per inch, at the required nominal pile driving resistance.

3.3 DRILLING

- A. Drill holes to facilitate driving only at upper third level of subsoil strata. Drill only through stratum that obstructs driving.

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- B. Hole Diameter: Maximum 1 inch larger than pipe diameter.

3.4 INSTALLATION

- A. Protect pile head during driving with full bearing on pile for even distribution of hammer blow.
- B. Deliver hammer blows to central axis of pile.
- C. Re-drive piles which have lifted or moved due to driving adjacent piles or by soil uplift.
- D. Do not damage piles during driving operations.
- E. Set tops of piles to elevations indicated.
- F. Cut off tops of piles to elevations indicated and prepare pile top to receive pile caps or grade beams.
- G. Fully welded splicer shall be used for extending pile length.
- H. The allowable compressive load of a pile is determined by application of a pile driving formula given in the geotechnical report, supplied by the Owner. Allowable load shall be verified by static load tests.
- I. For open pipe piles to be filled with concrete, remove soil and foreign matter from pile casing. Auger or churn drill shaft bottom into bearing stratum. Clean shaft bottom with flushing water. Pump dry.
- J. Allow inspection of pile casing prior to placement of reinforcement and concrete.
- K. Place reinforcing steel (if required) in accordance with Section 03320. Prevent foreign matter from entering shaft.
- L. Place concrete in single pour with equipment designed for vertical placement of concrete. Limit free fall of concrete to 15 feet. Vibrate concrete full depth of pile.
- M. Prepare pile top to receive pile cap or grade beams.
- N. Extend reinforcement or provide dowels for subsequent connection of pile caps or grade beams.

3.5 STATIC PILE TESTS

- A. General: Static pile tests will be used to verify design pile lengths and to confirm design load capacity of piles.
 - 1. Furnish test piles 60 inches longer than production piles.
 - 2. Actual length of piles will be based on results of static pile tests.
- B. Pile Tests: Arrange and perform the following pile tests:
 - 1. Axial Compressive Static Load Test: ASTM D1143.
 - 2. Axial Tension Static Load Test: ASTM D3689.
 - 3. Lateral Load Test: ASTM D 3966.
- C. Equip each test pile with two telltale rods, according to ASTM D 1143, for measuring deformation during load test.
- D. Drive test piles at locations indicated to a tip elevation below final cutoff elevation equal to pile length specified as basis of bid, or to refusal, whichever occurs first. Piles will be considered as driven to refusal when 5 blows of hammer are required to produce a total penetration of 1/4 inch or less.

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1. Allow a minimum of seven days to elapse after driving test piles before starting pile testing.
- E. Provide pile reaction frame, anchor piles, equipment, and instrumentation with sufficient reaction capacity to perform tests. Notify Architect at least 48 hours in advance of performing tests. On completion of testing, remove testing structure, anchor piles, equipment, and instrumentation.
 1. Number of Test Piles: Three single piles.
- F. Driving Test Piles: Use test piles identical to those required for Project and drive with appropriate pile-driving equipment operating at rated driving energy to be used in driving permanent piles.
 1. Pile Design Load: As indicated.
- G. Approval Criteria: Allowable design capacity of test piles shall be one-half of the load that results in the lesser of the following two values:
 1. Net settlement, after deducting rebound, of not more than 0.01 inch/ton of test load.
 2. Gross settlement of not more than 1 inch provided that load-settlement curve shows no sign of failure.
- H. Test Pile-Driving Records: Prepare driving records for each test pile, compiled and attested to by a qualified professional engineer. Include same data as required for driving records of permanent piles.
- I. Test piles that comply with requirements, including location tolerances, may be used on Project.

3.6 TOLERANCES

- A. The location of the pile shall be within plus or minus 3 inches from the location shown on the drawings.
- B. The pile shall be vertical to within 2% [1 in 48] of plumb.
- C. The maximum variation from top of pile elevation: plus 2 inches.
- D. The maximum variation from the required angle for batter piles: 4% [1 in 24].

3.7 OBSTRUCTIONS

- A. If any obstruction is encountered which should result in refusal, preventing pile driving to the depth required, or cause the pile to drift from the required location, driving shall be stopped and the Owner's Representative notified.
- B. Refusal shall be defined as the depth where the rate of penetration exceeds 100 blows per foot.

3.8 QUALITY CONTROL

- A. Piles shall be installed for the designated design compression load.
- B. Field quality control testing will be performed under provisions of Section 01410 by Owner-hired independent testing agency.
- C. Test Piles will be performed under provisions of Section 01410, using same diameter and type as specified for other piling, placed in same manner.
- D. Accepted test piles may be used in the work.

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3.9 UNACCEPTABLE PILES

- A. Unacceptable piles: piles that fail tests, are placed out of position, are below cut-off elevations, or are damaged.
- B. Provide additional piles or replace piles to conform to specified requirements.

END OF SECTION

PART 1 - GENERAL**1.1 WORK INCLUDED**

- A. Materials, labor, tools, equipment, and other required service needed to install all piles.
- B. Steel sheet piles: Long structural sections with a vertical interlocking system that creates a continuous wall. The sheet pile walls are used to retain either soil or water.
- C. Permanent and temporary sheet piles: Permanent sheet piles remain in the ground and serve as permanent retaining structures. The design of sheet pile is performed by responsible professional design engineer in charge.
- D. Temporary sheet piles: These are designed to provide safe access for construction and are removed afterwards. The design of sheet pile is Contractor's responsibility.

1.2 RELATED SECTIONS

- A. Section 01050 – Field Survey Services
- B. Section 01300 - Submittals
- C. Section 01420 – Testing Laboratory Services
- D. Section 02200 – Site Grading
- E. Section 09900 – Painting
- F. Section 03320 – Foundation Concrete
- G. Section 05120 – Structural Steel

1.3 REFERENCES

- A. ASTM A328 - Standard Specification for Steel Sheet Piling
- B. AWS D1.1 - Structural Welding Code – Steel

1.4 PROJECT SITE CONDITIONS

- A. The Contractor shall protect all active underground and overhead utilities and structures in the area. The Owner shall identify all known utilities, structures, and the condition of the subsurface soils.
- B. The Contractor shall thoroughly review all subsurface investigation data presented. This information is made available to the Contractor for his convenience and shall be used solely at Contractor's responsibility.
- C. The Contractor may perform additional test borings and other subsurface investigation operations at no cost to Owner. Additional investigation shall not damage adjacent buildings or impact the construction schedule.
- D. If subsurface conditions are found to be significantly different than indicated in the contract documents, the Contractor must immediately notify the Owner's Representative. Increases or decreases in the bid contract price will be negotiated.
- E. The Engineer will identify nearby structures that may be distressed during pile construction. The Contractor will monitor these structures for possible movement and will halt work immediately if problems develop.

1.5 QUALIFICATIONS & PERFORMANCE REQUIREMENTS

- A. Installer: Company specializing in performing the work of this section with minimum ten years of experience.
 - 1. Installer's responsibility includes providing a qualified professional engineer to prepare pile driving records.
- B. Drive sheet piles to elevations indicated on the drawings.
- C. Job Conditions:
 - 1. Do not drive sheet piles until excavation or filling and compaction in the area they are to occupy has been completed to design grades as shown on the drawings.
 - 2. Protect existing structures, including overhead and buried utility lines.

1.6 SUBMITTALS

- A. For permanent sheet piles only, if asked for by the Owner's Representative or Engineer, submit the following under the provisions of Section 01300.
 - 1. Accurately record the following:
 - a. Project name and number.
 - b. Name of Contractor.
 - c. Sheet pile sizes, length and location.
 - d. Ground elevation.
 - e. Elevation of tips after driving.
 - f. Final tip and head elevations of piles after driving pile group.
 - g. Sheet pile deviations from location and plumb.
 - h. Unusual occurrences during sheet pile driving.
 - 2. Shop Drawings: Show fabrication and installation details for sheet piles (For permanent sheet piles only)
 - 3. Certified Mill test reports.

1.7 QUALITY ASSURANCE (Permanent sheet piles only)

- A. Installer Qualifications: A firm experienced in installing driven sheet piles similar in material, design, and extent indicated for this Project, whose work has resulted in construction with a record of successful in-service performance, for the last 10 years.
- B. Welding Standards: Qualify welding procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

PART 2- PRODUCTS

- 2.1 OWNER-PROVIDED PRODUCTS – None
- 2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

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2.3 MATERIALS

- A. Sheet piling shall be grade ASTM A-328. Permanent sheet piling profile and wall thickness shall be as specified on the drawings.
- B. The interlocks of sheet piling shall be free-sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed.
- C. Sheet piling shall be full length sections of the dimensions shown.

PART 3- EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work. Notify Owner's Representative in writing of conditions detrimental to proper and timely execution of work. Do not proceed with work until unsatisfactory conditions have been mitigated.
- B. Beginning of installation means installer accepts existing conditions.

3.2 DELIVERY, STORAGE AND HANDLING

- A. Materials delivered to the site shall be new, undamaged, and be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the sheet piling, as required by the referenced specifications. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of sheet piling should also facilitate required inspection activities. (Sheet piling over 80 feet in length shall be handled using a minimum of two pickup points.

3.3 PREPARATION

- A. Notify the Owner's Representative, adjacent and affected building occupants before proceeding with the work.
- B. Use driving method which will not cause damage to nearby structures.
- C. Protect structures, equipment, and piping near the work from damage.

3.4 INSTALLATION

- A. Deliver hammer blows to central axis of pile to minimize damage to the sheet during driving.

3.5 OBSTRUCTIONS

- A. If any obstruction is encountered which should result in refusal, preventing pile driving to the depth required, or cause the sheet to drift from the required location, driving shall be stopped and the Owner's Representative notified.
- B. Refusal shall be defined as the depth where the rate of penetration exceeds 10 blows per inch.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Materials, labor, tools, equipment, and other required service needed to install all piles.
- B. Testing and inspection of materials used in piles.
- C. Cement grout in piles.
- D. Reinforcing steel in piles.

1.2 RELATED SECTIONS

- A. Section 01050 – Field Survey Services
- B. Section 01300 - Submittals
- C. Section 01420 – Testing Laboratory Services
- D. Section 02200 – Site Grading
- E. Section 02210 – Earthwork – Draining and Drainage
- F. Section 03300 – Cast-in-Place Concrete

1.3 REFERENCES

- A. ASTM C150 – Standard Specification for Portland Cement
- B. ASTM C33 - Standard Specification for Concrete Aggregates
- C. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
- D. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use in Concrete
- E. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- F. ASTM D1143 - Standard Test Methods for Deep Foundations Under Axial Compressive Loads
- G. ASTM D3689 - Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
- H. ASTM D3966 - Standard Test Method for Piles Under Lateral Load

1.4 PROJECT SITE CONDITIONS

- A. The Contractor shall protect all active underground and overhead utilities and structures in the area. The Owner shall identify all known utilities, underground structures, and the condition of the subsurface soils.
- B. The Contractor shall review all subsurface investigation data presented. This information is made available to the Contractor for his convenience and shall be used solely at the Contractor's responsibility.
- C. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by Owner and after acceptable temporary utility services have been provided.
- D. The Contractor may perform additional test borings and other subsurface investigation operations at no cost to Owner and with no impact to the construction schedule. Additional investigation shall not damage adjacent buildings or impact the construction schedule.

- E. If subsurface conditions are found to be significantly different than indicated in the contract documents, the Contractor must immediately notify the Owner's Representative. Increases or decreases in the bid contract price will be negotiated.
- F. The Engineer will identify nearby structures that may be distressed during pile construction. The Contractor will monitor these structures for possible movement and will halt work immediately if problems develop.

1.5 QUALITY ASSURANCE

- A. Inspection: inspection and testing of pile installation will be performed by Owner's Representative and/or a Geotechnical Engineer employed by the Owner. Items monitored include:
 - 1. Method of pile formation
 - 2. Grout pump pressures
 - 3. Grout take volumes
 - 4. Rate of auger withdrawal
 - 5. Reinforcing steel placement
 - 6. Grout compressive strength
- B. Survey Work: Provide lines and levels required before placement of each pile's horizontal axial location, top elevation, deviations from specified tolerances, and other data as required.
- C. Owner's quality control agency shall review pile installation and testing procedures and load test results. As Inspector, the Owner's quality control agency shall observe and evaluate the installation of each pile, prepare and submit certified auger-cast pile reports, and when necessary, make recommendations regarding design or procedural changes.
- D. Owner's quality control agency shall perform grout field quality control tests.
- E. Materials and installed work may require testing and retesting, at any time during progress of work. Allow free access to material stockpiles and facilities. Retesting of rejected materials and installed work will be Contractor's responsibility.
- F. Installer qualifications: Not less than ten (10) successfully completed contracts of similar size, complexity and subsurface conditions.

1.6 SUBMITTALS

- A. Evidence of Installer's qualifications.
- B. Reinforcement placing drawings.
- C. Description of the pile drilling and pumping equipment to be utilized.
- D. A pile layout plan referenced to the structural drawing, including a numbering system for each pile.
- E. Proposed Grout Design Mix and Mix Design Test Reports: Reports shall be in sufficient detail to indicate compliance with the specification.
- F. Procedure for installation and load testing of test piles, including sizes of primary members, data on testing equipment, and gage calibration. Test setup must be reviewed by a structural Engineer licensed in the state of Michigan for safety.
- G. Test Pile Load Test Reports, including results for soil probes.
- H. Report for each auger-cast pile, recording actual elevation at bottom and top, unusual conditions encountered (if any), final centerline location at top, variation from plumb, pumping pressures, and volume of grout placed.

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- I. Satisfactory proof of compliance with auger-cast pile installer qualification requirements as described in Article 1.5, "Quality Assurance."
- J. Record documents (boring log), including
 - 1. Date, weather and time of all pile installations
 - 2. Sizes, depths, and locations of all piles
 - 3. Sequence of placing
 - 4. Bottom and top of piling elevations

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS

- A. Cement: ASTM C150, Type I Portland Cement
- B. Fine aggregate: Sand, meeting the requirements of ASTM C33.
- C. Mineral filler: Cementitious and/or pozzolanic properties, conforming to ASTM C-618.
- D. Pozzolanic admixtures, ASTM C-618, Class C, to improve pumpability and ultimate strength.
- E. Fluidifier: Possessing characteristics which will increase the fluidity of the mixture, reduce bleeding, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength cement grout.
- F. Water: Fresh, clean, and free from oil, acid, sewage, alkali, salts, or organic matter.
- G. Reinforcing steel: Deformed bars in accordance with ASTM A615.
- H. Sheet metal casing: Galvanized, corrugated steel drain pipe.

2.4 GROUT MIX

- A. The grout mix shall consist of a mixture of cement, fluidifier, sand, and water proportioned and mixed so as to provide a grout capable of maintaining the solids in suspension without appreciable water gain, yet which may be placed without difficulty, and which will laterally penetrate and fill any voids in the foundation material. Mineral filler may be added to the above mix in lieu of a small percentage of the cement.
- B. The grout mix shall have a 28-day compressive strength of no less than 4500 psi, or as indicated on the drawings.
- C. Proportion mixes by either laboratory trial batch or field experience. Grout shall consist of Portland cement, sand, water; and approved admixtures. Grout shall be proportioned to produce a grout capable of maintaining the solids in suspension and able to be pumped without difficulty.
- D. Submit written reports to the Owner's Representative of proposed mix for grout at least 15 days prior to start of work. Do not begin grout production until mix design has been reviewed by Owner's Representative.
- E. Adjustment to Grout Mixes: Mix design adjustments may be requested by Contractor when characteristics of material, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Owner's

Representative. Laboratory test data for revised mix design and strength results must be accepted by Owner's Representative before using in work.

- F. Use water-reducing/fluidifier admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion may be used at Contractor's option.
- G. All materials shall be accurately measured by volume or weight as they are fed to the mixer. Time of mixing shall be not less than one minute at the site. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2-1/2 hours at grout temperatures below 70 degrees F and for a period not exceeding 2 hours at higher temperatures, not exceeding 100 degrees F. Grout shall not be placed when its temperature exceeds 100 degrees.

2.5 GROUT MIX TESTING

- A. Use Independent testing facility for preparing and reporting proposed mix designs.
- B. Four (4) specimens of 2 inch cubes or 3" x 6" cylinders or 6" x 12" cylinders, shall be obtained each morning and two (2) specimens obtained each afternoon during which piles are installed. Testing specimens shall be made and tested in accordance with applicable portions of ASTM C109, with the exception that the grout should be restrained from expansion by a top plate.
- C. Two of the specimens shall be tested after seven days, two will be tested after 28 days, and two will be held in reserve, for each pile.
- D. The Contractor shall submit all test specimens to the engineering testing laboratory selected by the Engineer and Owner. Test reports shall be submitted by the laboratory directly to the Engineer and Owner.

2.6 AUGERING EQUIPMENT

- A. The hole through which the grout is pumped during the placement of the pile shall be located at the bottom of the auger head below the bar containing the cutting teeth.
- B. The auger flight shall be continuous from the auger head to the top of the auger with no gaps or other breaks. The pitch of the auger flighting shall not exceed nine inches.
- C. The piling leads shall be prevented from rotation by a stabilizing arm.
- D. Augers over 40 feet in length shall contain a middle guard.

2.7 GROUT PUMPING EQUIPMENT

- A. Use a positive displacement piston-type capable of developing displacing pressure at the pump of 350 psi. Mount an "in-line" pressure gauge on the leads where the grout can be monitored to insure continuous flow.
- B. If ready-mix grout is used, use an agitating storage tank of sufficient size between the ready-mix truck and the grout pump to insure a homogeneous mix and continuity in the pumping operation.

PART 3- EXECUTION

3.1 PREPARATION

- A. Verify that field conditions are acceptable and are ready to receive work. Notify Owner's Representative in writing of conditions detrimental to proper and timely execution of work. Do not proceed with work until unsatisfactory conditions have been mitigated.
- B. Do not install piles until excavation in area is complete to a level 6 to 12 inches above pile cap bottom. Final excavation for pile caps will be accomplished after pile installation is complete.

- C. Stake locations of all piles using bench marks and references provided by Owner's Representative.
- D. Beginning of installation means installer accepts existing conditions.

3.2 GENERAL REQUIREMENTS

- A. Remove obstructions encountered within top 15 feet of pile length and fill excavations with compacted granular fill. Compact such fill per the requirements of the Owner's Representative or Geotechnical Engineer.
- B. Terminate pile tips at elevations indicated on the drawings. Site conditions may require a greater depth than listed on the design documents.
- C. Do not allow auger holes to stand overnight without grouting.
- D. Piles shall not be installed closer than 5 diameters center-to-center to an existing pile until the grout has set at least 12 hours.

3.3 PILING INSTALLATION

- A. Piles shall be installed by rotating a continuous flight, hollow-shaft auger into the ground to the required minimum depth below established grade as marked on the drawings, or to a greater depth as required to achieve penetration of 12 feet into granular materials having a minimum N-value of 25 blows per foot, as verified by a geotechnical testing agency.
- B. During drilling, the number of revolutions per auger pitch shall be restricted to the range of 1.5 to 2.0.
- C. The auger shall be maintained in a plumb position throughout the pile installation.
- D. When the auger reaches final depth, withdraw the auger 6 to 12 inches while still rotating. Insert grout and raise the pressure until the stopper is blown out of the hollow stem.
- E. Rotate the auger clockwise during the grouting operation, at least until the grout is observed flowing out the top of the drilled pile.
- F. Inject a volume of grout with sufficient pressure, as the auger is withdrawn, to fill the hole, prevent wall collapse, and cause lateral penetration of the grout into soft or porous zones of the surrounding soil.
- G. Inject sufficient grout to insure a continuous column of grout no less than the diameter(s) specified.
- H. Maintain a head of at least five feet of grout above the injection point in the hole around the auger at all times during the raising of the auger.
- I. Do not reverse the direction of auger rotation.
- J. Protect the top of hole to prevent soil from being dislodged and other loose material from falling into the hole and contaminating the grout. Redrill contaminated piles and regrout before the initial grout has had time to set.
- K. During the grouting process, if any interruption occurs in withdrawing the auger or pumping the grout, the pile shall be reaugered to a minimum depth of five feet from the point of interruption and the grouting process continued.

3.4 MIXING AND PLACING CEMENT GROUT

- A. Only approved pumping, continuous mixing, and agitating equipment shall be used in the preparation of the grout.
- B. All oil or other rust inhibitors shall be removed from mixing drums and grout pumps.
- C. Grout materials shall produce a homogeneous mixture of the desired consistency.

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- D. During any lapse in the operation, grout shall be recirculated through the pump.
- E. The minimum volume of grout placed in the hole shall be at least equal to the volume of the augered hole, plus 10 percent, unless the Engineer determines that the grout volume may be less.

3.5 REINFORCING STEEL

- A. Reinforcing steel shall be furnished and accurately installed as shown on the drawings.
- B. Reinforcing steel shall have at least 3 inches minimum cover, unless noted otherwise on the drawings.
- C. Use only one-piece longitudinal reinforcing with no splices.
- D. Multiple piles in close proximity to each other will require the vertical bars to remain straight to allow work access. Vertical bars will require field bending after installation.

3.6 TOLERANCES

- A. The location of the pile shall be within plus or minus 3 inches from the location shown on the drawings.
- B. The pile shall be vertical to within 2% [1 in 48] of plumb.
- C. The maximum variation from top of pile elevation: plus 2 inches

3.7 OBSTRUCTIONS

- A. If any obstruction is encountered which results in refusal of the auger, preventing augering of the pile hole to the depth required, or causes the hole to drift from the required location, the drilling shaft shall be stopped and the Owner's Representative notified.
- B. Refusal shall be defined as the depth where the rate of penetration of the standard augering equipment is one foot per minute or less.

3.8 PILE CAPS

- A. Where the pile cut-off is near the surface or above the bottom of the pile cap excavation, metal sleeves, or casing of the proper diameter and at least 12 inches in length shall be placed around the pile tops.
- B. If subsidence of the fresh grout at the pile top occurs while the grout is in a fluid state, the pile shall be immediately "topped-up" with fresh grout to the proper cut-off elevation. If the grout level drops to an elevation where the grout cannot be seen, the pile should be reaugered and regrouted. Tops of piles which subside more than 6 inches over night should be evaluated on an individual basis.

3.9 PILE TESTING PROGRAM

- A. General: Conduct pile test program to verify necessary pile tip elevations and pile load-bearing and uplift capacities.
- B. Develop Pile Test Program Procedure in accordance with the recommendations of geotechnical report; submit for review and approval by the geotechnical engineer.
- C. Test program requirements are summarized as follows
 - 1. Minimum of 3 test piles at predetermined locations to verify allowable compressive load and 2 test piles to verify allowable uplift load.
 - 2. At least 4 reaction piles per test pile.
 - 3. Precede pile installation with drilling of soil probe to verify location of bearing medium.

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4. All piles installed in accordance with material, placement, and quality control requirements specified for production piles.
 5. Load-test in accordance with ASTM D1143 for bearing loads, ASTM D3689 for tension loads and ASTM D3966 for lateral loads.
 6. Test piles to failure, one-half (1/2) critical buckling load, or 3 times design load, whichever is less.
 7. After completion of tests, reload test pile to failure or 3 times the design load. Test piles shall not be used as production piles.
- D. Depths of piles as shown on drawings are estimated from available soil data by the geotechnical engineer. Actual elevations, auger-cast pile lengths, bearing, and uplift capacities will be determined by the geotechnical engineer from conditions found in pile test. Final evaluations and acceptance of data will be determined by the ENGINEER

3.10 CORRECTIONS

- A. Modify or replace damaged, mislocated or otherwise substandard piles as directed by the Geotechnical Engineer and Owner's Representative at no cost to Owner.
- B. Required corrections may include modifications of pile caps to utilize substandard piles.

END OF SECTION

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HELICAL PIERS

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Materials, labor, tools, equipment, and other required service needed to install helical piers.
- B. Testing and inspection of materials used in helical pier.

1.2 RELATED SECTIONS

1.3 REFERENCES

- A. ASTM A29 - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished
- B. ASTM A36 - Standard Specification for Carbon Structural Steel
- C. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- D. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- E. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High-Temperature or High Pressure Service and Other Special Purpose Applications
- F. ASTM A252 - Standard Specification for Welded and Seamless Steel Pipe Piles
- G. ASTM A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
- H. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- I. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- J. ASTM A618 - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
- K. ASTM A656 - Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability

1.4 PROJECT SITE CONDITIONS

- A. The Contractor shall protect all active underground and overhead utilities and structures in the area. The Owner shall identify all known utilities, underground structures, and the condition of the subsurface soils.
- B. The Contractor shall review all subsurface investigation data presented. This information is made available to the Contractor for his convenience and shall be used solely at the Contractor's responsibility.
- C. The Contractor may perform additional test borings and other subsurface investigation operations at no cost to Owner. Additional investigation shall not damage adjacent buildings or impact the construction schedule.
- D. If subsurface conditions are found to be significantly different than indicated in the contract documents, the Contractor must immediately notify the Owner's Representative. Increases or decreases in the bid contract price will be negotiated.

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- E. The Engineer will identify nearby structures that may be distressed during pier installation. The Contractor will monitor these structures for possible movement and will halt work immediately if problems develop.

1.5 QUALITY ASSURANCE

- A. Inspection: inspection and testing of pier installation will be performed by Owner's Representative and/or a Geotechnical Engineer employed by the Owner. Items monitored include:
 - 1. Method of pier installation formation
 - 2. Installation Torque
- B. Installer qualifications: Not less than three (3) successfully completed contracts of similar size, complexity and subsurface conditions.

1.6 SUBMITTALS

- A. Evidence of Installer's qualifications.
- B. Product Data: Submit manufacturer's product data and installation instructions.
- C. Shop Drawings: Provide drawings indicating profiles and product components and accessories and indicate the following:
 - 1. Helical pier number, location and pattern by assigned identification number.
 - 2. Helical pier design load.
 - 3. Type and size of central steel shaft.
 - 4. Helix configuration (number and diameter of helix plates).
 - 5. Minimum effective installation torque.
 - 6. Helical pier attachment to structure relative to grade beam, column pad, pile cap, etc.
- D. Installation Records: Provide the Owner copies of helical pier installation records within 24 hours after each installation is completed. Include, at a minimum, the following information.
 - 1. Name of project and Contractor.
 - 2. Date and time of installation.
 - 3. Type of torque indicator used.
 - 4. Location of helical pier by assigned identification number.
 - 5. Actual helical pier type and configuration - including lead section (number and size of helix plates), number and type of extension sections (manufacturer's SKU numbers).
 - 6. Total length of installed helical pier.
 - 7. Cutoff elevation.
 - 8. Inclination of helical pier.
 - 9. Comments pertaining to interruptions, obstructions or other relevant information.
 - 10. Rated load capacities.

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PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS

All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS

- A. Helical piers and all associated hardware; including steel shafts, bearing plates, bolts, couplings and pier caps, shall be manufactured by Pier Tech Systems or approved equal.
 - 1. Design helical piers to meet the specified loads and acceptance criteria as shown on the drawings.
- B. All helical piers shall be protected from corrosion by:
 - 1. Shop application of hot dipped galvanization in accordance with ASTM A153.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that field conditions are acceptable and are ready to receive work. Notify Owner's Representative in writing of conditions detrimental to proper and timely execution of work. Do not proceed with work until unsatisfactory conditions have been mitigated.
- B. Do not install piers until excavation in area is complete to a level 6 to 12 inches above pile cap bottom. Final excavation for pile caps will be accomplished after pier installation is complete.
- C. Stake locations of all piers using bench marks and references provided by Owner's Representative.
- D. Beginning of installation means installer accepts existing conditions.

3.2 GENERAL REQUIREMENTS

- A. Terminate pier tips at elevations indicated on the drawings. Site conditions may require a greater depth than listed on the design documents.

3.3 PIER INSTALLATION

- A. The helical pier installation technique shall be consistent with the geotechnical, logistical, environmental and load carrying conditions of the project.
- B. Installation equipment shall be rotary type, hydraulic power driven torque motor with clockwise and counterclockwise rotation capabilities.
 - 1. Utilize a torque motor capable of continuous adjustment to number of revolutions per minute (RPM) during installation and with a torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed. Do not use percussion drilling equipment.
 - 2. Utilize equipment capable of applying adequate downward pressure and torque simultaneously to suit project soil conditions and load requirements, and capable of continuous position adjustment to maintain proper helical pier alignment.
 - 3. A calibrated torque indicator shall be used during helical pier installation. The torque indicator may be an integral part of the installation equipment or externally mounted in-line with the installation tooling.

C. Central Steel Shaft Installation Procedure:

1. Engage and advance helical pier into soil in a smooth, continuous manner. Provide extension sections to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt and nut.
2. Apply sufficient down pressure to uniformly advance the helical pier sections approximately 3 inches per revolution. Adjust rate of rotation and magnitude of down pressure for different soil conditions and depths.

D. Termination Criteria:

1. Satisfy the minimum installation torque and minimum overall length criteria as shown on the working drawings prior to terminating the helical pier installation.
2. The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.
3. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the installer shall have the following options:
 - a. Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:
 - b. Remove the existing helical pier and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If reinstalling in the same location, the topmost helix of the new helical pier shall be terminated at least 3 feet beyond the terminating depth of the original helical pier.
4. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:
 - a. Install the helical pier deeper using additional extension sections.
 - b. Remove the existing helical pier and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If reinstalling in the same location, the topmost helix of the new helical pier shall be terminated at least 3 feet beyond the terminating depth of the original helical pier.
 - c. De-rate the load capacity of the helical pier and install additional helical pier(s). The de-rated capacity and additional helical pier location shall be subject to the review and acceptance by the Owner.
5. If the helical pier is refused or deflected by a subsurface obstruction, terminate the installation and remove the pile. Remove the obstruction, if feasible, and reinstall the helical pier. If it is not feasible to remove the obstruction, install the helical pier at an adjacent location, subject to review and acceptance by the Owner.
6. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may remove the last plain

extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut the extension shaft to the correct elevation. Do not reverse (back-out) the helical screw foundation to facilitate extension removal.

7. The average torque for the last 3 feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last 3 readings recorded at 1 foot intervals.

E. Site Tolerances: Install helical piers to the following allowable variation:

1. Centerline of piling shall not be more than 3 inches from indicated plan location.
2. Pile plumbness shall be within 2 degrees of design alignment.
3. Top elevation of pile shall be within +1 inch to -2 inches of the design vertical elevation.

3.4 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 TOLERANCES

- A. The location of the pier shall be within plus or minus 3 inches [75 millimeters] from the location shown on the drawings.
- B. The pier shall be vertical to within 2% [1 in 48] of plumb.
- C. The maximum variation from top of pier elevation: plus 2 inches [50 millimeters]

3.6 OBSTRUCTIONS

- A. If any obstruction is encountered which results in refusal of the pier, preventing installation of the pier to the depth required or causes the hole to drift from the required location, the installation shall be stopped and the Owner's Representative notified.

3.7 PILE TESTING

- A. Piles shall be installed for the designated design compression load and shall be proved to successfully withstand a doubled test load [i.e., 60 ton piles will meet 120 ton test].

3.8 CORRECTIONS

- A. Modify or replace damaged, mislocated or otherwise substandard piles as directed by the Geotechnical Engineer and Owner's Representative at no cost to Owner.

END OF SECTION

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DRILLED SHAFTS

02380-1

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Materials, labor, tools, equipment, and other required services needed to complete drilled shaft installation. Drilled shafts are "piled" foundations for larger structures extending more than 20 foot vertically below grade and do not include shallow "pole-type" foundations used for pipe support bents, etc.
- B. Testing and inspection of materials used in drilled shafts
- C. Cement grout in drilled shafts
- D. Reinforcing steel in drilled shafts
- E. Drilling slurry

1.2 RELATED SECTIONS

- A. 01300 Submittals
- B. 03300 Cast-in-Place Concrete

1.3 REFERENCES

- A. ASTM A36 – Standard Specification for Carbon Structural Steel
- B. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- C. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel for Concrete Reinforcement.
- D. ASTM C150 – Standard Specification for Portland Cement
- E. ASTM A929 – Standard Specification for Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated steel Pipe.
- F. ASTM A996 – Standard Specification for Rail-Steel and Axel Steel Deformed and Bars for Concrete Reinforcement.
- G. ASTM C33 - Standard Specification for Concrete Aggregates
- H. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
- I. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use in Concrete
- J. AASHTO M36 - Corrugated Metal Culvert Pipe, Metallica Coated, for Sewers and Drains
- K. ACI 336.1 – Specification for the Construction of Drilled Caissons
- L. ASTM A252 –Standard Specification for Welded and Seamless Steel Pipe Piles
- M. ASTM D1143 - Standard Test Methods for Deep Foundations Under Axial Compressive Loads
- N. ASTM D3689 - Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
- O. ASTM D3966 - Standard Test Method for Piles Under Lateral Load
- P. ASTM C 494 – Admixtures of Type Required for Design Mix
- Q. ASTM C989 – Standard Specification for Ground Granulated Blast Furnace for Use in Concrete and Mortars.

- R. ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- S. ACI 211.1-91 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
- T. ACI 301 – Specifications for Structural Concrete
- U. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures
- V. American Welding Society D1.1 – Structural Welding Code
- W. American Welding Society D1.4 - Structural Welding Code –Reinforcing Steel
- X. IBC – International Building Code
- Y. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
- Z. ASTM C94 - Standard Specification for Ready Mix Concrete
- AA. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- BB. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
- CC. ASTM A53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B

1.4 PROJECT SITE CONDITIONS

- A. The Owner shall identify all known utilities, structures, and the condition of the subsurface soils.
- B. The Contractor shall thoroughly review all subsurface investigation data presented. This information is made available to the Contractor for his convenience and shall be used solely at Contractor's responsibility.
- C. The Contractor may perform additional test borings and other subsurface investigation operations at no cost to Owner. Additional investigation shall not damage adjacent buildings or impact the construction schedule.
- D. If subsurface conditions are found to be significantly different than indicated in the contract documents, the Contractor must immediately notify the Owner's Representative. Increases or decreases in the bid contract price will be negotiated.
- E. The Engineer will identify nearby structures that may be distressed during pile construction. The Contractor will monitor these structures for possible movement and will halt work immediately if problems develop.

1.5 QUALIFICATIONS OF DRILLED SHAFT CONTRACTOR

- A. The Contractor performing the work described in this specification shall have installed drilled shafts of both diameter and length similar to those shown on the plans for a minimum of three (3) years prior to the bid date of this project.
- B. At the time of bid, the Contractor shall submit both a list containing at least three (3) projects completed in the last three (3) years on which the Contractor has installed drilled shafts of a diameter and length similar to those shown on the plans, and a signed statement that the Contractor has inspected both the project site and all the subsurface information including any rock or soil samples made available. The list of projects shall contain names and phone numbers of Owner's Representatives who can verify the Contractor's participation on those projects.

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1.6 SUBMITTALS

- A. Survey Work: Engage a qualified Professional Surveyor or Professional Engineer (registered in the State of Michigan) to perform surveys, layouts, and measurements for drilled shafts. Before excavating, lay out each drilled shaft to lines and levels required. Record actual measurements of each drilled shaft's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
 - 1. Record and maintain information pertinent to each drilled shaft and cooperate with Owner's testing and inspecting agency to provide data for required reports.
- B. Record documents: Accurately record the following:
 - 1. Sizes, depths, and locations of all drilled shafts
 - 2. Sequence of placing
 - 3. Bottom and top of piling elevations
 - 4. Deviation from indicated locations
- C. Shop Drawings: Show concrete reinforcement detailing, fabricating, bending, and placing.
- D. If requested for in the pre-bid meetings by the Owner's Representative and the Engineer, no later than two weeks prior to constructing drilled shafts, the Contractor shall submit an installation plan for review. This plan shall provide the following information:
 - 1. Name and experience record of the drilled caisson superintendent in charge of drilled caisson operations for this project.
 - 2. List of proposed equipment to be used including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casing, etc.
 - 3. Details of overall construction sequence.
 - 4. Details of shaft excavation methods.
 - 5. Details of the methods to mix, circulate, and desand slurry.
 - 6. Details of the methods to clean the shaft excavation.
 - 7. Details of reinforcement placement including support and centralization methods.
 - 8. Details of concrete placement and vibration, including proposed operation procedures for free fall, tremie, or pumping methods.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I Portland Cement unless otherwise noted.
 - 1. Fly Ash/Slag
 - 2. Fly Ash Admixture: ASTM C 618, Class C or F
 - 3. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
- B. Fine aggregate: sand, meeting the requirements of ASTM C33.

- C. Coarse aggregate: 100% crushed limestone with a $\frac{3}{4}$ inch maximum size meeting the requirements of ASTM C33.
- D. Water: fresh, clean, and free from oil, acid, sewage, alkali, salts, or organic matter, complying with requirements of ASTM C94.
- E. Admixtures: Certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride. Submit mix designs with admixtures to Owner's Field Representative and Geotechnical Engineer for approval.
 - 1. Water-Reducing Admixture: ASTM C494, Type A.
 - 2. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
 - 3. High-Range, Water-Reducing Admixture: ASTM C494, Type G.
 - 4. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
- F. Reinforcing steel: deformed bars in accordance with ASTM A996, Grade 60.

2.4 CONCRETE MIX

- A. Prepare design mixes according to ACI 211.1, ACI 318 and ACI 301 for each type and strength of concrete determined by either laboratory trial mix or field test data bases. Use a qualified testing agency for preparing and reporting proposed mix designs for laboratory trial mix basis. Unless shown otherwise on the plans, Contractor shall use cement Type 1.
- B. Provide concrete mix design including the following criteria, unless specified otherwise:

<u>Item</u>	<u>Specification</u>
Coarse aggregate size (maximum)	$\frac{3}{4}$ inch
Slump (Dry Placement)	7 (plus or minus 1) inch
Slump (Wet Placement by tremie or pumping)	8 (plus or minus 1) inch
- C. Provide concrete to the following strength criteria: 4500 psi compressive strength (28 day).
- D. Do not add air entraining agent to concrete for caissons.
- E. Use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.
- F. Use set retarding admixtures during hot weather only when approved by the Engineer.
- G. Do not use calcium chloride.
- H. Limit water-soluble, chloride ion content in hardened concrete to 0.15-0.3% by weight of cement.
- I. Concrete mix design adjustments may be considered if characteristics of materials, project conditions, weather, test results, or other circumstances warrant. Resubmission and approval of proposed changes to concrete-mix proportions is the responsibility of the Contractor.
- J. Ready-Mixed Concrete: Comply with requirements and with ASTM C94. Do not add water after mixing.
 - 1. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

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2.5 CONCRETE MIX TESTING

- A. Two sets of two 2 inch cubes or 3 x 6 inch cylinders or 6 x 12 inch cylinders shall be tested each morning and two sets for each afternoon during which drilled shafts are installed. Testing specimens shall be made and tested in accordance with applicable portions of ASTM C109, with the exception that the grout should be restrained from expansion by a top plate.
- B. Two of the specimens shall be tested after seven days, two will be tested after 28 days, and two will be held in reserve.
- C. The Contractor shall submit all test specimens to the engineering testing laboratory selected by the Engineer and Owner. Test reports shall be submitted by the laboratory directly to the Engineer and Owner.

2.6 CASINGS (SHAFT LINER)

- A. Casing: Use permanent steel casings only where shown on plans, or with written authorization from the Engineer. Permanent steel casings shall conform to ASTM A252, Grade 2 and the following minimum wall thicknesses:
 - 1. For casing diameter less than or equal to 48" – 3/8" Minimum Wall Thickness
 - 2. For casing diameter greater than 48" and less than or equal to 78" – 1/2" Minimum Wall Thickness
 - 3. For casing diameter greater than 78" – 5/8" Minimum Wall Thickness
- B. Casings shall be steel, smooth, clean, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of both concrete and the surrounding earth materials.
- C. Steel Pipe Casings shall meet ASTM A 283, Grade C; ASTM A 36, carbon-steel plate, or ASTM A 929 steel sheet, zinc coated corrugated steel with joints full-penetration welded according to AWS D1.1.

2.7 SLURRY

- A. Only mineral slurries shall be employed when slurry is used in the drilling process, unless other drilling fluids are approved in writing by the Engineer.
- B. The slurry shall have both a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement.
- C. The slurry shall be premixed thoroughly with clean, fresh water and adequate time (as prescribed by the mineral manufacturer) allotted for hydration prior to introduction into the shaft excavation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Notify the Owner's Representative five days before proceeding with the work.
- B. Excavation of pile cap or grade wall to working elevations shall be completed before shaft construction begins.

- C. The Contractor shall control his operations to prevent damage to existing structures, equipment, and piping. Preventive measures shall include, but are not limited to, selecting construction methods which will prevent caving of the shaft excavation, monitoring, and controlling the vibrations from construction activities such as the driving of casing or sheeting, drilling of the shaft, or from blasting, if permitted.
- D. The Contractor shall perform the excavations required for shafts, and bells if required, through whatever materials are encountered, to the dimensions and elevations shown in the plans or otherwise required by the specifications and special provisions.
- E. The Contractor's methods and equipment shall be suitable for the intended purpose and materials encountered.
- F. The permanent casing method shall be used only at locations shown on the plans or when authorized by the Engineer.
- G. The Contractor shall keep a construction method log during the shaft excavation. The log shall contain information such as: the description and approximate top and bottom elevation of each soil and/or rock material, seepage or groundwater, and remarks.
- H. The Contractor shall not permit workmen to enter the shaft excavation for any reason unless: both a suitable casing has been installed and the water level has been lowered and stabilized below the level to be occupied. Adequate safety equipment and procedures will be provided by the Contractor to workmen entering the excavation.

3.3 INSTALLATION (DRY METHOD, OPEN-HOLE METHOD)

- A. Drill vertical pier shafts, belled bases, shear rings, and rock sockets to diameters and depths indicated.
- B. Clean shaft and bottom of loose material. Maintain shafts free of water.
- C. Allow inspection of shaft prior to placement of reinforcement and concrete.
- D. Place reinforcing steel in accordance with the following sections.
- E. Place concrete in single pour with equipment designed for vertical placement of concrete.
- F. Extend reinforcement or provide dowels for connection of pile caps or grade beams.
- G. Set tops of piles to elevations indicated.

3.4 INSTALLATION (TREMIE METHOD, CASING/SLURRY METHOD COMBINATION)

- A. Drill vertical pier shafts to diameters and depths indicated.
- B. Use mineral slurry to maintain stability of the hole perimeter while advancing the excavation. Place steel liners immediately after drilling. Set firmly in place. Use shaft liner if free water is encountered.
- C. Place steel liners in advance of drilling by either twisting, driving, or vibration. Remove material inside of liner after liner is securely in place.
- D. Clean shaft and bottom of loose material. Maintain shafts free of water.
- E. Allow inspection of shaft and liner prior to placement of reinforcement and concrete.
- F. Place reinforcing steel in accordance with the following sections.
- G. Place concrete in single pour with equipment designed for vertical placement of concrete.
- H. Progressively raise shaft liner during concrete placement. Do not permit top of pier to deform to a mushroom shape due to premature removal of liner.
- I. Extend reinforcement or provide dowels for connection of pile caps or grade beams.

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- J. Set tops of piles to elevations indicated.

3.5 REINFORCING STEEL

- A. Reinforcing steel shall be furnished and accurately installed as shown on the drawings.
- B. The clear spacing between bars in the rebar cage should be at least five (5) times the size of the maximum coarse aggregate.
- C. Reinforcing steel shall have at least 3 inch minimum cover.
- D. Hooks at the top of the rebar cage should not be bent outward if a temporary casing is used.
- E. Where clearance is a problem, hooks may be placed on dowels which may be rotated after concrete placement or casing removal and repositioned after the tremie is removed. The concrete must remain fluid during dowel repositioning.

3.6 CONCRETE PLACEMENT

- A. Concrete shall be placed as soon as possible after reinforcing steel placement.
- B. Concrete placement shall be continuous from the bottom to the top elevation of the shaft, and shall continue after the shaft excavation is full until good quality concrete is evident at the top of the shaft.
- C. Concrete shall be placed either by free fall or through a tremie or concrete pump.
- D. Free fall placement shall only be permitted in dry holes. The maximum height of free fall placement shall not exceed 15 feet. Concrete placed by free fall shall fall directly to the base without contacting either the rebar cage or hole sidewall. Drop chutes may be used to direct concrete to the base during free fall placement.
- E. Tremies may be used in either wet or dry holes, and shall consist of a tube of sufficient length, weight and diameter to discharge concrete at the shaft base elevation. The tremie inside diameter shall be at least 5 times the maximum aggregate size but less than 10 inches. The tremie used for wet excavation placement shall be watertight.
- F. Concrete pumps and lines may be used for concrete placement in either wet or dry excavations. All pump lines shall have a minimum 4 inch diameter and be constructed with watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.
- G. The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed 2 hours. The Contractor may request a longer placement time provided he supplies a concrete mix that will maintain a slump of 4 inches or greater over the placement time as demonstrated by trial mix and slump loss tests.
- H. When approved, admixtures such as water reducers, plasticizers, and retarders, shall be adjusted for the conditions encountered on the job so that the concrete remains in a workable plastic state.

3.7 TOLERANCES

- A. The location of the drilled caisson shall be within plus or minus 3 inches from the location shown on the drawings.
- B. The vertical alignment of the drilled caisson shall not vary by more than 1/4 inch per foot of depth.
- C. The alignment of a battered drilled caisson shall not vary by more than 1/2 inch per foot of depth from the prescribed batter.

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- D. After all the concrete is placed, the top of the reinforcing steel cage shall be no more than 4 inches above and no more than 2 inches below plan position.
- E. All casing diameters shown on the plans refer to outside diameter dimensions. The dimensions of casings are subject to American Pipe Institute tolerances applicable to regular steel pipe. When approved, the Contractor may elect to provide a casing larger in diameter than shown in the plans.
- F. Bells shall be excavated to the bearing area and height shown on the drawings as a minimum. The actual diameter of the bells shall not exceed 3 times the specified shaft diameter.
- G. The top elevation of the shaft shall have a tolerance of plus 1 inch or minus 3 inches.
- H. Excavation equipment and methods shall be designed so that the completed shaft excavation will have a planar bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of plus or minus 3/8 inch per foot of diameter.

3.8 OBSTRUCTIONS

- A. Surface and subsurface obstructions at drilled shaft locations shall be removed by the Contractor. Such obstructions may include manmade materials such as old concrete foundations and natural materials such as boulders.
- B. Special procedures or tools shall be employed, including but not limited to: chisels, boulder breakers, core barrels, air tools, hand excavation, temporary casing, and increasing the hole diameter.
- C. Blasting shall not be permitted unless specifically approved in writing by the Engineer.

3.9 PILE TESTING

- A. The Contractor shall furnish, install and test drilled shafts at the locations shown on the plans.
- B. The Contractor shall perform compression load tests, tension load tests, and lateral load tests as required to determine whether or not the allowable loads can be achieved under field conditions. Except for shafts required for testing, additional shaft construction will not be permitted until the load tests are completed.
- C. Contractor shall provide all equipment and apparatus as required to conduct the tests.
- D. The Contractor shall install, remove, relocate and reinstall weights and components as necessary to perform and complete the tests.
- E. Tests can be conducted as soon as practicable after the concrete in each test drilled shaft has attained the specified 28-day compressive strength, but not until at least 10 days have elapsed after placing concrete.
- F. Compression Load Tests
 - 1. Tests shall be performed in accordance with ASTM D1143. Method of load test shall follow "Quick Load Test Method for Individual Piles" as specified in ASTM D1143, Section 5.6. The maximum test load shall be at least twice the designated design load. Apply the load in increments equal to 10% of the maximum test load, with a constant time interval between increments of 5 minutes. Maintain the maximum test load for not less than 15 minutes, unless the shaft has failed as determined by the Engineer. Remove the test load in increments equal to 25% of the maximum test load, with a constant time interval between increments of 5 minutes.

G. Tension Load Tests

1. Tests shall be performed in accordance with ASTM D3689. Method of load test shall follow "Quick Load Test Method for Individual Piles" as specified in ASTM D3689, Section 7.7. The maximum test load shall be at least twice the design load as prescribed by the Engineer. Load application shall be the same as Compression Load Tests above.

H. Lateral Load Tests

1. Tests shall be performed in accordance with ASTM D3966. Method of load test shall follow "Standard Loading Procedures" as specified in ASTM D3966, Section 6.1.

- I. A qualified representative of the testing laboratory shall witness the testing and determine the capacity of the pile based on the testing results.

END OF SECTION

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HOT MIX ASPHALT PAVING

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PART 1 - GENERAL**1.1 SCOPE**

- A. This section includes hot mix asphalt (HMA) paving complete with asphalt materials; HMA mixtures; installation of HMA base course; HMA wearing course; and construction of HMA pavement.

1.2 RELATED SECTIONS

- A. Section 02200 – Site Grading
- B. Section 02224 - Excavating, Trenching, and Backfilling

1.3 REFERENCE STANDARDS

- A. ASTM – American Society of Testing and Materials
- B. ASSHTO – American Association of State Highway and Transportation officials.
- C. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.4 ALLOWABLE TOLERANCE

- A. Following the final rolling, the surface will be tested longitudinally using a 10-foot (3 m) straight edge at locations selected by ENGINEER. Variation of the surface from the testing edge of the straightedge between any two (2) contacts with the surface shall at no point exceed the following limits:
 - 1. For HMA Base Course Mixtures:
 - a. Multiple Courses:
 - i. 3/8 inch (9 mm) for top course
 - ii. 3/4 inch (20 mm) for lower courses
 - 2. For HMA Surface Course Mixtures:
 - a. Multiple Courses:
 - i. 1/8 inch (3 mm) for top course
 - ii. 1/4 inch (5 mm) for lower courses
 - b. Single Course: 1/4 inch (5 mm)
- B. Deviations greater than the specified tolerances shall be corrected by methods best suited for the purpose. Pavement that cannot be corrected to comply with the specified tolerances shall be removed and replaced at the Contractor's expense.

1.5 MATERIAL REPORTS

- A. CONTRACTOR shall supply ENGINEER with a certified job mix design for each type of HMA mixture specified for use on this project.
- B. The HMA mixture shall be composed of a combination of aggregate (course, fine, or mixtures thereof), mineral filler if required, anti-strip additive if required, and asphalt material. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture will meet the grading and physical properties of the approved Job Mix Formula.

1.6 EQUIPMENT

- A. The Contractor shall furnish sufficient equipment for completing the Work in a timely and efficient manner. The equipment shall be on the jobsite and ready for normal operation before placing the material. All equipment necessary for the satisfactory performance of

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this construction shall be on the project and approved before Work will be permitted to begin. All equipment shall be in good working order and subject to inspections and testing during construction. The equipment shall be of sufficient capacity that the operation can be continuous and a rate of production obtained, which insures good workmanship and eliminates overloading the equipment or frequent interruptions or delays.

- B. Equipment shall conform to the requirements as specified in MDOT, Section 501 and as specified herein.

1.7 SUBMITTALS

- A. The Contractor shall provide the Owner's Representative with certification that the various materials conform to the most recent ASTM Standards referred to in the Specifications.
- B. The Contractor shall provide the Owner's Representative with the certified batch plant delivery tickets prior to placing of the materials.
- C. The Contractor shall provide the Owner's Representative with the certified Job Mix Formula and Laboratory Design, where applicable.

PART 2 – PRODUCTS

2.1 ASPHALT MIXES

- A. Asphalt Paving Mixtures shall be design in accordance with Michigan Department of Transportation Standard Specifications and this specification
- B. Mixes shall be as follows unless otherwise specified in the plans
 - 1. Roadway Asphalt Paving Mixtures: Superpave type
 - a. Leveling Course: 4E3
 - b. Wearing Course 5E3
 - 2. Repair Asphalt Paving Mixtures: Superpave type or Marshall type
 - a. Leveling and Wearing Course: Low Volume Superpave (LVSP) or 13A

2.2 AGGREGATE MATERIALS

- A. The blended aggregate shall conform to ASTM D692, D1073; AASHTO M29, and as specified in MDOT, Sections 501 and 902 for superpave mixtures. Aggregates for Marshall Mixtures shall conform to the applicable requirements of Table A: Composition of Mixtures and Table B: Mix Design Criteria.

2.3 MINERAL FILLER

- A. The mineral filler gradation shall conform to AASHTO M17 and to mineral filler, 3MF, as specified in MDOT, Section 902.11.

2.4 ANTI-FOAMING AGENTS

- A. The anti foaming agents shall conform to anti foaming agents, as specified in MDOT, Section 904.

2.5 ASPHALT BINDER

- A. Asphalt binder for use in production of HMA mixtures shall be Performance Graded Asphalt Binder, PG 70-28P (High Stress Application), per MDOT Section 904, unless otherwise indicated on the Plans.

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2.6 LIQUID ASPHALTS

- A. Liquid asphalts for use in pavement construction shall conform to ASTM D2026, D2027, and D2028, AASHTO M81 and M82, and as specified in MDOT, Section 904.

2.7 EMULSIFIED ASPHALT (BOND COAT)

- A. Emulsified asphalt for use in pavement construction shall conform to ASTM D244, and as specified in MDOT, Section 904.

2.8 COMPOSITION OF MIXTURES

- A. HMA mixtures shall be mixed and placed in accordance with applicable requirements specified in MDOT Section 501, except as otherwise specified in this Section.
- B. Blended aggregate used for the bituminous wearing course on this Project shall have an Aggregate Wear Index (AWI) of 260, or higher.
- C. Aggregates, mineral filler (if required), and asphalt binder shall be combined as necessary to produce a mixture proportioned within the master gradation range limits shown in Table A or MDOT Section 902 and meeting the uniformity tolerance limits shown in Table C.
- D. Composition limits in Table A are shown in percent by weight, based on the total aggregate, including mineral filler, in the mixture.
- E. HMA mixture specified on the Plans or in the Proposal, when tested at optimum asphalt content (determined in accordance with MDOT Procedures Manual for Mix Design Processing), shall meet the requirements for stability, flow, voids in mineral aggregate (VMA), air voids, fines/binder ratio, fine aggregate angularity, L.A. Abrasion loss, and soft particles as specified in Table B, Mix Design Criteria or MDOT Section 902.
- F. Mixtures failing to meet the requirements specified in Table B or MDOT Section 902 will be rejected and the CONTRACTOR will be required to submit additional samples of HMA mixtures until a combination of material is found which will produce a mixture meeting the requirements.
- G. If there is a change in the source of any of the aggregates, a new job-mix formula will be required.
- H. After the job-mix formula is established, the aggregate gradation and the asphalt binder content of the HMA mixture furnished for the Work shall be maintained within the Range 1 uniformity tolerance limits permitted for the job-mix formula as specified in Table C.
 - 1. If two (2) consecutive aggregate gradations on one (1) sieve, or asphalt binder contents as determined by the field extractions are outside the Range 1 but within the Range 2 uniformity tolerance limits, CONTRACTOR shall suspend all operations. (Work days will be charged during the down time.)
 - 2. Before resuming any production, CONTRACTOR shall make all necessary alterations to the materials or plant so that the job-mix formula can be maintained within the deviations permitted under Table C.
- I. CONTRACTOR shall provide uniformity in the gradations of the aggregates placed in the cold feed bins so that the combination of aggregates produced for the mixture by blending the aggregates from two (2) or more cold feed bins will be uniformly fed by means of adjustable feeders onto a belt supplying the asphalt plant.
 - 1. Feeders shall be equipped with cutoffs which will automatically stop the operations to the asphalt plant at any time the flow of any aggregate fraction is changed so as to affect the uniformity of the finished product.

- J. CONTRACTOR has the option of using hot bins for proportioning the aggregates to meet the specified tolerances.
- K. Aggregate gradation tests will be made on aggregate extracted from samples of HMA mixture taken from the trucks as directed by ENGINEER. As a general guideline, samples will be taken at initial start of production and at other times when tests indicate that the aggregate gradation is fluctuating, truck samples will be taken at a frequency of one (1) sample per 250 Tons (225 metric tons) of mixture, but not more than four (4) samples per day. During other periods where tests indicate the aggregate gradation is stable, truck samples will be taken at a frequency of one (1) sample per 500 Tons (450 metric tons) of mixture, but no more than two (2) samples per day.
 - 1. Mixtures exceeding the maximum tolerances listed in Range 2 under Table C, or exceeding the maximum limits specified for the master gradation range will be rejected and CONTRACTOR may be required to remove and replace any bituminous pavements which ENGINEER determines were constructed with mixtures in the excess of these tolerances.
 - 2. Exact mixture proportions will be based on composite samples of aggregate and the particular bituminous material called for on the Plans and in the Proposal.

PART 3- EXECUTION

3.1 EXECUTION

- A. Prior to the installation of any HMA pavement, examine the subgrade for the grades, lines, and levels required to receive the new work. Ascertain that all excavations and compacted subgrades are adequate to receive the HMA pavement to be installed. Correct all defects and deficiencies before proceeding with the work.
- B. HMA mixtures shall not be placed, nor the tack coat applied, when rain is threatening or when moisture on the existing surface would prevent satisfactory bonding.

3.2 PAVERS

- A. The paver shall be an approved self-powered machine capable of spreading and finishing the mixture in a uniform layer at the desired thickness and cross section and ready for compaction. The use of any machine in poor mechanical or worn condition will not be permitted. The paver shall be of such design that the supporting wheels, treads, or other devices ride on the prepared base. The full width of the surface being applied shall be screed by an oscillating or vibrating screed.
- B. The paver at all times shall provide a uniformly finished surface, free from tearing or other blemishes that would require hand work. The screed shall be adjustable to provide for tilting to secure the proper compressive action necessary to provide the desired surface texture.
- C. The paver shall be equipped with a hopper and an automatic material depth control device so that each distributing auger and corresponding feeder shall respond automatically to provide for a constant level of mix ahead of the screed unit to the full width of the lane being paved.
- D. In order to ensure that adequate material shall be fed to the center portion of the lane being paved, reverse pitch augers or paddles shall be installed at the inside of one or both ends of the auger shafts to force the mix to the middle portion of the lane. If necessary to prevent segregation of the mix as it drops off the feed conveyor, baffle plates shall be installed at the required location.

- E. When extensions are added to the paver, they shall be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas. The extensions shall also be equipped with a continuation of the automatically controlled spreading augers. The screed and any extensions shall be provided with an approved method of heat distribution.
- F. Unless specified otherwise, pavers shall be equipped with an automatically controlled and activated screed and strike-off capable of grade reference and transverse slope control. A manufacturer approved grade referencing attachment, not less than 30 feet in length, shall be used for all lower courses and the first lane of the wearing course. After the first lane of the wearing course has been placed, a ten-foot or longer grade referencing attachment may be substituted for constructing subsequent adjacent lanes of wearing course mixture.
- G. Automatic screed controls will not be required on sections of projects where conditions interfere with their proper operation. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be taken from the hopper of the spreading machine and shall be distributed immediately into place by means of suitable shovels and other tools and spread with rakes and lutes in a uniformly loose layer of such depth as will result in a completed course having the required thickness.
- H. Excessive throwing back of the HMA mixture will not be permitted. Automatic screed controls utilizing either the string line, ski type grade reference system, or a non contact averaging system will be required on all work regardless of the paver width. The string line reference system may be required on new construction. In the event the base has been finished with equipment having automatic grade control, or the Contractor demonstrates that an alternate method of spreading and finishing will result in a satisfactory riding surface, the Engineer may conditionally waive the string line requirement and authorize use of the ski type reference system.
- I. Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually for the remainder of the normal working day, provided this method of operation will produce results meeting the specification requirements.
- J. If the paver must be stopped for a significant period of time, a joint shall be constructed and the paver moved from the roadway before the bituminous mixture has cooled sufficiently to prevent proper compaction. If the bituminous mixture is permitted to cool to the extent that the required density cannot be obtained, the mixture shall be removed and replaced at the Contractor's expense.

3.3 ROLLERS AND COMPACTION

- A. Steel wheel rollers shall weigh at least eight tons and shall be self-propelled, vibratory or static, tandem rollers, or shall be self-propelled static three-wheel rollers. Steel wheel rollers shall be free of defects, faulty steering mechanism, or worn king bolts. Rollers shall be in good condition, capable of reversing without backlash and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. Rollers shall be equipped with wheel sprinklers and scrapers. Roller wheels shall be smooth and free from openings or projections which will mark the surface of the pavement.
- B. Vibratory rollers shall have a shutoff to deactivate the vibrators when the roller speed is less than 0.5 mph and shall have provisions to lock in the manufacturer's recommended speed, vibration per minute, and the amplitude of vibration (dynamic force) for the type of bituminous mixture being compacted.
- C. Rollers shall be of sufficient size to compact the HMA mixture to the required density without tearing, displacing, or cracking the mat.

- D. After the HMA mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly compacted. The method employed must be approved by the Owner's Representative and be capable of compacting the mixture to the specified density while it is in a workable condition. When no density requirements are specified, a system of compaction for roadway pavements shall be employed which has previously produced required bituminous pavement densities. A control strip and random density samples may be employed to aid the Owner's Representative in evaluating the system.
- E. Each layer of HMA mixture shall be compacted with approved rollers. At least two (2) rollers will be required when the mixture lay-down rate exceeds 800 square yards per hour.
- F. Unless otherwise directed, rolling shall begin at the low side and proceed longitudinally parallel to the road centerline. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. When paving in echelon, rollers shall not compact within six inches of an edge where an adjacent lane is to be placed.
- G. Rollers shall move in a slow uniform speed with the drive wheels nearer the paver and shall be kept, as nearly as possible, in continuous operation. Rolling shall continue until all roller marks are eliminated.
- H. Rollers shall not park on the HMA pavement.
- I. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. An excess of liquid shall not be used.
- J. Rollers shall not be refueled on the HMA pavements.
- K. The final rolling operation on each layer of HMA mixture shall be accomplished by use of tandem steel-wheel rollers, or by use of vibratory rollers operated in the static mode.
- L. Pneumatic tire rollers will not be permitted on wearing courses.
- M. Skin patching on an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or is in any way defective shall be removed and replaced at the Contractor's expense.

3.4 HEATING HMA MATERIALS

- A. HMA material which requires heating before application shall be heated in such a manner as to insure a uniform temperature throughout the entire mass with efficient and positive control at all times. It shall be heated to a temperature consistent with the type of material used and only to such temperature as will insure the necessary fluidity.
 - 1. Excessively high temperatures shall be avoided.
 - 2. A thermometer shall be provided to enable ENGINEER to observe the temperature at any time.
 - 3. HMA material which has been overheated will be rejected.
- B. Asphalt emulsion shall be circulated continuously when heated above atmospheric temperature so as to prevent it from separating.
 - 1. Heating of asphalt emulsion to the required temperature for application shall be done entirely in the distributor unless a uniform temperature is maintained in the storage tank by means of a circulating heater.
 - 2. Asphalt emulsion which has been damaged by continuous heating for too long a time or by alternate heating and cooling will be rejected.

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3.5 PATCHING

- A. Where patching is required on a HMA surface or concrete surface because of small holes or pitted surface, the holes shall be cleaned of all dirt and foreign material.
- B. The HMA patching material shall be placed, struck off and compacted so that when completed, the patch shall be flush with the adjacent pavement. The compaction may be done with a hand tamper, vibratory compactor or roller.
- C. When patching is required for repairing a cut in the pavement, made for the construction of underground structures and utilities, the granular backfill shall be compacted to not less than 95% of the maximum unit weight. The patch cross section shall match the pavement cross section.
- D. Where existing paved asphalt surfaces meet new pavement, either patches or new paving, the joint shall be sealed with polymer modified asphalt cement conforming to MDOT Standard Specification Section 904 "Asphaltic Materials" and shall be installed per MDOT Standard Specification Section 505 "Over Band Crack Fill"
- E. The surface of the HMA patch shall be smooth and shall not vary more than 1/4 inch (5 mm) from the crown and grade of the adjacent pavement. Variations over 1/4 inch (5 mm) from the established grade shall be corrected as determined by ENGINEER.

3.6 HMA APPROACHES, SIDEWALKS, AND SHOULDERS

- A. This Work shall consist of constructing a HMA surface course as specified on the Plans, or as approved by ENGINEER. HMA surface course shall be placed on a prepared foundation.
- B. HMA materials used shall be as specified on the Plans, or as approved by ENGINEER. Materials acceptable for use are specified in Part 2 of this Section, and as specified in MDOT, Section 904.
- C. HMA approach mixture shall be in accordance with MDOT, Section 501, unless otherwise approved by ENGINEER.
- D. Existing pavement or aggregate base shall be prepared to receive the HMA surface course as specified in this Section.
- E. Bond coat shall meet the requirements specified in this Section. Care shall be taken to prevent spreading of bituminous material on adjoining surfaces.
- F. The HMA mixture shall be placed to the thickness specified on the Plans or as determined by ENGINEER.
- G. Placing the HMA mixture shall conform to this Section.
- H. When approved by ENGINEER, the paver used for placing HMA approaches and sidewalks will not be required to have an automatically controlled or activated screed or strike off assembly or the corresponding grade referencing equipment.

3.7 CLEAN-UP

- A. Areas adjacent to the new Work shall be backfilled with sound earth as required and the surface shall be covered with 6AA aggregate, in accordance with the paving profile specified on the plans or as directed by the Owner's Representative. Compact aggregate and broom off excess material from the pavement surface.

3.8 TESTING

- A. During the course of the Work, ENGINEER may require testing for mix designs, aggregate gradation, and physical properties, asphalt content, compaction or density, and thickness of material. Testing and coring required shall be performed by a testing

laboratory approved by ENGINEER. Cost for testing and coring shall be at the expense of OWNER. The testing laboratory shall furnish ENGINEER with two certified copies of the results of all tests.

- B. Testing procedures shall conform to current MDOT Standards for Construction.
- C. Testing of asphalt binders, liquid asphalts, asphalt emulsions, tars shall conform to MDOT, Section 904.
- D. Rolling shall proceed until the required compaction is attained and the amount of rolling required shall be based on the test results of a nuclear gage or on using a specified minimum number of rollers. When the total tonnage for the Project is in excess of 1,000 Tons (900 metric tons), the nuclear gage method will be used to govern the compactive requirements.
- E. Control density for the HMA mixture to be placed, will be determined using the Gm from the Job Mix Formula.
 - 1. Control Density: During CONTRACTOR's start up operations, a rolling procedure to attain the control density will be established.
 - a. Rolling procedure will be based on the number and type of rollers used and the rolling pattern.
 - b. Goal of the compactive effort will be to establish a rolling procedure which will achieve 100% of the control density but in any case, the density achieved shall not be less than 95% of the control density.
 - c. Density values less than 98% will be sufficient cause for ENGINEER to require an adjustment in the number or type of rollers being used or in the rolling pattern.
 - 2. Once the procedure has been established on the start up section, the procedure shall be used for the remainder of the mixture to be placed, unless subsequent tests indicate a need to change the number of rollers or the rolling pattern.
 - 3. If difficulties are encountered or if there is a significant change in aggregate or bitumen content, ENGINEER will determine the control density for the new mixture and require CONTRACTOR to again establish the number and type of rollers and the rolling pattern required on the new mixture to attain the control density. Compactive procedures thus determined shall be used when placing the remainder of that mixture.
 - 4. Density checks will be made at the discretion of ENGINEER to determine if the compactive procedure being used is achieving the required density, or if a change in procedure is necessary.
 - 5. Each layer of bituminous mixture shall be compacted to at least 95% of the control density, using the established procedure.

TABLE A: COMPOSITION OF MIXTURES

Mixture No.	2C	3C	4C	13A	36A
Binder %	4-6	4.5-7	5-8	5-8	5.5-8
Percent passing sieve					
1-1/2" (37.5 mm)	100				
1" (25 mm)	91-100	100			
3/4" (19 mm)	90 max	91-100	100	100	
1/2" (12.5 mm)	78 max	90 max	91-100	75-95	100
3/8" (9.5 mm)	70 max	77 max	90 max	60-90	92-100
No. 4 (4.75 mm)	52 max	57 max	67 max	45-80	65-90
No. 8 (2.36 mm)	15-40	15-45	15-52	30-65	55-75
No. 16 (1.18 mm)	30 max	33 max	37 max	20-50	
No. 30 (600 um)	22 max	25 max	27 max	15-40	25-45
No. 50 (300 um)	17 max	19 max	20 max	10-25	
No. 100 (150 um)	15 max	15 max	15 max	5-15	
No. 200 (75 um)	3-6	3-6	3-6	3-6	3-10
Crushed Min. %	90	90	90	25	60

TABLE B: MIX DESIGN CRITERIA

Mixture No.	2C	3C	4C	13A	36A
VMA Min. %	11	13	14	14	15
Air Voids % Target (1)	3	4	4	3	3
Fines/Binder Ratio Max. (2)	1.2	1.2	1.2	1.2	1.2
Fine Agg. Angularity Min. (3)	4	4	4	2.5	3
Flow-in. (mm)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)
L.A. Abrasion Max. % loss (4)	40	40	40	40	40
Soft Particle Max. % (5)	12	12	8	8	8
Stability Min. pds (kN)	1200 (5.3)	1200 (5.3)	1200 (5.3)	900 (4.0)	900 (4.0)

Notes:

(1) The JMF target may be adjusted in the field, prior to placement, to meet the project design criteria for a specific application; for example, 2.0 percent air voids on shoulders or bike paths

(2) Fines/Binder Ratio. The ratio of aggregate material finer than the No. 200 (75 um) sieve to asphalt binder content by weight including fines and bituminous contributed by reclaimed asphalt pavement (RAP).

(3) The fine aggregate angularity of blended aggregate, determined by MTM 118, must meet the minimum requirement. In mixtures containing RAP, the required minimum fine aggregate angularity must be met by virgin material.

(4) Los Angeles abrasion loss must be met for the composite mixture; however, each individual aggregate must be less than 50.

(5) The sum of the shale, siltstone, structurally weak, and clay-ironstone particles shall not exceed 8.0 percent for aggregates used in top course. The sum of the shale, siltstone, structurally weak, and clay-ironstone shall not exceed 12 percent for base and leveling courses.

TABLE C: UNIFORMITY TOLERANCE LIMITS FOR HMA MIXTURES

Type of Course	Range (a)	Percentage Passing Designated Sieves				Asphalt Binder Content
		(b)	No. 8 2.35 mm	No. 30 600 μ m	No. 200 75 μ m	
Top and Leveling Course	Range 1	± 5.0	± 5.0	± 4.0	± 1.0	± 0.40
	Range 2	± 8.0	± 8.0	± 6.0	± 2.0	± 0.50
Base Courses	Range 1	± 7.0	± 7.0	± 6.0	± 2.0	± 0.40
	Range 2	± 9.0	± 9.0	± 9.0	± 3.0	± 0.50
(a) This range allows for normal mixture and testing variations. The mixture shall be proportioned to test as closely as possible to the Job Mix Formula.						
(b) This includes all sieve sizes No. 4 (4.75 mm) and larger listed on the Job Mix Formula.						

END OF SECTION

PART 1– GENERAL**1.1 DESCRIPTION**

- A. This section contains guidelines and specifications applicable to the installation of water/sewer pipelines using pipe bursting. It includes minimum requirements for design, materials, equipment and procedures used in the pipe bursting process for trenchless construction of pipelines as identified on the drawings.

1.2 RELATED SECTIONS

- A. Section 02224 Backfilling/Trenching/Excavating
- B. Section 02625 HDPE Pipe for Fire Protection

1.3 QUALIFICATIONS

- A. The contractor shall be trained by the respective manufacturer of the pipe bursting equipment in the use of that machinery. The contractor shall provide certification from the manufacturer that the contractor has been trained and is proficient in the use of the equipment. Only the contractor's employees trained and certified by the manufacturer shall be allowed to operate the equipment during the project.
- B. The contractor must have successfully completed 3,000 feet of pipe bursting which includes one successful static pipe bursting project. Contractor shall submit a list of these projects including the owner, engineer, addresses, phone numbers and dates that said projects were completed with their proposal.

1.4 METHODS

- A. The method approved for rehabilitation of existing water/sewer pipelines by pipe bursting and installation of new HDPE pipe is static pipe bursting. Bursting rods shall be pushed from a pit through the existing pipe to a pipe pit where the bursting appurtenances and pipe are connected and pulled back through the existing pipe.
- B. Static pipe bursting systems shall be characterized by a tapered or blunt nosed pull head being pulled through the host pipe and breaking the host pipe by applying radial pressure to the host pipe. The host pipe fails by 'hoop' tensile stress applied by the head, and is fragmented and pushed into the surrounding bedding and soil as the pull head progresses.
 - 1. The pull head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the HDPE pipe behind it. Under no circumstances shall the pipe pull head, which is attached directly to the HDPE pipe, be used to expand or otherwise increase the diameter of the host pipe, or fragmented host pipe.
 - 2. The pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

1.5 EQUIPMENT

- A. Pipe bursting tool shall be static. The bursting action of the tool shall increase the external dimensions sufficiently, causing breakage of the pipe at the same time expanding the surrounding ground.
- B. The contractor shall provide equipment on the pulling mechanism to verify the pulling force exerted on the pipe does not exceed the manufacturer's recommendation for allowable pulling force to prevent damage to the pipe. Allowable pulling force for all diameters shall be determined by the contractor depending on the pipe size, wall thickness, manufacturer, field conditions, pull distance, bearing capacity of soils, adjacent infrastructure, related equipment and cable strength.

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- C. The unit must maintain automatic thrust and pull back.
- D. Contractor shall provide the means to locate the pipe bursting head at any time during operation.

1.6 SUBMITTALS

- A. Submit manufacturer's specific technical data with information and pipe dimensions pertinent to this job if required by the engineer. A certificate of "Compliance with Specification" or suitable alternative shall be furnished for all materials to be supplied.

PART 2 – PRODUCTS

- 2.1 Pipe shall meet the requirements of the HDPE pipe specified in this project. Fittings shall not be used during the bursting process.
- 2.2 Joint Assembly – Joint Assembly shall be in accordance with the manufacturer's recommended assembly procedure.

PART 3 – EXECUTION

3.1 SAFETY

- A. The contractor shall carry out operations in strict accordance with all applicable OSHA and HSC safety standards. Particular attention is drawn to those safety requirements involving work entry into confined spaces. It shall be the contractor's responsibility to familiarize and its employees with OSHA Standards and regulations pertaining to all aspects of the work.

3.2 INSERTION AND RECEIVING EXCAVATIONS

- A. The anticipated location and number of insertion and receiving excavations are shown on the plans. Any changes shall be submitted in writing for approval by the HSC Construction Representative 10 days (or as determined by the Construction Representative) prior to excavation.
- B. Before any excavation, it will be the responsibility of the contractor to check the design plans and determine the location of existing utilities in the vicinity of the work area that may affect the construction of the new utility. Utilities that interfere with or may be damaged by the burst shall be located and exposed prior to bursting.
- C. Damage to utilities and the resulting repair, temporary service cost, etc., shall be borne by the contractor. Access pits shall be backfilled in accordance with Section 02224.
- D. All excavations shall be properly sheeted/shored in accordance with relevant specifications for trench safety systems. Any damage resulting from improperly shored excavations shall be corrected to the satisfaction of the Engineer with no compensation due to the contractor.
- E. All open excavations shall be kept secure at all times by the use of barricades with appropriate lights and signs, construction tape, covering with steel plates, etc., or as directed by the HSC Construction Representative.
- F. One or more receiving pits shall be excavated at the end(s) of the water/sewer pipe to be replaced or at appropriate points within the length of the existing pipe including but not limited to hydrants, valves, and fittings. Pit shall be centered over the existing pipe.
- G. Pit length shall be such that the minimum bending radius for the HDPE pipe, per the pipe supplier is maintained. Sheeting, shoring and bracing requirements shall be in accordance with HSC specification.

- H. The number of pits for machine and pipe insertion shall be the minimum necessary to most efficiently accomplish the work. The contractor shall give consideration to the use of excavation required for other purposes such as for water/sewer service reconnections, hydrants, valves and manhole replacement.
- I. Where manholes are used as machine or new pipe insertion pits, the contractor shall identify such manholes and replace them at no additional cost to HSC if damaged. Any manhole modification or replacement required shall be considered incidental to the installation of the new pipe.
- J. The cost of diversion pumping around a manhole or insertion pit, if required, from a manhole upstream to a manhole downstream, shall be incidental to the installation of the new pipe.
- K. New pipe shall be handled in accordance with manufacturers specifications. Protect new pipe from damage before and during the pipe bursting operation. Recommended bend radius and pull force shall not be exceeded.
- L. The host pipe shall be inspected by TV prior to bursting operation in accordance with these specifications.
 - 1. TV inspection of the host pipe shall indicate condition of host pipe and suitability of host pipe for HDPE pipe insertion by pipe bursting methods.
 - 2. Obstructions such as corporation taps, valves and valve bodies, previous repairs and collapsed piping shall be remedied prior to bursting and installing new pipe.
 - 3. Spot repairs shall be made in accordance with the drawings and these specifications.
- M. Prior to beginning any pipe bursting work, excavate or pothole to verify in the field the location and elevation of existing active utilities and structures scheduled to remain and requiring protection from damage because of the Work. Existing utilities shall include, but is not limited to, gas mains and services, water mains and services, sanitary sewers and house leads, oil lines, telephone lines and services, cable television lines and services, electric lines and services, and any other similar buried utilities.
- N. Determine amount of "humping" expected due to existing soil conditions and size of pipe burst. Notify the ENGINEER where existing utilities may be adversely affected due to the progress or performance of the Work. CONTRACTOR is responsible for any excavation or potholing necessary to determine the elevation of existing utilities that cross the proposed water main at no additional cost to the Project unless otherwise indicated in the Proposal. Where necessary to relieve transient loading and prevent damage to existing utilities during the bursting operation, existing utilities shall be excavated.
- O. Valves and fittings shall be excavated and removed as necessary to complete the Work. Concrete encasements and thrust blocks shall be excavated and broken out prior to beginning the Work.

END OF SECTION

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UNDERGROUND DUCTILE IRON WATER LINES

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PART 1 - GENERAL

- 1.1 Work Included: Pressurized Ductile Iron Underground services for Fire Water, City Water and Service Water Lines.
- 1.2 REFERENCES
 - A. ANSI/AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water
 - B. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe
 - C. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - D. EMTN Document Number 02.644.001, Underground Services Valve Lockout Procedure
 - E. ANSI/AWWA C110/A21.10 – Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water
 - F. ANSI/AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe Fittings
 - G. ANSI/AWWA C606 – Grooved and Shouldered Joints
 - H. ANSI/AWWA C509 – Resilient-Seated Gate Valves for Water and Sewage Systems
- 1.3 SUBMITTALS
 - A. Underground Ductile Iron Water Lines Test Form 2 pages,

PART 2 – PRODUCTS

- 2.1 OWNER PROVIDED PRODUCTS – NONE
- 2.2 CONTRACTOR PROVIDED PRODUCTS
 - A. All materials, equipment, services, and labor required to perform the work of this section.
- 2.3 WATER LINE PRODUCTS
 - A. Ductile iron grade 60/42/10 pipe 24" and smaller, Tyton® (Clow, U.S.Pipe) push-on joint pipe conforming to ANSI/AWWA C151/A21.51, nominal lengths, cement lining conforming with ANSI/AWWA C104/A21.4 specifications, asphaltic coated outside, wall thickness class 52 to conform to ANSI/AWWA C150/A21.50; Gauge pipe for all field cut pipe lengths; Fire line pipe must be labeled UL/ FM Approved. **
 - B. Ductile iron grade 60/42/10 pipe 4"-36", TR Flex® (U.S.Pipe), or Flex-Ring® (American), unless noted otherwise on the design drawings, conforming to ANSI/AWWA C151/A21.51; nominal lengths, cement lining conforming with ANSI/AWWA C104/A21.4 specifications, asphaltic coated outside, wall thickness Class 52 to conform to ANSI/AWWA C150/A21.50. Fire line pipe must be labeled UL/ FM Approved for 16"/12" respectively.
 - C. Ductile iron grade 60/42/10 pipe 30"-64", HP Lok® (U.S.Pipe), or Flex-Ring® (American) 30"-48" or Lok-Ring® (American) 54"-64", unless noted otherwise on the design drawings, conforming to ANSI/AWWA C151/A21.51; nominal lengths, cement lining conforming with ANSI/AWWA C104/A21.4 specifications, asphaltic coated outside, pressure class 200 to conform to ANSI/AWWA C150/A21.50
 - D. Gaskets: -Restraint joint gaskets for push joint pipe to be Field-Lok 350® gaskets only. Field –Lock gaskets to be FM approved for Tyton® restraint joints per ANSI/AWWA C111/A21.1. **No standard tyton gaskets are to be delivered to job site unless used with TR Flex or HP Lok pipe.
 - 1. Fastite gasket for Flex Ring® restraint joints per ANSI/AWWA C111/A21.1.

2. Tyton gaskets for TR Flex®, HP Lok® restraint joints per ANSI/AWWA C111/A21.1.
- E. Fittings: Trim Tyton 350 psi pressure rated for all fittings up to 24", larger than 24", 250 pressure rated or greater unless noted otherwise on the design drawings, per ANSI/AWWA C110/A21.10, C153/A21.53 and C111/A21.11 with cement lining conforming with ANSI/AWWA C104/A21.4. Fittings must be labeled or have documentation of UL or FM Approval up to 12" diameter.
- F. Fittings: 200 psi pressure rated; 30"-36" TR Flex® (U.S. Pipe), 30"-64", HP Lok® (U.S. Pipe), or 30"-48" Flex-Ring® (American) or 54"-64" Lok-Ring® (American) unless noted otherwise on the design drawings, with cement lining conforming with ANSI/AWWA C104/A21.4.
- G. Hydrants: Mueller Super Centurion model A423 with monitor elbow, with 6 inch Tyton Joint inlet, per AWWA C502. Include the following:
 1. Two 2-1/2 inch NSHT hose connections with caps and chains attached. Provide 2 1/2" gate valves on these connections if indicated on the drawings.
 2. One Kocheck (SZMC5045-3Y) 5 inch Sorz metalface pumper connection (white) with cap and chain attached as indicated on the drawings.
 3. One 4 inch flanged monitor elbow, per ANSI/AWWA C110/A21.10.
 4. 1-1/2 inch Pent operating nut; hydrant opens turning "left", or counter clockwise.
 5. Hydrant must be FM approved for 250 psi working pressure.
 6. Specify depth of bury, also called trench depth, for each hydrant.
 7. Color: Red enamel to match existing hydrants in system.
 8. 316 Stainless steel bolts.
 9. One Mueller operating wrench A310 with each hydrant provided.
 10. Mueller Super Centurion Hydrant 350psi Kit
- H. Monitor and Nozzle as indicated on the drawings:
 1. Monitor: Elkhart Monitor Model 299-11 "Python," with 4" - 150 lb. ASA flange base and 2-1/2 inch (NSHT) male tip. FM approved. Color: Red enamel to match existing hydrants.
 2. Nozzle: Elkhart Nozzle, Model CSW "Select-O-Flow," with shutoff capabilities; 300, 550, and 750 gpm flows; 2-1/2 inch (NSHT); swivel base for mounting on monitors: chrome-plated trim. FM approved.
- I. Valves: NRS resilient wedge gate valve, 250 psi rated working pressure, 2 inch square operating nut, Tyton/Tyton joint for pipe 24" and smaller. For pipe larger than 24", valve joint shall conform to pipe joint. Valve to open turning left, 316 stainless steel exterior bolting and high strength stems. All valves to have indicator plates. Valves to be FM listed. Epoxy coated inside and outside. Accepted valves: American 2500 Series, Mueller A2360-40 or Clow F-6112.
- J. Valve boxes risers: 5-1/4 inch D-Valve box, 3 piece adjustable with WATER cover, extension range as required for each riser, #6 base for valves 10" and smaller and #160 for valves 12" or larger. ASTM A48 class 30B. 5-1/4 inch Cast iron valve box extensions model #58 (12") #59 (to 18") #60 (24") Acceptable manufactures: East Jordan or Star. Include in all risers East Jordan valve box extension risers: Valve Stem extension kits with 1" bars, extend to 12" below cover, with valve position indicators.
- K. Fire Water Valve Indicator Posts: American Flow Control Series A240 for use with gate valves 4"-16" in size. Open left, red enamel in color, UL/FM approved, target plate

OPEN-SHUT, manual lever wrench for each riser with latching/locking provision; suitable for required pipe depth.

- L. Anchor assembly coating; Roskote A-51® or NO-OX-ID "GG-2" per manufacturer's recommended procedures.
- M. Wedge Retainer Glands will be required on any connections to existing piping with MJ fittings. The gland will be made from high strength ductile iron per ASTM A536, Grade 65-45-12 and is compatible with all mechanical joints conforming to ANSI/AWWA C111/A21.11. 3" thru 16" will have a pressure rating of 350 psi with 18" thru 48" having a pressure rating of 250 psi.
- N. Risers at building entrances shall be ductile iron threaded flange pipe per ANSI/AWWA C115/A21 15 class 53 unless noted otherwise on the design drawings.
- O. All new "T" bolts and nuts are to be fabricated of 316 Stainless Steel. Nuts are to be factory coated to prevent galling – coating color RED. Tighten "T" bolts per torque recommendations in AWWA C111 (75-90 ft. lbs. 4"-24" sizes).
- P. All new rod shall be ¾" – 10 Hot Dipped galvanized low carbon steel threaded rod, all new nuts shall be ¾" – 10 Hot Dipped galvanized heavy hex nuts. See Part 3.2.D for coating requirements.
- Q. Where new flanged end valves are installed, all flange bolts and nuts are to be 316SS, ASTM F593, group 2 and gaskets are to be Red Rubber SBR (Styrene Butadiene Rubber)
- R. Polyethylene pipe encasement shall be used on all DI Pipe. Polywrap shall be 8 mills thick meeting the latest revisions of ASTM D-4979 and ANSI/AWWA C105/A21.5
- S. Restrain all mechanical joints with MEGALUG by EBBA Iron series 1100 Mechanical Joint Restraints. Restraints shall be manufactured of ductile iron conforming to ASTM A536 and shall have a pressure rating equal to that of the pipe on which it is used. The restraining glands shall have been tested to ASTM F1674, be listed by Underwriters Laboratories, and be approved by Factory Mutual.

2.4 REPAIR MATERIALS

- A. In situations of repair work contractor shall use a mechanical joint solid sleeve with a pressure rating of 350 psi for 3"- 24" sizes and 250 psi for 30"- 48" sizes, per ASTM A536 and in accordance with ANSI/AWWA C153/A21.53 with cement lining conforming to ANSI/AWWA C104/A21.4. Some situations may require the use of a MJ Cut-in-Sleeve and Valve. The Sleeve shall meet the requirements of the above. The MJ Cut-In Valve shall meet or exceed all applicable requirements of ANSI/AWWA C509 standard and is certified to ANSI/NSF 61. Stainless Steel repair clamps will not be allowed.
- B. Wedge Retainer Glands will be required with the use of all mechanical joint solid sleeves. The gland will be made of high strength ductile iron per ASTM A536, grade 65-45-12 and is compatible with all mechanical joints conforming to ANSI/AWWA C111/A21.11. 3"-16" shall have a pressure rating of 350 psi and 18" - 48" having a pressure rating 250 psi

PART 3 – EXECUTION

3.1 PREPARATION

- A. Establish lines and levels. Locate and layout, by instrumentation and similar means, grading, fill placement, piping, and structures.
- B. The Contractor shall field verify the location and the elevation of all existing tie points and line crossings prior to laying any pipe.

- C. Existing horizontal and vertical control points for the project will be established by the Owner per the Site Benchmark system.
- D. Maintain a complete, accurate log of all control and survey work as it progresses.
- E. On request of Owner, submit documentation to verify accuracy of field engineering work.
- F. Do not lay pipe or fittings in a trench with standing water present.
- G. HANDLING OF DUCTILE IRON PIPE: Load and unload ductile and cast iron pipes, fittings, valves, hydrants, and accessories by lifting with hoists or skidding to avoid damage. Under no circumstances shall such material be dropped. Pipe handled on the skidways shall not be skidded or rolled against pipe already unloaded.
- H. If possible, when distributing material, unload each piece opposite or near where it is to be laid in the trench, in a manner and position where it will remain free of foreign material.
- I. The Owner will operate valves or other controls on any piping system. Inform the Owner's Rep 48 hours before a required shut down is needed for a tie-in.
- J. Give 24 hours' notice on startups and testing. Contractor personnel will not operate valves or other controls on any piping system unless authorized by the Owner's Representative.

3.2 PIPE CONNECTIONS

- A. For Tyton® push-on type joints all pipe joints 24" and smaller, use Field-Lok 350® gaskets throughout. For pipe larger than 24" use TR-Flex, HP-Lok, Flex-Ring or Lok-Ring.
- B. Where connections are made to existing pipes or fittings use new fittings and gaskets with wedge retainer glands.
- C. The use of wedge retainer glands shall be kept to a minimum.
- D. Coat all restraining bolts, nuts, set screws, and hardware used in underground installation with anchor assembly coating per manufacturer's recommendations. See Part 2.3.L for coating material.
 - 1. Clean all steel anchoring devices to be coated of all dirt, scale, and moisture.
 - 2. Apply anchor assembly coating liberally with brush or rubber glove; never brush thin. Minimum coat thickness shall be ¼ inch. Allow one hour minimum to dry before backfilling.
- E. If fitting is assembled on grade, do not allow fitting to rotate when placing fitting and pipe assembly into the trench.
- F. Do not exceed allowable deflection and separation based on restrained push-on joint type and diameter of pipe. Obtain allowable joint deflection and separation tables from American Ductile Iron Pipe prior to beginning work.

3.3 INSTALLATION OF DUCTILE IRON PIPE

- A. Prepare trench and bedding in accordance with Section 02224 – Excavating, Trenching, and Backfilling.
- B. Install pipe in accordance with the following:
 - 1. Clean the last 8 inches outside the spigot end and inside the bell to remove oil, grit, tar (other than standard coating), and other foreign materials from the joint prior to assembling pipe and fittings. Complete installation per pipe manufacturer's recommendations.
 - 2. Tolerances for laying pipe are 0.10 foot vertical and horizontal.

3. Install polyethylene pipe encasement per Ductile Iron Pipe Research Association "Polyethylene Encasement Installation Guide."
- C. Adequately anchor all pressure pipe before backfilling and testing.
 1. FIELD-LOK® gaskets provide adequate anchorage.
 2. At tees spliced into mains, install small pipe splice or spool in MJ sleeve along with retainer glands for continuous line anchorage.
 3. Whenever a mechanical joint connection exist within 10 lft of a tee, contractor shall rod the connection back to the main. See Part 3.3.C.4 for coating requirements.
 4. All anchorages must be approved by the Owner's Representative. Install Roskote® or NO-OX-ID "GG-2" on all steel anchorage items.
 5. The anchorage of lines shall be according to UL requirements and recommendations for same size lines.
- D. Backfill around pipe and trench in accordance with Section 02224 – Excavating, Trenching, and Backfilling.
- E. Temporary anchorage of the piping system for testing may be required and is to be reviewed before hydrostatic testing by the Owner's Representative.
- F. Immediately after installing structures such as hydrants, PIV's, etc., compact and grade surface to finish grade and install bollards.
- G. Valving
 1. Bench operate all valves in presence of Owner's Representative prior to installation. Check completely operability of the valve in closed and open position. Check for foundry slag at joint connection grooves. Clean as necessary.
- H. All dead end valves, pipes, mains, services, etc. that will be left for longer than 48 hours shall have restrained plugs or caps installed on them.
 1. Encasement to be wrapped around all ductile iron pipe, fittings, valves and hydrants to within a foot of finish grade. Secure wrap according to manufacturer's instruction.

3.4 STERILIZATION OF CITY WATER LINE

- A. All pipe shall be sterilized by using Liquid chlorine.
- B. Verify that water main is complete, flushed and clean.
- C. Inject disinfectant chlorine solution, through a corporation cock inserted in the horizontal axis of the water main.
- D. Inject at the beginning of the pipe line or a valved section.
- E. Slowly fill the line with potable water from the existing distribution line.
- F. Bleed water from a valve at the end of the line to ensure distribution and prevent pressure build up in excess of 20 psi.
- G. Inject disinfectant, chlorine solution, to obtain a concentration of 40 to 50 parts per million.
- H. Chlorine residual may be checked with N, N-diethyl-p-phenylenediamine (DPD), 40 to 50 parts per million solution will produce a deep red color.
- I. Maintain disinfectant in pipe line for 24 hours.

- J. Flush disinfectant from pipe line.
- K. Owner or Engineer will verify disinfectant removal with DPD reagent.
- L. Owner, with assistance from the Contractor, will obtain samples for laboratory tests, a minimum of 24 hours after flushing the disinfectant from the pipeline, in accordance with AWWA requirements.
- M. Do not place water main into service until laboratory tests show satisfactory results in accordance with the state Department of Public Health standards for safe drinking water.
- N. Repeat the complete disinfection process if laboratory results deem the water unsafe for drinking.
- O. Replace corporation cocks with brass plugs when the disinfection process is complete and water is determined safe for drinking.
- P. The use of chlorine pills or tablets placed in the pipe during construction to be used in the disinfection process is prohibited.

3.5 HYDROSTATIC TESTING

- A. After the trench has been prepared as specified in other related sections, subject the system to a hydrostatic proper test pressure, 150 psi for city water and service water lines and 200 psi for fire water. Pressure must remain steady for 2 hours. Replace and retest any cracked or defective pipe, fittings, or valves discovered as a result of this test. Bring all leaks to the attention of the Owner's Representative.
- B. Pressure testing must be witnessed by Owner's Representative. Contractor must complete the testing form, sign it, and have the Owner's Representative sign it.
- C. Pressure testing procedure
 - 1. Prevent the freezing of any part of the system during and after the test.
 - 2. Inspect the entire system to ensure that all parts are adequately anchored.
 - 3. Open the supply valve and allow the system to slowly fill with the material it was designed to carry. Systems must be vented to the appropriate areas. Check lines for improper valve closures. Valves shall be operated with care to prevent water hammer.
 - 4. Leave the supply valve open and inspect the system for leaks.
 - 5. After leaks have been repaired, reinspect those joints which may reasonably be expected to have shifted during replacement or tightening operations.
 - 6. Owner's Representative shall be notified prior to the test, allowing reasonable time for him to be present during test, and to obtain approval to operate the system supply valve.
 - 7. All leaks shall be brought to the attention of the Owner's Representative; and if the cause of the leak is known, it too shall be reported.
 - 8. The test shall be left on and remain steady for two hours.
 - a. His decision shall be based on the objective of providing a sound system capable of doing the job for which it was designed.
 - 9. Install suitable pressure gauge(s) at the appropriate locations on the system being tested.
 - 10. Prior to testing, inspect the entire system to ensure that all parts are adequately anchored.

- a. Also, prior to testing, observe the requirements under "Hydrostatic Testing".
 - b. Sterilization and pressure testing are interrelated.
11. First, test with line pressure by partially opening the supply valve and venting the system to appropriate areas. Visually inspect each pipe and accessory joint for leaks. Next, close the supply valve and proceed to the test pressure specified. If leaks should be encountered, proceed as indicated.

3.6 FLUSHING AND CLEANING

- A. Flush the lines by discharging water through the opening furthest from supply on each valved branch line connected to the new portion of the piping system. Open the supply valve only enough to fill the lines, without causing shock to the system. After the air has been expelled from the system, the supply valve should be completely opened and as much water pushed through the line as necessary. The flow should be left on until surges have subsided and the water appears clear.
- B. It is important to ensure that no foreign material that could interfere with the operation of valves, sprinkler heads, eyewashes, etc. remain in the lines after testing and flushing.
- C. Check and schedule with the Owner's Representative before flushing lines to eliminate possibility of causing water shortage for production and fire protection.

END OF SECTION

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UNDERGROUND DUCTILE IRON WATER LINES

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Contractor's Material and Test Certificate for Water Mains		
PROCEDURE Upon completion of work, inspection and tests shall be made by the Contractor's representative and witnessed by an Owner's Representative. All defects shall be corrected and system left in service before Contractor's personnel finally leave the job. A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, Owners, and Contractor. It is understood that the Owner's Representative's signature in no way prejudices any claim against Contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.		
PROPERTY NAME		DATE
PROPERTY ADDRESS		
PLANS	ACCEPTED BY APPROVING AUTHORITIES (NAMES)	
	ADDRESS	
	INSTALLATION CONFORMS TO ACCEPTED PLANS <input type="checkbox"/> YES <input type="checkbox"/> NO EQUIPMENT USED IS APPROVED <input type="checkbox"/> YES <input type="checkbox"/> NO IF NO, STATE DEVIATIONS	
INSTRUCTIONS	HAS PERSON IN CHARGE OF PLANT SYSTEM BEEN INSTRUCTED AS TO LOCATION OF CONTROL VALVES AND CARE AND MAINTENANCE OF THIS NEW EQUIPMENT? IF NO, EXPLAIN. <input type="checkbox"/> YES <input type="checkbox"/> NO	
	HAVE COPIES OF APPROPRIATE INSTRUCTIONS, CARE AND MAINTENANCE CHARTS BEEN LEFT ON PREMISES? IF NO, EXPLAIN. <input type="checkbox"/> YES <input type="checkbox"/> NO	
LOCATION	SUPPLIES BUILDINGS	
PIPES AND JOINTS	PIPE TYPES AND CLASS	JOINT TYPE
	PIPE CONFORMS TO _____ STANDARD <input type="checkbox"/> YES <input type="checkbox"/> NO FITTINGS CONFORM TO _____ STANDARD <input type="checkbox"/> YES <input type="checkbox"/> NO IF NO, EXPLAIN	
	BURIED JOINTS NEEDING ANCHORAGE CLAMPED, STRAPPED, OR BLOCKED IN ACCORDANCE WITH _____ STANDARD <input type="checkbox"/> YES <input type="checkbox"/> NO IF NO, EXPLAIN	
FLUSHING: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at flows not less than 390 GPM (1476 L/min) for 4-inch pipe, 610 GPM (2309 L/min) for 5-inch pipe, 880 GPM (3331 L/min) for 6-inch pipe, 1560 GPM (5905 L/min) for 8-inch		

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UNDERGROUND DUCTILE IRON WATER LINES

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TEST DESCRIPTION	pipe, 2440 GPM (9235 L/min) for 10-inch pipe, and 3520 GPM (13323 L/min) for 12-inch pipe. When supply cannot produce stipulated flow rates, obtain maximum available. <u>HYDROSTATIC:</u> Hydrostatic tests shall be made at not less than 150 psi for two hours or 50 psi (3.4 bars) above static pressure in excess of 150 psi (10.3 bars) for two hours for city water and service water lines. Hydrostatic tests shall be made at not less than 200 psi for two hours or 50 psi (3.4 bars) above static pressure in excess of 150 psi (10.3 bars) for two hours for the fire water system. <u>LEAKAGE:</u> New pipe laid with rubber gasketed joints shall, if the workmanship is satisfactory, have little or no leakage at the joints. The amount of leakage at the joints shall not exceed 2 qts. per hr. (1.89 L/h) per 100 joints irrespective of pipe diameter. The amount of allowable leakage specified above may be increased by 1 fl. oz. per in. valve diameter per hr. (30 mL/25 mm/h) for each metal seated valve isolating the test section. If dry barrel hydrants are tested with the main valve open, so the hydrants are under pressure, an additional 5 oz. per minute (150 mL/min) leakage is permitted for each hydrant.		
FLUSHING TESTS	NEW PIPING FLUSHED ACCORDING TO _____ STANDARD <input type="checkbox"/> YES <input type="checkbox"/> NO IF NO, EXPLAIN		
	HOW FLUSHING FLOW WAS OBTAINED <input type="checkbox"/> PUBLIC WATER <input type="checkbox"/> TANK OR RESERVOIR <input type="checkbox"/> FIRE PUMP		THROUGH WHAT TYPE OPENING <input type="checkbox"/> HYDRANT BUTT <input type="checkbox"/> OPEN PIPE
	LEAD-INS FLUSHED ACCORDING TO _____ STANDARD <input type="checkbox"/> YES <input type="checkbox"/> NO IF NO, EXPLAIN		
	HOW FLUSHING FLOW WAS OBTAINED <input type="checkbox"/> PUBLIC WATER <input type="checkbox"/> TANK OR RESERVOIR <input type="checkbox"/> FIRE PUMP		THROUGH WHAT TYPE OPENING <input type="checkbox"/> Y CONN. TO FLANGE <input type="checkbox"/> OPEN PIPE & SPIGOT
HYDROSTATIC TEST	ALL NEW PIPING HYDROSTATICALLY TESTED AT _____ PSI FOR _____ HOURS		BURIED JOINTS COVERED <input type="checkbox"/> YES <input type="checkbox"/> NO
LEAKAGE TEST	TOTAL AMOUNT OF LEAKAGE MEASURED NO LEAKAGE ALLOWED FOR VISIBLE JOINTS _____ GALS. _____ HOURS		
	ALLOWABLE LEAKAGE (BURIED) NO LEAKAGE ALLOWED FOR VISIBLE JOINTS _____ GALS. _____ HOURS		
CONTROL VALVES	WATER CONTROL VALVES LEFT WIDE OPEN <input type="checkbox"/> YES <input type="checkbox"/> NO IF NO, STATE REASON		
REMARKS	DATE LEFT IN SERVICE _____ ADDITIONAL COMMENTS		
SIGNATURES	NAME OF INSTALLING CONTRACTOR		
	TEST WITNESSED BY		
	FOR PROPERTY OWNER (SIGNED)	TITLE	DATE
	FOR INSTALLING CONTRACTOR (SIGNED)	TITLE	DATE
ADDITIONAL EXPLANATION AND NOTES			

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PCCP UNDERGROUND SERVICE WATER

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PART 1 GENERAL**1.1 REFERENCES**

- A. ANSI/AWWA C304 – Design of Prestressed Concrete Cylinder Pipe (PCCP)
- B. ANSI/AWWA C301 – Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, For Water and Other Liquids
- C. ANSI/AWWA C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4” Through 144”
- D. ANSI/AWWA C504 – Rubber Seated Butterfly Valves
- E. INSTALLATION MANUAL PRESTRESSED CONCRETE CYLINDER PIPE, Price Brothers
- F. Section 02224 – BACKFILLING/TRENCHING/EXCAVATION

1.2 SUBMITTALS

- A. Underground PCCP Water Lines Test Form 2 pages.
- B. Shop drawings for Contractor provided valves and fittings.
- C. Video inspection record of completed pipe, DVD format with viewing software.

PART 2 PRODUCTS**2.1 OWNER PROVIDED PRODUCTS – None****2.2 CONTRACTOR PROVIDED PRODUCTS**

- A. All Prestressed Concrete Cylinder Pipe with required appurtenances including blind flanges on risers, water for testing and sand bedding/backfill material.
- B. All equipment, services, and labor required to perform the work of this section including; water hoses to fill the SW piping from the Owner's city water system, air for individual joint testing, gate valves with; gaskets, bolts and blind flange, gear operators with valve box as shown, interior video inspection record of the completed pipe system, grout and mortar for joint corrosion protection and interior steel cylinder protection.

2.3 SERVICE WATER LINE PRODUCTS

- A. Valves: Nonrising stem gate valves of the various sizes shown on the drawings conforming to AWWA C515, rated for 200psig working pressure, flanged connection to an AWWA C207 Class E piping flange on the PCCP service water pipe. Each valve shall be provided with a class E blind flange with required gaskets and stainless steel bolts. The 36-inch valves shall be provided with bevel gear operators for horizontal operation. Valves shall be provided with wrench nut, valve box and one T-handle wrench of appropriate length per every two valves. All exterior surfaces shall be coated with a rust protection system; No-Ox, Roskote A-51 or equivalent.
- B. All flange bolts and nuts are to be 316SS, ASTM F593, group 2.

PART 3 EXECUTION**3.1 PREPARATION**

- A. Establish lines and levels. Locate and layout, by instrumentation and similar means, grading, fill placement, piping, and structures.
- B. The Contractor shall field verify the location and the elevation of all existing tie points and line crossings prior to laying any pipe.

- C. Existing horizontal and vertical control points for the project will be established by the Owner per the Site Benchmark system.
- D. Maintain a complete, accurate log of all control and survey work as it progresses.
- E. On request of Owner, submit documentation to verify accuracy of field engineering work.
- F. Do not lay pipe or fittings in a trench with standing water present.
- G. Contractor shall unload pipe and fittings from the manufacturer's delivery trucks within two hours of arrival on site.
- H. HANDLING OF PCCP: Pipe and fittings shall be handled as indicated in the Price Brothers Installation Manual and directed by the pipe manufacturer's field representative. In general the Contractor must load and unload PCCP, fittings, valves, and accessories by lifting with hoists to avoid damage. Under no circumstances shall such material be dropped. Pipe handled on the skidways shall not be skidded or rolled against pipe already unloaded. If possible, when distributing material, unload each piece opposite or near where it is to be laid in the trench, in a manner and position where it will remain free of foreign material.
- I. The Owner will operate valves or other controls on any piping system. Inform the Owner's Rep 48 hours before a required shut down is needed for a tie-in. Give 24 hours notice on startups and testing. Contractor personnel will not operate valves or other controls on any piping system unless authorized by the Owner's Representative.

3.2 PIPE CONNECTIONS

- A. All joints on the service water system shall be restrained using the manufacturer's standard snap ring restraints for smaller diameter piping and clamp type harnessed joints for larger diameter pipe.
- B. All exterior joints shall be grouted for corrosion protection prior to backfill. Grout bands shall be provided by the pipe manufacturer.

3.3 INSTALLATION OF PRESTRESSED CONCRETE CYLINDER PIPE

- A. Install pipe in accordance with the following:
 - 1. Install in accordance with Price Brothers INSTALLATION MANUAL and as directed by the manufacturer's field representative.
 - 2. Tolerances for laying pipe are 0.10 foot vertical and horizontal.
 - 3. Pipe shall be fully bedded in sand backfill, compacted to 95% Proctor.
- B. Joint testing
 - 1. Each joint shall be air tested immediately after installation, before backfill, to verify proper gasket seal. Owner's representative shall witness joint tests and provide a written record of each test.
 - 2. Pipe manufacturer shall provide test apparatus; Contractor shall supply air and labor for test.
 - 3. Larger diameter pipes shall be manufactured to provide internal connections for the air test.
 - 4. Smaller diameter piping shall be manufactured to allow external connection for the air test. Prior to connecting the air test apparatus externally, the air chamber must be pressurized to verify a clear path to the testable joint plenum. After conducting air testing, test plugs shall be re-inserted.

- C. Cleaning and video inspection
 - 1. After piping installation is complete and immediately before hydrostatic testing, the Contractor must thoroughly clean the interior of the entire service water system, removing all debris and sand or gravel. After cleaning, the Contractor shall provide a video inspection record of the interior of the piping system taken by a professional videographer with demonstrated experience in underground piping systems.
- D. Riser air release and bypass connections
 - 1. The risers shall be provided with blind flanges by the pipe manufacturer. The Contractor shall provide temporary valves on these blind flanges to remove air prior to hydrostatic testing.
 - 2. After passing the hydrostatic testing, the contractor shall replace the temporary valves with a 4-inch bypass connection between adjacent service water supply and return risers. A gate valve shall be installed on the bypass connection.
- E. Any painted surfaces damaged by the Contractor during handling or installation of the service water piping shall be cleaned and touched up with appropriate paint.

3.4 HYDROSTATIC TESTING

- A. After the service water piping system has been totally installed, subject the system to a hydrostatic test pressure of 150 psi. Pressure must remain steady for 2 hours. Replace and retest any cracked or defective pipe, fittings, or valves discovered as a result of this test. Bring all leaks to the attention of the Owner's Representative.
- B. Pressure testing must be witnessed by Owner's Representative. Contractor must complete the testing form, sign it, and have the Owner's Representative sign it.
- C. Pressure testing procedure
 - 1. Prevent the freezing of any part of the system during and after the test.
 - 2. Inspect the entire system to ensure that all parts are adequately anchored.
 - 3. Open the supply valve and allow the system to slowly fill with the material it was designed to carry. Systems must be vented to the appropriate areas. Check lines for improper valve closures. Valves shall be operated with care to prevent water hammer.
 - 4. Leave the supply valve open and inspect the system for leaks.
 - 5. After leaks have been repaired, reinspect those joints which may reasonably be expected to have shifted during replacement or tightening operations.
 - 6. Owner's Representative shall be notified prior to the test, allowing reasonable time for him to be present during test, and to obtain approval to operate the system supply valve.
 - 7. All leaks shall be brought to the attention of the Owner's Representative; and if the cause of the leak is known, it too shall be reported.
 - 8. The test shall be left on and remain steady for two hours.
 - a. The Owner Representative's decision shall be based on the objective of providing a sound system capable of doing the job for which it was designed.
 - 9. Install suitable pressure gauge(s) at the appropriate locations on the system being tested.

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10. Prior to testing, fill the entire service water underground piping with water and allow it to absorb water at low pressure and temperatures to stabilize.
11. First, test with line pressure by partially opening the supply valve and venting the system to appropriate areas. Visually inspect each pipe and accessory joint for leaks. Next, close the supply valve and proceed to the test pressure specified. If leaks should be encountered, proceed as indicated.

END OF SECTION

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UNDERGROUND SERVICE WATER LINE TEST FORM**Contractor's Material and Test Certificate for Service Water piping****PROCEDURE**

Upon completion of work, inspection and tests shall be made by the Contractor's representative and witnessed by an Owner's Representative. All defects shall be corrected and system left in service before Contractor's personnel finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, Owners, and Contractor. It is understood that the Owner's Representative's signature in no way prejudices any claim against Contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

PROPERTY NAME

DATE

PROPERTY ADDRESS

PLANS

ACCEPTED BY APPROVING AUTHORITIES (NAMES)

ADDRESS

INSTALLATION CONFORMS TO ACCEPTED PLANS
EQUIPMENT USED IS APPROVED
IF NO, STATE DEVIATIONS

☐ YES ☐ NO
☐ YES ☐ NO

INSTRUCTIONS

HAS PERSON IN CHARGE OF PLANT SYSTEM BEEN INSTRUCTED AS TO LOCATION OF CONTROL VALVES AND CARE AND MAINTENANCE OF THIS NEW EQUIPMENT?
IF NO, EXPLAIN.

☐ YES ☐ NO

HAVE COPIES OF APPROPRIATE INSTRUCTIONS, CARE AND MAINTENANCE CHARTS BEEN LEFT ON PREMISES?
IF NO, EXPLAIN.

☐ YES ☐ NO**LOCATION**

SUPPLIES BUILDINGS

PIPES AND JOINTS

PIPE TYPES AND CLASS

JOINT TYPE

PIPE CONFORMS TO _____ STANDARD
NO
FITTINGS CONFORM TO _____ STANDARD
NO
IF NO, EXPLAIN

☐ YES ☐☐ YES ☐

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	BURIED JOINTS NEEDING ANCHORAGE CLAMPED, STRAPPED, OR BLOCKED IN <input type="checkbox"/> YES <input type="checkbox"/> NO ACCORDANCE WITH _____ STANDARD IF NO, EXPLAIN		
TEST DESCRIPTION	<u>HYDROSTATIC</u> : Hydrostatic tests shall be made at not less than 150 psi for two hours. <u>LEAKAGE</u> : New pipe laid with rubber gasketed joints shall, if the workmanship is satisfactory, have little or no leakage at the joints. The amount of leakage shall not exceed 10 gallons per inch of diameter per mile of pipe per 24 hours. Contractor shall provide a meter or other approved device to measure the volume of make-up water during the test.		
	Prior to conducting the test, the pipe shall be totally filled with water and allowed to soak under low pressure to allow the pipe to absorb water and temperature to stabilize.		
HYDROSTATIC TEST	ALL NEW PIPING HYDROSTATICALLY TESTED AT _____ PSI FOR _____ HOURS	BURIED JOINTS COVERED <input type="checkbox"/> YES <input type="checkbox"/> NO	
LEAKAGE TEST	TOTAL AMOUNT OF LEAKAGE MEASURED _____ GALS _____ HOURS NO LEAKAGE ALLOWED FOR VISIBLE JOINTS		
	ALLOWABLE LEAKAGE (BURIED) _____ GALS. _____ HOURS NO LEAKAGE ALLOWED FOR VISIBLE JOINTS		
CONTROL VALVES	WATER CONTROL VALVES LEFT WIDE OPEN IF NO, STATE REASON <input type="checkbox"/> YES <input type="checkbox"/> NO		
REMARKS	DATE LEFT IN SERVICE _____ ADDITIONAL COMMENTS		
SIGNATURES	NAME OF INSTALLING CONTRACTOR		
	TEST WITNESSED BY		
	FOR PROPERTY OWNER (SIGNED)	TITLE	DATE
	FOR INSTALLING CONTRACTOR (SIGNED)	TITLE	DATE
ADDITIONAL EXPLANATION AND NOTES			

PART 1– GENERAL**1.1 DESCRIPTION**

- A. The work in this section consists of providing and installing Factory Mutual (FM) approved High Density Polyethylene (HDPE) pipe and fittings for underground fire protection lines by method of open cut or pipe bursting.

1.2 RELATED SECTIONS

- A. Section 02224 Backfilling/Trenching/Excavating
- B. Section 02610 Underground Ductile Iron Water Lines
- C. Section 02510 Utility Pipe Bursting

1.3 REFERENCES

- A. ASTM D 3350 Polyethylene Plastics Pipe and Fittings Materials
- B. ASTM F 714 Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- C. Factory Mutual Research Corporation Requirements
- D. Manufacturer's printed recommendations.
- E. ASTM D2620 Fabricated Fittings

1.4 QUALITY ASSURANCE

- A. The contractor's fusion operator shall have a minimum of 1 year of experience using the fusion equipment. Only the contractor's employees with the required experience shall be allowed to operate the fusion equipment during the project.

1.5 EQUIPMENT

- A. The contractor shall be responsible to verify that the fusion equipment is in good operating condition. The fusion equipment shall be provided with a working indicator of heater temperature and a working indicator of fusion pressure.

1.6 SUBMITTALS

- A. Submit under the provisions of Section 01300
- B. Underground Water Lines Test Form 2 pages – See Section 02610

PART 2 – PRODUCTS**2.1 PIPE**

- A. The HDPE pipe shall be Factory Mutual Approved, marked according to its pressure designation as 200, and be marked with the Factory Mutual diamond logo.
- B. Pipe shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D 3350 with a minimum cell classification of 445574C. Pipe shall have a manufacturing standard of ASTM F 714.
- C. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.
- D. Each production run of pipe shall be tested for melt index, density, % carbon, and dimensions.

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HDPE PIPE FOR FIRE PROTECTION

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2.2 FITTINGS

- A. Butt Fusion Fittings – Fittings shall be PE4710 HDPE, minimum cell classification of 445574C as determined by ASTM D 3350. Molded butt fusion fittings shall have a manufacturing standard of ASTM D 3261. Molded and fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. All fabricated fittings shall be made using a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records. Fittings will be made and tested to Factory Mutual requirements. The FM logo shall be on the fitting.
- B. Electrofusion Fittings – Fittings shall be PE4710 HDPE, minimum cell classification of 445574C as determined by ASTM D 3350. Electrofusion Fittings shall have a manufacturing standard of ASTM F 1055. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. These fitting shall be meet Factory Mutual requirements.
- C. Flanged and Mechanical Joint Adapters – Flanged and Mechanical Joint Adapters shall be PE 3608 HDPE, minimum cell classification of 345464C as determined by ASTM D3350. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D 3261. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Back-up rings shall be epoxy coated Ductile Iron. These fitting shall be meet Factory Mutual requirements.
- D. Bolts and nuts for flanged joints shall be 316 Stainless Steel per ASTM F593 Group 2 and ASTM 594. Gaskets are to be Red Rubber SBR (Styrene Butadiene Rubber).
- E. All new “T” bolts and nuts are to be fabricated of 316 Stainless Steel. Nuts are to be factory coated to prevent galling – coating color RED. Tighten “T” bolts per torque recommendations in AWWA C111 (75-90 ft. lbs. 4”-24” sizes).

PART 3 – EXECUTION

3.1 PREPARATION

- A. Establish lines and levels. Locate and layout, by instrumentation and similar means, grading, fill placement, piping, and structures.
- B. The Contractor shall field verify the location and the elevation of all existing tie points and line crossings prior to laying any pipe.
- C. Existing horizontal and vertical control points for the project will be established by the Owner per the Site Benchmark system.
- D. Maintain a complete, accurate log of all control and survey work as it progresses.
- E. On request of Owner, submit documentation to verify accuracy of field engineering work.
- F. Do not lay pipe or fittings in a trench with standing water present.
- G. The Owner will operate valves or other controls on any piping system. Inform the Owner’s Rep 48 hours before a required shut down is needed for a tie-in. Give 24 hour notice on startups and testing. Contractor personnel will not operate valves or other controls on any piping system unless authorized by the Owner’s Representative.

3.2 HAULING, UNLOADING and DISTRIBUTING PIPE: During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. During transportation each pipe shall rest on suitable pads, strips, skids or blocks securely wedged or tied in place. Any pipe damaged shall be replaced.

3.3 FUSION

- A. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400-450 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce joint weld strength equal to or greater than the tensile strength of the pipe itself. Each fusion weld shall be assigned a unique identifier. Temperature, fusion pressure and cooling time shall be recorded for each weld. The contractor is responsible to provide the Owner a copy of the Quality Control records with recordings for these 3 variables for each weld.
- B. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE main line pipe being fused. The size of the heating iron shall be larger than the size of the outlet branch being fused.
- C. Mechanical joining or electro fuse coupler's will be used where the butt fusion method cannot be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring. Where Mechanical joints are used, these connections must be made using components that meet Factory Mutual requirements and show the FM logo.
- D. Electro Fusion Welded fittings shall be installed per the manufacturer's recommendations including removal of the thin exterior layer of material from the outside of the pipe being joined with the electro fusion fitting, marking of fitting stab depth, and completing the electro fusion within the recommended time. The Contractor is responsible to provide the Owner a copy of the manufacturer's electro fusion installation guidelines at the beginning of the project.
- E. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.
- F. Only appropriately sized, and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
 - 1. Heat Plate - Heat plates shall be in good condition with no deep gouges or scratches within the pipe circle being fused. Plates shall be clean and free of any contamination. Heater controls shall properly function, and cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's recommendations.
 - 2. Carriage – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
 - 3. General Machine - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
- G. Other equipment specifically required for the fusion process shall include the following:
 - 1. Pipe rollers shall be used for support of pipe to either side of the machine
 - 2. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement and /or windy weather.

3. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
4. Facing blades specifically designed for cutting HDPE pipe.

3.4 INSTALLATION OF HDPE PIPE.

- A. Install pipe in accordance with the following:
- B. Clean the last 8 inches outside the spigot end and inside the bell to remove oil, grit, tar (other than standard coating), and other foreign materials from the joint prior to assembling pipe and fittings. Complete installation per pipe manufacturer's recommendations.
- C. Tolerances for laying pipe are 0.15 foot vertical and horizontal.
- D. All pipes shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced by the CONTRACTOR. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Damaged pipe shall be rejected by the CONTRACTOR and removed from the project site. CONTRACTOR shall check each pipe shipment for quantity and proper pipe size, color and type. Pipe shall be loaded, off-loaded, and otherwise handled in accordance with AWWA M23. Care shall be taken to insure that pipe is not dropped or damaged. Any damaged pipe shall be rejected by the CONTRACTOR and removed from the project site.
- E. HDPE pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's accordance with this specification.
- F. Backfilling/Trenching/Excavation: refer to Section 02224.
- G. Pipe Bursting: refer to Section 02510.

3.5 HYDROSTATIC TESTING

- A. After the trench has been prepared as specified in other related sections, subject the system to a hydrostatic proper test pressure, 150 psi for city water and service water lines and 200 psi for fire water. Pressure must remain steady for 2 hours. Replace and retest any cracked or defective pipe, fittings, or valves discovered as a result of this test. Bring all leaks to the attention of the Owner's Representative.
- B. Pressure testing must be witnessed by Owner's Representative. Contractor must complete the testing form, sign it, and have the Owner's Representative sign it.
- C. Pressure testing procedure
 1. Prevent the freezing of any part of the system during and after the test.
 2. Inspect the entire system to ensure that all parts are adequately anchored.
 3. Open the supply valve and allow the system to slowly fill with the material it was designed to carry. Systems must be vented to the appropriate areas. Check lines for improper valve closures. Valves shall be operated with care to prevent water hammer.
 4. Leave the supply valve open and inspect the system for leaks.
 5. After leaks have been repaired, reinspect those joints which may reasonably be expected to have shifted during replacement or tightening operations.
 6. Owner's Representative shall be notified prior to the test, allowing reasonable time for him to be present during test, and to obtain approval to operate the system supply valve.

7. All leaks shall be brought to the attention of the Owner's Representative; and if the cause of the leak is known, it too shall be reported.
8. The test shall be left on and remain steady for two hours.
 - a. His decision shall be based on the objective of providing a sound system capable of doing the job for which it was designed.
9. Install suitable pressure gauge(s) at the appropriate locations on the system being tested.
10. Prior to testing, inspect the entire system to ensure that all parts are adequately anchored.
 - a. Also, prior to testing, observe the requirements under "Hydrostatic Testing".
11. First, test with line pressure by partially opening the supply valve and venting the system to appropriate areas. Visually inspect each pipe and accessory joint for leaks. Next, close the supply valve and proceed to the test pressure specified. If leaks should be encountered, proceed as indicated.

3.6 FLUSHING AND CLEANING

- A. Flush the lines by discharging water through the opening furthest from supply on each valved branch line connected to the new portion of the piping system. Open the supply valve only enough to fill the lines, without causing shock to the system. After the air has been expelled from the system, the supply valve should be completely opened and as much water pushed through the line as necessary. The flow should be left on until surges have subsided and the water appears clear.
- B. It is important to ensure that no foreign material that could interfere with the operation of valves, sprinkler heads, eyewashes, etc. remain in the lines after testing and flushing.
- C. Check and schedule with the Owner's Representative before flushing lines to eliminate possibility of causing water shortage for production and fire protection.

END OF SECTION

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UNDERGROUND HDPE NATURAL GAS LINE

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PART 1 - GENERAL**1.1 DESCRIPTION OF WORK**

- A. Provide complete piping system(s) with all material, equipment, labor, accessories, services, tests and start-up necessary to completely execute piping and specialties work as herein specified and indicated on the drawings.

1.2 CODES, STANDARDS, AND QUALITY ASSURANCE

- A. Installation, according to natural gas supplier's standards and subject to supplier inspection.
- B. Installation in accordance with ANSI B31.8 Codes, Gas Transmission and Distribution Piping.
- C. Installation in accordance with ANSI Z223.1 and NFPA 54, National Fuel Gas Code.
- D. Installation in accordance with Michigan Gas Safety Standard, current edition.
- E. Installation in accordance with ASTM D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
- F. ASTM D2513 Standard Specification for Polyethylene Gas Pressure Pipe, Tube & Fittings.
- G. ASTM D3350 Standard Specification for Polyethylene Plastic Pipe & Fittings Materials.
- H. ASTM D3261 Specification for Butt Fusion Polyethylene Plastic Fittings for PE Plastic Pipe & Tubing.
- I. ASTM F1055 Specification for Electro Fusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
- J. ASTM F1973 Specification for Factory Assembled Transition Fittings in Polyethylene Fuel Gas Distribution Systems.

PART 2 - PRODUCTS**2.1 OWNER PROVIDED PRODUCTS - None****2.2 CONTRACTOR PROVIDED PRODUCTS**

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 PRODUCTS

- A. HDPE (high density polyethylene) pipe; PE 3608 SDR 11, IPS (Iron Pipe Size) with co-extruded yellow colored sheath, homogeneously and permanently bonded into the pipe outside surface to provide permanent identification of gas piping service. The yellow sheath material shall be the same as the pipe material except for color. Pipe, Tubing and Fittings shall conform to ASTM D3350 and ASTM D2513.
- B. Fittings: Molded HDPE PE 3608 SDR 11 IPS (Iron Pipe Size) fittings (12" diameter and below) conforming to ASTM D2513. Color: Black.
- C. Transition Fittings: HDPE PE 3608 SDR 11 IPS polyethylene pipe by Schedule 40 Grade B Seamless Carbon Steel pipe (plain end by plain end for welded connections) conforming to ASTM F1973. The carbon steel portion of the transition fitting is to be externally epoxy coated except for the weld zone.
- D. Electro Fusion Welded Couplings: Molded HDPE PE 3608 outside diameter couplings conforming to ASTM F1055; Color: Black; complete with heating wire and terminals.

Contractor is to provide the specialized equipment required to install the Electro Fusion Welded Couplings.

- E. The same manufacturer shall be used to supply the HDPE pipe and fittings. Pipe and fittings from different manufacturers shall not be interchanged.
- F. All piping components must be capable of meeting the requirements for an operating pressure of 100 PSIG even if the planned operating pressure is less. All fittings shall have the same pressure rating as the pipe.
- G. Tracer wire: #12 AWG insulated copper wire. Wire splices for buried tracer wire installation are to be completed with "MudBug" Utility Wire Connectors or Owner approved equivalent.
- H. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow. Tape to read (Caution Buried Gas Line).
- I. Warning Signs and Posts: As detailed on the drawings. Post material shall be carbon steel. Sign base metal shall be aluminum. Contractor shall provide a submittal of the sign and post details to the Construction Representative for Owner's review and approval. The submittal shall include the exact verbiage on the sign.
- J. All other materials needed to complete work required shall be supplied by the contractor.

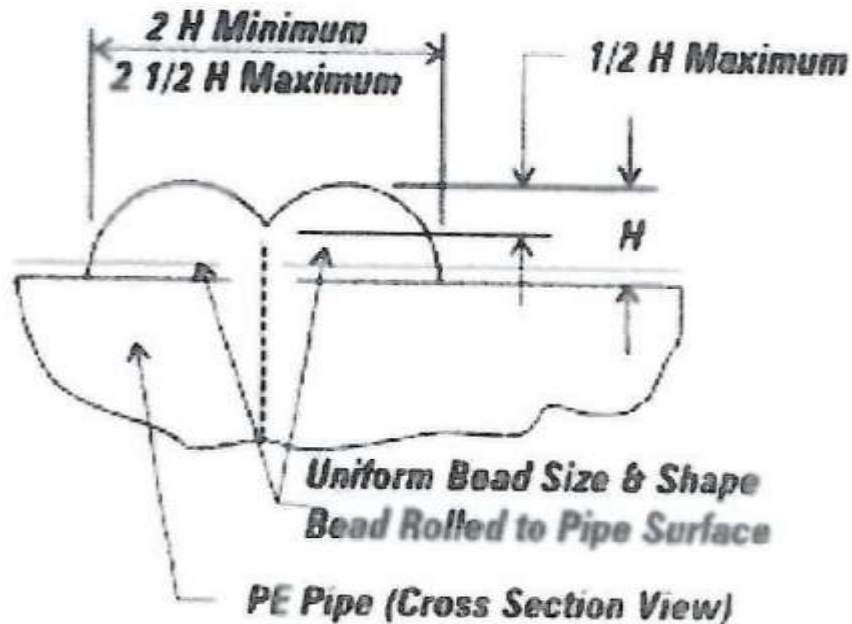
PART 3 - EXECUTION

3.1 GENERAL

- A. Establish lines and levels. Locate and layout by instrumentation, grading, fill placement and piping.
- B. The Contractor shall verify the location and the elevation of all existing tie points and line crossings prior to laying any pipe.
- C. Existing horizontal and vertical control points for the project will be established by the Owner.
- D. Maintain a complete, accurate log of all control and survey work as it progresses.
- E. On request of Owner, submit documentation to verify accuracy of field engineering work.
- F. Do not lay pipe in trench or hole with standing water present.

3.2 BUTT FUSION WELDING TESTING REQUIREMENTS

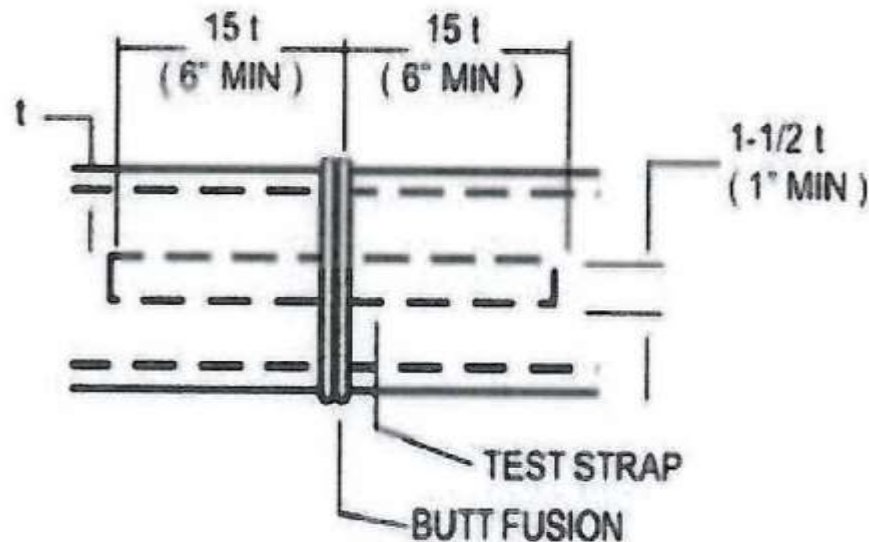
- A. Visual Inspection:
 - 1. The Owner's Representative will conduct random visual inspections of completed butt fusion welded joints.
 - 2. Inspection Criteria: On both sides of the joint, the double bead should be rolled over to the surface and be uniformly rounded and consistent in size all around the joint. The double bead width should be 2 to 2-1/2 times its height above the surface and the v-groove depth between the beads should be not more than half the bead height (see sketch below)



B. Bent Strap Testing:

1. Bent Strap Testing Frequency and Interval:
 - a. One test set at the start of each project for each diameter of pipe to be installed
 - b. Minimum of one test set for each set of fusion equipment (if the equipment is removed from service for repair, a test is to be completed before the equipment is returned to service)
 - c. Minimum of one test set for each fusion equipment operator
 - d. Minimum of one test set per calendar work week
2. The Contractor will provide labor, equipment and material to complete Bent Strap Testing at the above frequency and interval. For clarification purposes, if the work is completed with one equipment operator with the same fusion equipment on only one diameter of pipe during one work week, only one set of Bent Strap Tests is required.
3. ASTM D2657 will be used as a guideline to complete the Bent Strap Tests per these steps:
 - a. Contractor shall complete a trial butt fusion welded joint
 - b. The fusion shall be allowed to cool completely
 - c. The Contractor shall cut out 3 test straps from the joint per the sketch below
 - d. Owner's Representative will visually inspect the cut surface at the joint. There should be no gaps, voids, misalignment or unbonded areas within the weld zone of the joint.

- e. Under the Owner's Representative observation, the Contractor shall bend the straps until the ends of the straps touch. The weld joint should not show any signs of failure after being bent.
4. If any tests are failed, the Contractor shall determine the cause of the failure, implement corrective actions and repeat the test procedure.



3.3 HDPE PIPE INSTALLATION

- A. Trenching: The trench shall be excavated to at least 1 inch and not more than 3 inches below specified grade for bottom of pipe. The subgrade shall be made by backfilling which shall be thoroughly tamped to provide uniform and continuous bearing and support for the pipe at every point between joints, except it will be permissible to disturb the finished surface to a maximum of 2 inches near the middle of each length to permit withdrawal of pipe slings or other lifting tackle.
- B. Install the tracer by laying the tracer wire directly on top of the installed pipe. Do not leave excess wire below grade. Extend the ends of the tracer wire up above grade at all new pipe risers leaving at least 2' of tracer wire above grade wrapped around the pipe riser. All underground splices of the tracer wire shall be completed using the specified wire connector. Complete a continuity check of the installed tracer wire with a pipe locator operating in the conductive mode. Repair any detected continuity problems.
- C. Backfilling: Approved materials, hand-shoveled in layers not exceeding 6 inches, shall be placed under, around, and above the pipe across the full width of the trench. These 6 inch layers are to be tamped firmly to insure complete and uniform bearing, especially beneath the pipe.
- D. Use butt fusion in accordance with manufacturer's procedures. Butt fusion equipment shall be capable of:
 1. 400° F temperature; verify with manufacturer's procedures
 2. True alignment of joined sections
 3. 75 psi interfacial fusion pressure

4. EXTRUSION WELDING IS NOT ACCEPTABLE

- E. Joining: Butt fusion welding per the manufacturer's procedures is the default method for joining pipe and fittings. Where specified by the drawings, joints are to be completed by Electro Fusion Welded Couplings properly matched to the OD of the pipe and installed per the coupling manufacturer's procedures.
- F. Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR. for example, SDR 11 to SDR 13.5. Transitions greater than one SDR shall be made with a transition nipple (short length of the heavier wall pipe with one end machined to the lighter wall) or with an electrofusion welded coupling.
- G. Thermal Expansion and Contraction: The expansion and contraction characteristics of HDPE shall be considered in the installation of the pipe system. Final tie-ins shall be made as close to the operating temperature as possible. For summer applications with two fixed connection points, a slightly longer length of pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- I. Install pipe at the locations and elevations indicated on the drawings.
Tolerances:
 - 1. Vertical - ± 1 inch from design
 - 2. Horizontal - ± 2 inches from design

3.4 PURGING AND TESTING PROCEDURE FOR NATURAL GAS SYSTEMS

- A. Line Opening Preparations
 - 1. If a section of in-service natural gas piping needs to be opened for modification, the Owner will be responsible for managing the Lock Out/Tag Out requirements, Line Opening requirements and for venting and purging all Natural Gas from the section of piping that is scheduled to be opened. The Owner will purge residual Natural Gas out of the gas piping with Nitrogen prior to the Line Opening. The Owner will provide the Nitrogen unless noted otherwise.
 - 2. Under no circumstances shall gas piping be purged into the combustion chamber of any appliance or equipment nor shall the gas piping be purged inside of an enclosed structure. It is highly recommended that a temporary Owner provided outdoor purge stack be installed in a location remote from manufacturing facilities or occupied buildings to provide a safe location in which to vent the purge gases to the atmosphere. Personnel access to the area around the purge stage shall be restricted as a safety precaution.
 - 3. Apply the purge at a steady rate to avoid stratification or pocketing of the gas.
 - 4. The Owner will sample the purge gas to ensure that the Natural Gas has been removed from the gas piping. The Contractor is responsible to either witness the gas sampling or to review the documented gas sample results before proceeding with any line opening work on the piping.
 - 5. Caution: Nitrogen can be an asphyxiation hazard. Do not purge Nitrogen into an enclosed space such as a building or a temporary field enclosure like a welding tent.

B. Pressure Testing

1. Pressure Test Sequence: The new HDPE gas line **must** be backfilled prior to pneumatic testing as a Safety precaution. The Contractor may elect, at the Contractor's option, to conduct a 5 PSIG pneumatic test before the line is backfilled as a preliminary integrity check.
2. Personnel access to the immediate area around the buried line shall be restricted during the pneumatic test to mitigate any potential injuries that might result from a catastrophic failure of the piping system.
3. Pressure test the line to the higher of 90 psi or 1 ½ times the Maximum Allowable Operating Pressure for 60 minutes with either compressed air or Nitrogen and document test results on the supplied forms. Pressure testing must be witnessed by Owner's Representative. Contractor must complete the testing form, sign the form, and also have the Owner's Representative sign the form.
4. Pressure Test Acceptance Criteria: Any observable loss in pressure over the test period shall be considered a FAILED test result. It is possible that the pressurized gas used for the pneumatic test may lose some pressure due to a reduction in temperature for the test gas after it enters the buried pipeline. If this is suspected, allow the temperature of the test gas to stabilize, then add more gas if required to restore the required test pressure and restart the test period.
5. After completion of a successful pressure test, if air was used for the pressure test gas, purge the line with Nitrogen and leave line full of Nitrogen at a pressure of 0 PSIG. The Owner will sample the purge gas to ensure that the air has been removed from the gas piping.

C. Natural Gas Purging

1. Purging the Nitrogen from the new gas piping with Natural Gas shall be the Owner's responsibility and is not part of the Contractor's scope of work.
2. If necessary and upon request, the Gas Utility will furnish a qualified representative with the necessary instruments to assist the Owner in purging new piping and fuel line systems.
3. Under no circumstances shall gas piping be purged into the combustion chamber of any appliance or equipment nor shall the gas piping be purged to the inside of an enclosed structure. It is highly recommended that a temporary Owner provided outdoor purge stack be installed in a location remote from manufacturing facilities or occupied buildings to provide a safe location in which to vent the purge gases to the atmosphere. Personnel access to the area around the purge stage shall be restricted as a safety precaution.
4. Apply the purge at a steady rate to avoid stratification or pocketing of the gas.
5. The Owner will sample the purge gas to ensure that the Nitrogen has been removed from the gas piping.

D. Tertiary Leak Survey

1. The Owner may elect to complete a leak detection survey with a Portable Flame Ionization Detector of the completed installation after it is charged with Natural Gas. If any leaks are detected by this leak survey, it will be the Contractor's responsibility to repair the leaks at no cost to the Owner unless there is evidence of post-installation damage to the piping.

END OF SECTION

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UNDERGROUND HDPE NATURAL GAS LINE

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HDPE FUSION WELD VISUAL INSPECTION REPORT

Project Name: _____

PCAP/CIO: _____/_____

Date: _____

Contracting Company Name: _____

Fusion Equipment Operator's Name: _____

Fusion Equipment Manufacturer & Model: _____

Pipe Size: _____

Double Bead Inspection Results: Bead rolled over to pipe surface on both sides of joint all around pipe? If No, note what was observed.

☐ Yes ☐ No

Bead Width Inspection Results: Width of double bead 2 to 2-1/2 times bead height? If No, note what was observed.

☐ Yes ☐ No

Depth of V-Groove Inspection Results: Depth of V-Groove \leq 1/2 bead height? If No, note what was observed.

☐ Yes ☐ No

Circle One: Accepted Rejected

Inspected by: _____ (Owner's Representative)

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HDPE FUSION WELD BENT STRAP TEST REPORT

Project Name: _____

PCAP/CIO: _____/_____

Date: _____

Contracting Company Name: _____

Fusion Equipment Operator's Name: _____

Fusion Equipment Manufacturer & Model: _____

Pipe Size: _____

Visual Inspection Results: Weld gaps, voids, misalignment or unbonded areas? If Yes, note what was observed.

Strap #1: ☐ Yes ☐ No

Strap #2: ☐ Yes ☐ No

Strap #3: ☐ Yes ☐ No

Bent Strap Test: Failure after Bending? If Yes, note observed failure.

Strap #1: ☐ Yes ☐ No

Strap #2: ☐ Yes ☐ No

Strap #3: ☐ Yes ☐ No

Circle One: Accepted Rejected

Inspected by: _____ (Owner's Representative)

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NATURAL GAS PRESSURE TEST REPORT

CWP/WORK ORDER #: _____

DATE: _____

CONTRACTOR: _____

TESTED BY: _____

WITNESSED BY: _____

Drawing No.	Section Tested From	To	Size & Length	Adj. Air Pressure	Actual Pressure	Actual Time	Results

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STORM SEWER

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- A. This section includes storm sewer Work indicated on the Plans complete with pipes, box sections, joints, structures, pipe bedding, pipe laying, final inspection, and appurtenances.

1.2 RELATED WORK

- A. Section 02224 – Excavating, Trenching, and Backfilling

1.3 REFERENCES

- A. ASTM C-76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
- B. ASTM C-443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- C. ASTM C270 - Standard Specification for Mortar for Unit Masonry
- D. ASTM C-478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
- E. ASTM C1433 - Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.
- F. AASHTO - American Association of State Highway and Transportation Officials
- G. MDOT - Michigan Department of Transportation 2012 Standard Specifications for Road and Bridge Construction

PART 2 PRODUCTS**2.1 OWNER-PROVIDED PRODUCTS – None.****2.2 CONTRACTOR-PROVIDED PRODUCTS**

- A. All other materials, equipment, services, and labor required to perform the Work of this section and not listed in Section 01019 – Owner-Furnished Products.

2.3 CONCRETE PIPE PRODUCTS

- A. Storm Sewer Pipe: Reinforced concrete pipe; tongue and groove joint with "O" ring premium rubber gasket, ASTM C-76 CL III unless noted different on drawings or as required for job site conditions. Gasket per ASTM C-443.
- B. Epoxy grout: Sikadur 35 Hi-Mod LV unless noted different on drawings.

2.4 JOINTS FOR CONCRETE PIPE

- A. Premium joints for circular pipe shall conform to ASTM C443 limited as follows: Section 5.1 of C443, "Physical Requirements for Gaskets," shall be replaced with Section 6.9 of C361, "Rubber Gaskets." Also, Section 5 of C443 shall be limited to a modified grooved tongue to receive a rubber gasket.
- B. Only lubricant, as supplied by the pipe manufacturer, shall be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirement.

2.5 CORRUGATED POLYETHYLENE PIPE

- A. Smooth Lined Corrugated Polyethylene Pipe:
 - 1. Smooth lined corrugated polyethylene pipe shall meet the requirements of MDOT Sections 909.06 and AASHTO M252, Type S for sizes 4" to 10" diameter, and AASHTO M294 Type S for sizes 12" to 60" diameter.

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STORM SEWER

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2. Fittings shall conform to the corresponding pipe specification and be constructed of the same material classification as the pipe. Fittings shall be welded on the interior and exterior at all junctions.
 3. Joints shall be bell and spigot type with rubber gaskets on both sides of the joint conforming to ASTM F477. Split collar couplers are not allowed. Joints shall be watertight meeting the performance requirements of ASTM D3212. Gaskets shall be Nitrile Butadiene Rubber gaskets (NBR) or Buna-N, and shall have Vulcanizate Properties and Heat Resistance properties meeting ASTM D 573.
- B. Underdrains/Edge drains:
1. Corrugated plastic tubing for edge drain or under drains shall be in accordance with the Section 02200 – Site Grading.

2.6 HDPE PIPE

- A. HDPE (high density polyethylene); PE 3408 DR 26 and DR17, or as shown on drawings – plain ends; IPS outside diameter Drawings will indicate which DR pipe is to be used. If the drawings do not specify the pipe DR, consult Engineer.
1. Fittings: comparable and compatible, butt 45° ELL, saddle reducing laterals, 45° mitered laterals, 150 lb. flange riser as required compatible to piping; Joining:
 - a. Butt fusion per the manufacturer's procedures.
 - b. Electro Fusion per the manufacturer's procedures.
 - c. Flanged joints: HDPE stub end, epoxy coated Ductile Iron Slip-On Flange, Neoprene gasket, 316 S.S. bolting.

2.7 POLYVINYL CHLORIDE (PVC) PIPE

- A. PVC solid wall pipe in sizes 6-inch through 15-inch shall be ASTM D3034, SDR35, and in sizes 18-inch through 24-inch shall be ASTM F679, SDR 35, polyvinyl chloride pipe (PVC). All storm sewer leads shall be ASTM D3034, SDR 26.
- B. Joints for polyvinyl chloride pipe (PVC) shall be ASTM D3212, push-on type. A joint in which an elastomeric ring gasket is compressed in annular space between a bell end or socket and a spigot end of pipe. Gaskets for PVC pipe shall be elastomeric seal type conforming to ASTM F477.
- C. Wyes or tees shall be molded wye or tee fitting per ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the service lead pipe specified. Saddle connections are not allowed.
- D. Pipe joint lubricant shall be manufacturers standard nontoxic.

2.8 HDPE STORM SEWER LEADS

- A. HDPE (high density polyethylene); PE 3408, DR17, IPS outside.
1. Joining:
 - a. Butt fusion per the manufacturer's procedures.
 - b. Electro Fusion per the manufacturer's procedures.

2.9 STORM STRUCTURES

- A. Materials for storm sewer structures shall conform to the requirements indicated on the Plans and as specified below.
- B. Precast Concrete:
 - 1. Precast concrete manhole base, cone, and riser units shall conform to ASTM C478, and shall be circular with circular reinforcement. For manhole depths to 32 feet, the wall thickness of the sections shall be 5 inches
 - 2. Riser sections of a manhole shall have modified grooved tongue joints with "O" ring gaskets or a tongue and groove joint with a Butyl Rubber based gasket type sealant meeting the requirements of AASHTO M-198 and having a nominal size of one inch.
 - 3. Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. Shop Drawings shall be provided for all manhole tees. The joints on the precast manhole tee shall be the same as the joints on the storm sewer section.
 - 4. Precast concrete base, top slab, and grade ring units shall conform to ASTM C478.
 - 5. Non-round, precast concrete utility structures shall conform to the requirements of ASTM C858 and ASTM C857.
- C. Manhole Steps:
 - 1. Cast iron manhole steps shall conform to ASTM A48, Class 30, gray iron with a minimum cross section dimension of one inch in any direction.
 - 2. Steel reinforced plastic steps shall be of suitably approved co-polymer polypropylene conforming to ASTM D4101, with 1/2 inch minimum diameter deformed reinforcing bar conforming to ASTM A615, Grade 60.
 - 3. Manhole steps shall be of the type and size indicated on the Plans and shall comply with applicable occupational safety and health standards. Manhole steps shall be installed at locations indicated on the Plans.

2.10 MORTAR

- A. ASTM C270, Type M; 2500 psi, average 28-day compressive strength.

2.11 FRAMES AND COVERS

- A. Frames and covers for manholes, catch basins, and inlets shall conform to ASTM A48, Class 30, gray iron.
- B. The castings shall be neatly made and free from cracks, holes, and other defects. Surfaces of casting shall be ground to assure proper fit and to prevent rocking. Heavy duty cast iron covers within paved roadways shall be designed to withstand a minimum AASHTO HS-20 loading. Clear opening width shall be a minimum of 24 inches. Unless otherwise noted castings shall be in accordance with the following:
 - 1. Catchbasins
 - a. In ditch or yards: EJIW 1047, Type N Oval Grate
 - b. In roadways: EJIW 1047, Type M2 grate
 - 2. Manholes
 - a. EJIW 1047; base flange manhole cover; heavy duty solid cover

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3. Catchbasin traps:
 - a. EJIW 5944 with cleanout
4. Manufacturer/supplier: East Jordan Iron Works, East Jordan, MI
Neenah Foundry Company, Neenah, WI

2.12 FLEXIBLE MANHOLE CONNECTORS

- A. Kor-N-Seal® assembly with stainless steel Korband®, ASTM C-923. Assembly number per pipe size shown on drawings.

2.13 END SECTIONS

- A. Precast concrete end sections shall conform to ASTM C76, and as specified in MDOT Section 401. The joint for connection to pipe shall be by means of a standard tongue and groove with cold-applied pipe joint sealer.

2.14 CONCRETE

- A. In accordance with MDOT Section 701, use Grade S3, 3,000 psi strength, Type I Portland cement, 3" maximum slump; 6.5% air content +/- 1.0%; no admixtures without the Engineer's approval.

2.15 CONCRETE REINFORCEMENT

- A. In accordance with MDOT Section 905, use ASTM A615, Grade 60 for bars and ASTM A185 for welded wire fabric.

PART 3 EXECUTION

3.1 PREPARATION

- A. Establish lines and levels. Locate and layout, by instrumentation and similar means, grading, fill placement, piping, and structures.
- B. The Contractor shall field verify the location and the elevation of all existing tie points and line crossings prior to laying any pipe.
- C. Existing horizontal and vertical control points for the project will be established by the Owner.
- D. Maintain a complete, accurate log of all control and survey work as it progresses.
- E. Upon request of Owner, submit documentation to verify accuracy of survey work.
- F. Load and unload piping, fittings, and accessories by lifting with hoists or skidding to avoid damage. Under no circumstances shall such material be dropped. Pipe handled on the skidways shall not be skidded or rolled against pipe already unloaded. If possible, when distributing material, unload each piece opposite or near where it is to be laid in the trench, in a manner and position where it will remain free of foreign material.
- G. The outside surface of the spigot end and the inside surface of the bell end of the pipe shall be cleaned and free of any foreign materials, other than the sealant recommended by the manufacturer, prior to installation.
- H. All pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately prior to installation. Defective or damaged material shall be rejected and removed from the Project by the Contractor.
- I. Prior to the installation of any storm sewer piping, structures, or materials, examine all trenches and other excavations for the proper grades, lines, levels, and clearances required to receive the new Work. Ascertain that all excavation bottoms, compacted

subgrades, and pipe bedding are adequate to receive the storm sewer materials to be installed. Correct all defects and deficiencies before proceeding with the Work.

3.2 EXISTING STORM SEWERS AND DRAINS

- A. Expose the existing storm sewer and structures to which the new Work is to be connected and notify the Owner's Representative of same. The Owner's Representative will verify the vertical and horizontal locations of the existing system and shall inform the Contractor as to the necessary adjustments required to align the new storm sewer Work with the existing system.

3.3 INSTALLATION GENERAL

- A. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length.
- B. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize air-borne particles, shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of the pipe materials being cut and according to the best trade practices. When cutting pipe, care shall be taken to prevent damage to the interior and exterior surfaces. Damage to either shall be cause for rejection of a complete section of pipe.
- C. During the preparation of the pipe bedding and until the trench has been satisfactorily backfilled, the trench shall be kept free of water. A dewatering system shall be provided and maintained by the Contractor. The dewatering system shall remain in operation until the trench is backfilled.
- D. Excavation and backfill shall be as indicated on the Plans and as specified in Section 02224 – Excavating, Trenching, and Backfilling.

3.4 PIPE BEDDING

- A. After the bottom of trench has been excavated, the pipe bedding material will be installed in accordance with the Plans and Section 02224 – Excavating, Trenching, and Backfilling.
- B. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 02224 – Excavating, Trenching, and Backfilling. Particular care shall be taken to assure filling and tamping all spaces under, around, and above the top of the pipe.
- C. A continuous and uniform bedding as specified in Section 02224 – Excavating, Trenching, and Backfilling, shall be provided in the trench for all buried pipe.

3.5 PIPE LAYING

- A. The pipe shall be protected during handling against impact shocks and free fall. Hooks shall not be permitted to come in contact with premolded joint surfaces.
- B. Pipes having premolded joint rings or attached couplings shall be handled so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing material. Care shall be taken to avoid dragging any pipe on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.
- C. All pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid shall be checked by the Contractor with line and grade pole or laser system to insure that this result is obtained. When employing a laser system, the Contractor shall have an independent and alternate means of checking the line and grade. The finished Work shall be straight and shall be sighted through between manholes.

- D. Construction shall begin at the outlet end and proceed upstream with spigot ends pointing in direction of flow. Bell holes shall be excavated so that the full length of the barrel will bear uniformly on the bedding material.
- E. Lubricants, primers, or adhesives as recommended by the pipe or joint manufacturer shall be used immediately prior to jointing.
- F. The pipe shall be centered in the bells or grooves and pushed home to form a smooth and continuous invert. After laying of pipe, care shall be taken so as not to disturb its line and grade. Any pipe found off grade or out of line shall be re-laid properly by the Contractor.
- G. Mechanical means shall be used for pulling home all pipe where manual means will not result in pushing and holding the pipe home. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.
- H. Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes to the top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than five degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with suitable concrete plugs and mortar.
- I. Tolerances:
 - 1. Vertical- +/- 1/2" from design
 - 2. Horizontal- +/- 2 inches from design

3.6 STORM STRUCTURES

- A. Construct storm sewer manholes, catch basins, inlets, and other structures to the grades, lines and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment bricks, etc., as shown and as required for a complete installation. Storm sewer structures shall conform to the type of material and dimensions indicated on the Plans.
- B. Cast-in-place structures shall be constructed in accordance with MDOT Section 403.
- C. Precast Concrete Structures:
 - 1. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth. Provide concrete grade rings at top of structure for future adjustment of castings.
- D. Provide and install all frames and covers to the elevations indicated on the Plans. Castings shall be set in a full bed of cement mortar 1/2-inch thick, minimum. Mortar joints shall be struck smooth.
- E. Steps shall be installed at the plant by the manufacturer of precast units.
- F. Pipe up to 42 inches in diameter, shall be connected to storm structures using a Kor-N-Seal® assembly with stainless steel Korband. The pipe shall be properly supported, so that any settlement will not disturb the connection.
- G. Sumps shall be provided, as indicated on the Plans, in all catch basins and storm manholes having outlets of 18 inches in diameter or less.
- H. Flow channels shall be constructed in all structures not requiring a sump and shall be constructed as indicated on the Plans.

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Rev.0**3.7 UNDERDRAINS / EDGE DRAIN**

- A. Underdrains and edge drains shall be installed in accordance with Section 02200- Site Grading.

3.8 FIELD QUALITY CONTROL

- A. After all the pipe and structures have been laid, constructed, and backfilled, the system shall be final inspected. The sewer system shall be ready for the final inspection within 2 weeks after the completion of each 2,000-foot section of sewer installed.
- B. Joints shall be visually inspected for watertight integrity prior to backfilling.
- C. The final inspection shall consist of a visible and audible check of the sewers and structures to ascertain that the steps have been placed, all lift holes jointed, the channeling of the manhole bottoms completed, all visible or audible leaks stopped, all pipe has been placed straight and true to the proper slopes and elevations, the required brick courses for adjustment, the frame and cover properly installed, the required end section installed, all trenches and structures backfilled in a workmanlike manner, and that the system has been thoroughly cleaned.
- D. The final inspection shall be considered complete when all the repairs have been made.

3.9 DEFLECTION TEST FOR PLASTIC PIPE

- A. Plastic pipe shall be tested for deflection, but no sooner than 30 days following the backfilling of the pipe.
- B. Maximum allowable deflection (reduction in vertical inside diameter) shall be five (5) percent.
- C. Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.
- D. Optional devices for testing include a deflectometer, calibrated television, photography, or a properly sized "go, no-go" mandrel or sewer ball. Mandrel shall have a minimum of nine (9) legs.

END OF SECTION

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STORM SEWER DEFLECTION TEST REPORT

CWP/WORK ORDER #: _____

DATE: _____

CONTRACTOR: _____

TESTED BY: _____

WITNESSED BY: _____

Drawing No.	Manhole From	Manhole To	Pipe Diameter	Pass	Fail	Comments

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GRAVITY CONTAINMENT SEWER

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PART 1 - GENERAL

1.1 SCOPE

- A. This work includes containment sewer and maintenance sewer work indicated on the plans complete with pipes, joints, structures, pipe bedding, final inspection, and appurtenances.

1.2 RELATED WORK

- A. Section 02224 – Excavating, Trenching, and Backfilling

1.3 REFERENCES

- A. ASTM C270 - Standard Specification for Mortar for Unit Masonry
- B. ASTM C-478 - Standard Specification for precast Reinforced Concrete Manhole Sections
- C. AASHTO - American Association of State Highway and Transportation Officials
- D. MDOT - Michigan Department of Transportation 2012 Standard Specifications for Bridge Construction

1.4 SUBMITTALS

- A. Calculations for HDPE manholes per ASTM F1759 “Design of High Density Polyethylene (HDPE) Manholes for Subsurface Applications” including:
 - 1. Required wall and base thickness for depth and groundwater conditions based on acceptable stress and deflection limits.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS

- A. None.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the Work of this section.

2.3 GRAVITY CONTAINMENT SEWER PIPE

- A. HDPE (high density polyethylene); PE 3408 DR 26 and DR17, or as shown on drawings – plain ends; IPS outside diameter. Drawings will indicate which SDR pipe is to be used. Consult Engineer if the drawings do not specify the pipe DR.
 - 1. Fittings: comparable and compatible, butt 45° ELL, saddle reducing laterals, 45° mitered laterals, 150 lb. flange riser as required compatible to piping;
 - 2. Joining:
 - a. Butt fusion per the manufacturer's procedures.
 - b. Electro Fusion per the manufacturer's procedures.
 - c. Flanged joints: HDPE stub end, epoxy coated Ductile Iron Slip-On Flange, Neoprene gasket, 304 S.S. bolting.

2.4 TRACER WIRE

- A. Copper clad steel wire with 30 mil High Density Polyethylene insulation. Concentric copper cladding metallurgically bonded to a steel core through a continuous solid cladding process. Copper cladding to measure 3% minimum of the overall wire diameter. Wire to be 12 AWG, .0808 in. diameter, .00242 inch nominal copper thickness, 9.5270 ohms nominal resistance per 1,000 feet, 675 pounds breaking strength. Wire to be Copperweld® or equal.

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2.5 VALVES

- A. 2" to 12" high-grade polymeric materials, ball valves, with fused body shell. Flanged end configuration. NORDSTROM POLY-CHEM valve.

2.6 STRUCTURES

- A. Materials for containment sewer structures shall conform to the requirements indicated on the Plans and as specified below.
- B. Precast Concrete:
1. Precast concrete manhole base, cone, and riser units shall conform to ASTM C478, and shall be circular with circular reinforcement. For manhole depths to 32 feet, the wall thickness of the sections shall be 5 inches. Manhole sections shall have modified grooved tongue joints with "O" ring gaskets or a tongue and groove joint with a Butyl Rubber based gasket type sealant meeting the requirements of AASHTO M-198 and having a nominal size of 1-inch (25 mm).
 2. Precast concrete base, top slab, and grade ring units shall conform to ASTM C478.
 3. Precast concrete utility structures, other than manholes, shall conform to the requirements of ASTM C858 and ASTM C857.
- C. HDPE
1. HDPE manholes shall be made from HDPE resins meeting the following requirements:
 - a. HDPE extruded solid wall pipe shall be a minimum grade of PE 3608 with a minimum cell classification value of 345464C as defined in ASTM D3350. Dimensions of all pipe shall meet ASTM F714 requirements unless otherwise approved.
 - b. HDPE Profile wall pipe shall be manufactured to the dimensions and material requirements of ASMT F894 with a minimum cell classification value of 334433C as defined in ASTM D3350.
 - c. HDPE sheet, plate and other HDPE materials shall be minimum grade of PE3608 with a minimum cell classification value of 345464C as defined in ASTM D3350
 2. Perform fusions in accordance with ASTM F2620.
 3. Inlets and outlets shall be extrusion welded on the inside and outside of the structure.
 4. All manhole connections shall be butt fusion welded, electrofusion welded, or flanged connection.
 5. All butt fusion welds shall be made as described in ASTM F2620.
 6. Manholes shall be leak tested with water or air when fabrication is complete. Hydrostatic test minimum duration of one hour. If air is used, minimum of 1 PSI shall be used for 30 minutes.
 7. HDPE manholes shall not be used in areas subject to traffic
- D. Flexible Neoprene Joints: Kor-N-Seal® assembly with stainless steel Korband®, ASTM C-923. Assembly number per pipe size shown on drawings. If boot cannot be installed as part of the manufacturing process for the manhole, then provide and install waterstop grouting ring, WS series, as manufactured by Press-Seal Gasket Corporation, conforming

to ASTM C923 and ASTM C1478, with stainless steel hardware. Install per manufacturer's instructions, grout inside with non-shrink grout.

- E. Protective Coating: Maintenance and containment sewer line concrete manholes and other structures as outlined on the plans shall be coated with Permacoat 4000 Epoxy Coating by Chemproof Polymers, Inc, two coats, 25-30 mils thick.

F. Manhole Steps:

1. Steel reinforced plastic steps shall be of suitably approved co-polymer polypropylene conforming to ASTM D4101, with 1/2 inch minimum diameter deformed reinforcing bar conforming to ASTM A615, Grade 60.
2. Manhole steps shall be of the type and size indicated on the Plans and shall comply with applicable occupational safety and health standards. Manhole steps shall be installed at locations indicated on the Plans.

2.7 MORTAR: ASTM C270, Type M; 2500 psi, average 28-day compressive strength.

2.8 FRAMES AND COVERS

- A. Frames and covers for manholes shall conform to ASTM A48, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. The castings shall be neatly made and free from cracks, holes, and other defects. Surfaces of casting shall be ground to assure proper fit and to prevent rocking. Heavy duty cast iron covers within paved roadways shall be designed to withstand a minimum AASHTO HS-20 loading.
- B. All areas: EJIW 1047 heavy duty solid cover, unless otherwise noted.

2.9 STRUCTURE ENCAPSULATION SYSTEM

- A. WRAPIDSEAL Heat Shrinkable Wraparound Sleeves
- B. Manufacturer: Canusa – CPS
- C. Supplied by HD Waterworks (734) 398-5950

2.10 CONTAINMENT TRAPS: CAST IRON

- A. All areas: EJIW 5944 with cleanout or equivalent
- B. Manufacturer: East Jordan Iron Works, East Jordan, MI
Neenah Foundry Company, Neenah, WI

PART 3 - EXECUTION

3.1 VERIFICATION OF EXCAVATION AND BEDDING

- A. Prior to the installation of any sewer piping, structures, or materials, examine all trenches and other excavations for the proper grades, lines, levels, and clearances required to receive the new Work. Ascertain that all excavation bottoms, compacted subgrades, and pipe bedding are adequate to receive the sewer materials to be installed. Correct all defects and deficiencies before proceeding with the Work.

3.2 EXISTING SEWERS

- A. Expose the existing sewer and structures to which the new Work is to be connected and notify the Engineer of the same. The Engineer will verify the vertical and horizontal locations of the existing system and shall inform the Contractor as the necessary adjustments required to align the new sewer Work with the existing system.

3.3 PREPARATION

- A. Establish lines and levels. Locate and layout, by instrumentation and similar means, grading, fill replacement, piping, and structures.

- B. The Contractor shall field verify the location and the elevation of all existing tie points and line crossings prior to laying any pipe.
- C. Existing horizontal and vertical control points for the project will be established by the Owner.
- D. Maintain a complete, accurate log of all control points and verify survey work as it progressed.
- E. Upon request of Owner, submit documentation to verify accuracy of survey work.
- F. Do not lay pipe in trench or hole with standing water present. Trench must be dewatered prior to laying any pipe.
- G. The outside surface of the spigot end and the inside surface of the bell end of the pipe shall be cleaned and free of any foreign materials, other than the sealant recommended by the manufacturer, prior to installation.
- H. All pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately prior to installation. Defective or damaged material shall be rejected and removed from the Project by the Contractor.

3.4 INSTALLATION – GENERAL

- A. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length.
- B. Cutting of the pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square cut end without damage to the pipe and that minimize air borne particles shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of the pipe materials being cut and according to the best trade practices. When cutting pipe, care shall be taken to prevent damage to the interior and exterior surfaces. Damage to either shall be cause for rejection of a complete section of pipe. During the preparation of the pipe bedding and until the trench has been satisfactorily backfilled, the trench shall be kept free of water. A dewatering system, in accordance with Section 02319 - Dewatering, shall be provided and maintained by the Contractor. The dewatering system shall remain in operation until the trench is final backfilled to the finish grade.
- C. Excavation and backfill shall be as indicated on the Plans and as specified in Section 02224 – Excavating, Trenching, and Backfilling.

3.5 PIPE BEDDING

- A. After the bottom of trench has been excavated, the pipe bedding material will be installed in accordance with the Plans and Section 02224 – Excavating, Trenching, and Backfilling. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 02224 – Excavating, Trenching, and Backfilling and as noted on details in the Plans. Particular care shall be taken to assure filling and tamping all spaces under, around, and above the top of pipe.
- B. A continuous and uniform bedding as specified in Section 02224 – Excavating, Trenching, and Backfilling shall be provided in the trench for all buried pipe.

3.6 PIPE LAYING - GENERAL

- A. Installation of pipe shall conform to ASTM D2321 and as recommended by the pipe manufacturer.
- B. The pipe shall be protected during the handling against impact shocks and free fall. Hooks shall not be permitted to come in contact with premolded joint surfaces.

- C. Care shall be taken to avoid dragging any pipe on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.
- D. All pipes shall be laid to the line and grade called for on the Plans. Each pipe laid shall be checked by the Contractor with line and grade pole or laser system to insure that this result is obtained. When employing a laser system, the Contractor shall have an independent and alternative means of checking the line and grade. The finished work shall be straight and shall be sighted through the manholes.
- E. Construction shall begin at the outlet end and proceed upgrade with spigot ends pointing in the direction of flow.

3.7 HDPE PIPE INSTALLATION

- A. Butt fusion joining techniques shall be in accordance with Plastic Pipe Institute "Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe TR-33". Use butt fusion or electro fusion in accordance with manufacturer's procedures. Fusion equipment shall be capable of:
 - 1. 400° F to 450° F temperature; verify with manufacturer's procedures.
 - 2. True alignment of joined sections
 - 3. 75 psi interfacial fusion pressure.
- B. Visually inspect and compare all butt fused joints against the manufacturer's recommended appearance guidelines prior to installing pipe. The width of butt fusion beads shall be 2-2 ½ times the bead height above the pipe and the beads should be rounded and uniformly sized all around the pipe circumference. The v-groove between the beads shall not be deeper than half the bead height above the pipe surface. The joint shall be perpendicular to the horizontal axis of the pipe. Visually unacceptable joints shall be cut out and re-fused.
- C. Optional Fusion for Fittings: Extrusion welding by manufacturer-trained and qualified craftsmen.
 - 1. Extrusion welding shall not be used for pressure pipe applications.
 - 2. Extrusion welding shall not be used where shear or structural strength is important.
- D. Thermal Expansion and Contraction: The expansion and contraction characteristics of HDPE shall be considered in the installation of the pipe system. Final tie-ins shall be made as close to the operating temperature as possible. For summer applications with two fixed connection points, a slightly longer length of pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.
- E. Install tracer wire along pipe length, wrapping around each end twice, and extending above grade. Secure to pipe every 20 feet and at all bends.
- F. Tolerances:
 - 1. Vertical- +/- 1/2 inch from design
 - 2. Horizontal- +/- 2 inches from design

3.8 STRUCTURES

- A. Construct sewer structures to grades, lines, and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment brick, grade rings, etc. as shown and as required for a complete installation. Sewer structures shall conform to the type of material and dimensions indicated on the Plans.

- B. Precast Structures:
 - 1. Construct precast concrete as detailed on the Plans. Provide mortar joints struck smooth. Provide three to five courses of eight-inch brick or concrete grade rings at the top of the structure for future adjustment of castings.
- C. Provide and install all frames and covers to the elevations indicated on the Plans. Castings shall be set in a full bed of cement mortar 1/2-inch thick, minimum. Mortar joints shall be struck smooth.
- D. Steps shall be installed at the plant by the manufacturer of precast units.
- E. Pipe up to 42 inches in diameter, shall be connected to storm structures using a Kor-N-Seal® assembly with stainless steel Korband. The pipe shall be properly supported, so that any settlement will not disturb the connection.
- F. Install WrapidSeal™ Structural Encapsulation System per Manufacturer's recommendations around the surface casting and grade rings as well as the first exterior joint of precast structures.
- G. Flow channels shall be installed on all manholes. Flow channel shall conform to the shape and size of the connecting sewers. Benches shall be sloped from the manhole wall toward the channel.

3.9 FIELD QUALITY CONTROL

- A. After all the pipe and structures have been laid, constructed, and backfilled, the system shall be final inspected. The sewer system shall be ready for the final inspection within 2 weeks after the completion of each 2,000 foot section of sewer installed.
- B. The final inspection shall consist of a visible and audible check of the sewers and structures to ascertain that the steps have been placed, all lift holes have been jointed, all visible or audible leaks stopped, all pipe has been placed straight and true to the proper slopes and elevations, the required brick courses for adjustment, the frame and cover properly installed, all trenches and structures backfilled in a workmanlike manner, and that the system has been thoroughly cleaned.
- C. Manhole coating shall be checked to ensure coating integrity, no visible coating defects, no bare spots, and that the coating is integral with all pipe penetrations, patches, joints and boots.
- D. The final inspection shall be considered complete when all repairs have been made.

3.10 DEFLECTION TEST FOR PLASTIC PIPE

- A. All Plastic pipe shall be tested for deflection, but no sooner than 30 days following the backfilling of the pipe.
- B. Maximum allowable deflection (reduction in vertical inside diameter) shall be five (5) percent.
- C. Locations with excessive deflection shall be excavated and repaired by rebedding and/or replacement of the pipe.
- D. Optional devices for testing include calibrated television, or sonar, sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. A properly sized nine leg "go/no go" mandrel may be acceptable if the size of the internal melt bead does not interfere with the mandrel. Deflection measuring device shall be approved by the Engineer prior to use.

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3.11 STRUCTURE PROTECTIVE COATING

- A. Coating shall be applied per manufacturer's recommendations to a minimum of one foot above crown of pipe. Coating shall be placed prior to placing structure in the ground when at all possible. Concrete surfaces receiving coating shall be cured and prepared in accordance with manufacturer's recommendations.
- B. Prior to coating the concrete surface shall be sandblasted or etched as recommended by the manufacturer, and all holes and voids shall be filled as necessary to provide a smooth backing for the coating. Coating shall not be applied until the concrete has sufficiently cured.

END OF SECTION

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CONTAINMENT SEWER INSPECTION REPORT

CWP/WORK ORDER #: _____

DATE: _____

CONTRACTOR: _____

INSPECTION BY: _____

WITNESSED BY: _____

Visual Inspection		Pass	Fail	Comments
Visual Inspection	Steps: Level, 12" on center, aligned			
	Lift holes Plugged with mortar			
	No leaks present			
	Manhole Joints are uniform around circumference, 1/2" or less, not leaking			
	Manhole Boots sealing the circumference of the pipe			
Pipe (Upstream)	Straight			
	Clean			
	Proper Slope			
	Proper Invert Elevation			
Pipe (Downstream)	Straight			
	Clean			
	Proper Slope			
	Proper Invert Elevation			
Final Adjustment	Brick Courses			
	Wrapid Seal			
Frame and Cover	Elevation			
	Secured			
Sewer Trenches	Backfilled and Compacted			
Manhole Coating	Integrity			
	Cracks/ Holes			
	Holidays			

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CONTAINMENT SEWER DEFLECTION TEST REPORT

CWP/WORK ORDER #: _____

DATE: _____

CONTRACTOR:_____

TESTED BY: _____

WITNESSED BY: _____

[illegible]

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SANITARY SEWER

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- A. This section includes sanitary sewer Work indicated on the Plans complete with pipes, joints, fittings, structures, pipe bedding, final inspection and appurtenances.

1.2 RELATED WORK

- A. Section 02224 – Excavating, Trenching and Backfilling

1.3 REFERENCES

- A. ASTM C270 - Standard Specification for Mortar for Unit Masonry
- B. ASTM C-478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
- C. AASHTO - American Association of State Highway and Transportation Officials
- D. ASTM D3034 - Standard Specification for PVC Pipe, SDR 35

1.4 SUBMITTALS

- A. Pipe Crush Test Report
- B. Pipe Leakage Test Report

PART 2 PRODUCTS**2.1 OWNER PROVIDED PRODUCTS**

- A. None.

2.2 CONTRACTOR PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 SANITARY SEWER PIPE

- A. Sanitary Sewer main pipe and fittings; Ring-Tite, PVC gravity sewer pipe and fittings conforming with ASTM D3034, SDR 35 or SDR 26; joints shall be bell & spigot to conform to ASTM D3212 unless noted different on drawings.
- B. Sanitary Sewer service leads pipe and fittings; Ring-Tite, PVC gravity sewer pipe and fittings conforming with ASTM D3034, SDR 26; joints shall be bell & spigot to conform to ASTM D3212 unless noted different on drawings.

2.4 MANHOLE PRODUCTS

- A. Manholes: Precast reinforced concrete, base, cone and riser units conforming to ASTM C478, and shall be circular with circular reinforcement. For manhole depths to 32 feet, the wall thickness of the sections shall be five (5) inches. Manhole sections shall have modified grooved tongue joints with "O" ring gaskets or a tongue and groove joint with a Butyl Rubber based gasket type sealant meeting the requirements of AASHTO M-198 and having a nominal size of 1-inch (25 mm).

Precast concrete base, top slab, and grade ring units shall conform to ASTM C478.
- B. Flexible Manhole Connections: Kor-N-Seal® assembly with stainless steel Korband®, ASTM C-923 unless noted otherwise on attached drawings. Assembly number per pipe size shown on drawings.
- C. Manhole Steps:
 - 1. Steel reinforced plastic steps shall be of suitably approved co-polymer polypropylene conforming to ASTM D4101, with 1/2 inch minimum diameter deformed reinforcing bar conforming to ASTM A615, Grade 60.

2. Manhole steps shall be of the type and size indicated on the Plans and shall comply with applicable occupational safety and health standards. Manhole steps shall be installed at locations indicated on the Plans.

2.5 MORTAR: ASTM C270, Type M, 2500 psi, average 28 day compressive strength.

2.6 FRAMES AND COVERS

- A. Frames and covers for manholes shall conform to ASTM A48, Class 30, gray iron.
- B. The castings shall be neatly made and free from cracks, holes, and other defects. Surfaces of casting shall be ground to assure proper fit and to prevent rocking. Heavy duty cast iron covers within paved roadways shall be designed to withstand a minimum AASHTO HS-20 loading. Clear opening width must be a minimum of 24 inches.
- C. All areas: EJIW 1047 heavy duty solid cover, unless otherwise noted.

PART 3 EXECUTION

3.1 PREPARATION

- A. Establish lines and levels. Locate and layout, by instrumentation and similar means, grading, fill replacement, piping, and structures.
- B. The Contractor shall field verify the location and the elevation of all existing tie points and line crossings prior to laying any pipe.
- C. Existing horizontal and vertical control points for the project will be established by the Owner.
- D. Maintain a complete, accurate log of all control points and verify survey work as it progresses.
- E. On request of Owner, submit documentation to verify accuracy of survey work.
- F. Do not lay pipe in trench or hole with standing water present. Trench must be dewatered prior to laying any pipe.
- G. The outside surface of the spigot end and the inside surface of the bell end of the pipe shall be cleaned and free of any foreign materials, other than the sealant recommended by the manufacturer, prior to installation.
- H. All pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately prior to installation. Defective or damaged material shall be rejected and removed from the Project by the Contractor.

3.2 PVC PIPE INSTALLATION

- A. Trenching, pipe bedding and backfilling shall confirm with Section 02224 – Excavating, Trenching and Backfilling unless shown otherwise on the plans.
- B. Building leads shall extend to 5-feet outside the building and shall be air tested and deflection tested.
- C. Tolerances:
 1. Vertical +/- 1/2 inch from design
 2. Horizontal +/- 2 inch from design

3.3 MANHOLE INSTALLATION

- A. Manhole depths/lengths vary and shall be determined by the top of the manhole casting and the invert of the sewer main. Location and size of inlets and outlets vary, refer to manhole schedule on plans.

- B. Flow channels shall be installed on all manholes. Flow channel shall conform to the shape and size of the connecting sewers. Benches shall be sloped from the manhole wall toward the channel.

3.4 FIELD INSPECTION

- A. Elevation and horizontal coordinates of installed piping shall be checked by the Contractor prior to backfilling. Joints shall be visually inspected for watertight integrity prior to backfilling. All visible leaks or cracks in sewers and manholes shall be repaired regardless of test results.
- B. Air Testing Sewer (Mainline Sewer and Building Leads) The procedure for air testing of sewers shall be as follows:
 - 1. The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure and shall provide an air-tight seal. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer.

The pressure gauge shall have a minimum diameter of 3-1/2" and a range of 0-10 psig. The gauge shall have minimum divisions of 0.10 psig and an accuracy of +/-0.04 psig.
 - 2. The sewer shall be pressurized to 5 psig greater than the greatest back pressure caused by ground water level over the top of the sewer pipe. At least two minutes shall be allowed for the air pressure to stabilize between 4.5 and 5 psig. If necessary, air shall be added to the sewer to maintain a pressure of 4.5 psig or greater.
 - 3. After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 4.5 psig, or such other pressure as is necessary to compensate for ground water level.
 - 4. The time required for the air pressure to decrease 1.0 psig during the test shall not be less than the time shown in the following table:

SPECIFICATION TIME REQUIRED FOR 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED											
1 Pipe Diameter (In.)	2 Minimum Time (Min:Sec)	3 Length For Minimum Time (Ft.)	4	Specification Time For Length (L) Shown (Min:Sec)							
			Time For Longer Length (Sec.)	100 Ft.	150 Ft.	200 Ft.	250 Ft.	300 Ft.	350 Ft.	400 Ft.	450 Ft.
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02

5. If a sewer fails to pass the air test, the Contractor shall determine the location of the leaks, repair them and retest the sewer. The air test shall be repeated until satisfactory results are obtained.
6. Method of testing and measurement shall be approved by the Owner's Representative. The Contractor shall provide the necessary equipment and labor for making all tests.
7. The Contractor is required to perform a 5 psig air test on all laterals that is to be witnessed by the City Plumbing Inspector.
8. Chemical or cement grouting will not be considered an acceptable method of repairing leaking pipe, joints or structural failures, except where specifically approved by the Owner's Representative.

NOTE: The air test can be hazardous under certain conditions. It is extremely important that all air plugs be properly secured and that care be exercised during the test and in the removal of plugs. A 15" plug with 4.5 psi applied to it exerts almost 800 pounds of force. This is an example of the potential hazard that exists if plugs are not correctly installed or are not completely relieved of air pressure before being removed. As a safety precaution, it is suggested that pressurizing equipment be provided with a pressure relief device to reduce hazards and to avoid over-pressurization of any sewer lines.

C. Deflection Test

1. The PVC sewer between 6" and 18" in size shall be tested for deflection by a deflectometer or the "Go-No Go" Gauge method.
2. The deflection testing shall take place not sooner than 30 days after completion of the backfilling.

3. If the deflection exceeds 5% in any area, the trench shall be re-excavated, the pipe embedment and backfill shall be removed and replaced in accordance with the original specifications. If the pipe has been damaged, the Contractor shall remove the pipe and replace it with new pipe, installed in accordance with these specifications. The pipe shall be retested for deflection after the repair and backfill is completed.
4. The Contractor shall be responsible for providing approved gauges or deflectometer, accessories and all equipment and labor required to perform this test, including any necessary cleaning of the lines prior to testing and shall perform the test.

<u>TEST MANDREL SIZES</u>		
Nominal Pipe Size	5% Deflection Mandrel O.D. For SDR 35 Pipe	5% Deflection Mandrel O.D. For SDR 26 Pipe
6"	5.5"	5.39"
8"	7.37"	7.22"
10"	9.22"	9.02"
12"	10.98"	10.72"
15"	13.43"	13.15"
18"	16.16"	15.78"

END OF SECTION

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SANITARY SEWER

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SANITARY SEWER DEFLECTION TEST REPORT

CWP/WORK ORDER #: _____

DATE: _____

CONTRACTOR: _____

TESTED BY: _____

WITNESSED BY: _____

Drawing No.	Manhole From	Manhole To	Pipe Diameter	Pass	Fail	Comments

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SANITARY SEWER

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SANITARY SEWER LEAKAGE TEST REPORT

CWP/WORK ORDER #: _____

DATE: _____

CONTRACTOR: _____

TESTED BY: _____

WITNESSED BY: _____

Test No.	Drawing No.	Manhole From	Manhole To	Size & Length	Height of Water Over Pipe	Adj. Air Pressure	Pass	Fail

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CHAIN LINK FENCE AND GATES

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PART 1 – GENERAL

1.1 SCOPE

- A. Galvanized coated chain link fencing and accessories for industrial use.
- B. Section includes the supply and installation of fence framework, fabric, gates, barbed wire, accessories and related hardware; excavation, installation, and backfill of line, corner, termination and gate posts; concrete foundation for posts, and installation of swing and sliding gates.

1.2 REFERENCES

- A. ASTM A121 - Zinc-Coated (Galvanized) Steel Barbed Wire.
- B. ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM A392 - Zinc-coated Steel Chain-Link Fence Fabric.
- E. ASTM B429 - Aluminum Alloy Extruded Structural Pipe and Tube.
- F. ASTM F567 - Practice for Installation of Chain-Link Fence.
- G. ASTM F626 – Standard Specification for Fence Fittings.
- H. ASTM F900 - Industrial and Commercial Swing Gates.
- I. ASTM F1043 - Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
- J. ASTM F1083 – Standard Specification for Pipe, Steel, Hot Dipped Zinc Coated (Galvanized) Welded Fence Structures.
- K. ASTM F1184 - Industrial and Commercial Horizontal Slide Gates.
- L. CLFMI (Chain Link Fence Manufacturers Institute) - Product Manual.

1.3 SYSTEM DESCRIPTION

- A. Fence Height: 8 feet nominal unless otherwise noted
- B. Line Post Spacing: At intervals not exceeding 10 feet
- C. Fence Post and Rail Strength: Conform to ASTM F1043 Light Industrial Fence quality.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Shop Drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- C. Product Data: Manufacturer's catalog cut sheets indicating material compliance and specified options.
- D. Samples: If requested, samples of materials (fabric, wires and accessories).

1.5 QUALITY ASSURANCE

- A. Supply material according to CLFMI – Product Manual
- B. Perform installation according to ASTM F567
- C. Manufacturer: Company specializing in manufacturing products specified in the Section with five years' experience.

PART 2 – PRODUCTS

2.1 CHAIN LINK FENCE FABRIC

- A. Galvanized wire: Zinc coated wire ASTM A392 Galvanized Wire Fabric – 1.2oz/sf.

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- B. Size: Helically wound and woven to height of 8 feet with 2" diamond mesh, 9 gauge, with wire diameter of 0.148" and a break load of 1,290 lbf.
- C. Selvage of fabric twisted at top and twisted at bottom.

2.2 STEEL FENCE FRAMING

- A. Steel Pipe – Type I: ASTM F1083, standard weight schedule 40; minimum yield strength of 30,000 psi; sizes as indicated. Hot dipped galvanized with minimum average 1.8 oz/sf of coated surface area.
- B. Steel pipe – Type II: Cold formed and welded steel pipe complying with ASTM F1083, Group IC, with minimum yield strength of 50,000 psi, sizes as indicated. Protective coating per ASTM F1083, external coating type B, zinc with organic overcoat, 0.9 oz/sf minimum zinc coating with chromate conversion coating and verifiable polymer film. Internal coating Type B, minimum 0.9 oz/sf zinc or Type D, zinc pigmented 81% nominal coating, minimum 3 mils thick.
- C. Formed steel "C" sections: Roll formed steel shapes complying with ASTM F 1043, Group II, 45,000 psi minimum yield strength steel; sizes as indicated. External coating as per ASTM F1043, Type A, minimum average 2.0 oz/sf of zinc per ASTM A123, or 4.0 oz/sf per ASTM A525.
- D. Steel square sections: Steel having minimum yield strength of 40,000 psi; sizes as indicated. Hot-dipped galvanized with minimum 1.8 oz/sf of coated surface area.
- E. End (terminal) and Corner Posts 3" Nominal Diameter Minimum
- F. Line Posts 2-1/2" Nominal Diameter Minimum
- G. Rails and Braces 1-5/8" Nominal Diameter Minimum

2.3 ACCESSORIES

- A. Chain link fence accessories: ASTM F 626 Provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing.
- B. Post caps: Formed steel or cast malleable iron weather tight cone closure cap for tubular posts. Provide one cap for each post. Cap to have provision for barbed wire when necessary. "C" shaped line post without top rail or barbed wire supporting arms do not require post caps. Where top rail is used, provide tops to permit passage of top rail.
- C. Top rail and rail ends: Pressed steel per ASTM F626, for connection of rail and brace to terminal posts.
- D. Top rail sleeves: 7" expansion sleeve with a minimum 0.137" wire diameter and 1.80" length spring, allowing for expansion and contraction of top rail.
- E. Wire ties: 9 gauge 0.148" galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge 0.092" for rails and braces. Hog ring ties of 12-1/2 gauge 0.0985" for attachment
- F. Brace and tension (stretcher bar) bands: Pressed steel, 1/16" thick, minimum 300 degree profile curvature for secure fence post attachment.
- G. Tension (stretcher) bars: One piece lengths equal to 2 inches less than full height of fabric with a minimum cross-section of 3/16" x 3/4". Provide tension (stretcher) bars where chain link fabric meets terminal posts.
- H. Tension wire: Galvanized coated steel wire, 6 gauge, 0.192" diameter wire with tensile strength of 75,000 psi.
- I. Truss rods & tightener: Steel rods with minimum diameter of 5/16". Capable of withstanding a tension of minimum 2,000 lbs.

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- J. Barbed wire: ASTM A 121 Class 3, zinc coated steel wire double-strand, 12-1/2 gauge 0.099" twisted line wire with galvanized steel, 4 point barbs spaced approximately 5" on center.
- K. Barbed wire supporting arms: Pressed steel arms with provisions for attaching 3 rows or barbed wire. Arms shall withstand 250 lb. downward pull at the outermost end of arm without failure.
 - 1. Provide 45°, 3 strands, single arm.
 - 2. Provide intermediate arms with hole for passage of top rail.
- L. Nuts and bolts are galvanized.
- M. Cables: U.S. Domestic RR-W-410E 3/4" diameter 6 x 19 class wire rope, regular lay, extra improved plow steel (EIPS) independent wire rope core (IWRC), Class A galvanized in accordance with ASTM A741, and have a minimum breaking strength of 58,800 lbs.
- N. Termination Anchors (Helical Screws): Lead helical shafts shall be Model C150-0169 (Catalog No. C110-0385). Plain shaft extensions shall be Model C150-0145 (Catalog No. C110-0470). The termination heads shall be oval eye adapters (Catalog No. C110-0041). Materials to be provided by Chance Construction Products or approved equal.

2.4 SETTING MATERIALS

- A. Concrete: Minimum 28-day comprehensive strength of 3,000 psi.

2.5 GATES

- A. General:
 - 1. Gate Types, Opening Widths and Directions of Operation: As indicated.
 - 2. Factory assemble gates.
 - 3. Design gates for operation by one person.
- B. Swing Gates
 - 1. Fabricate gates to permit 180 degree swing
 - 2. Gate Frames: Fabricate chain link swing gates in accordance with ASTM F900 using galvanized steel tubular members, 2" square, weighing 2.60 lb/ft. Fusion or stainless steel welded connections forming rigid one-piece unit.
 - a. For gates over 8' high or 15' wide, provide minimum 1-1/2" square additional horizontal and vertical members to ensure proper strength.
 - 3. Chain Link Fence Fabric: Mesh and gauge to match fence. Install fabric with hook bolts and tension bars at all 4 sides. Attach gate frame at not more than 15" on center.
 - 4. Hardware Materials: Hot dipped galvanized steel or malleable iron shapes to suit gate size.
 - 5. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non lift off type hinge design shall permit gate to swing 180 degree inward and outward.
 - 6. Latch: Cargo style latch or similar.
 - 7. Keeper: Provide keeper for each gate leaf over 5' wide. Gate keeper shall consist of mechanical device for securing free end gate when in the full open position.
 - 8. Barbed Wire Top: Incorporate provisions for barbed extensions by extending vertical members 13" to accommodate three strands of barbed wire.

9. Gate Posts: Steel pipe ASTM F1083 standard weight Schedule 40; minimum yield strength of 25,000 psi, size as indicated. Hot dipped galvanized with minimum 1.8 oz/sf of zinc or respective material finish in accordance with ASTM F1043.

<u>Gate leaf single width</u>	<u>Post Size (diameter)</u>	<u>Weight</u>
6 ft or less	2.875 inch	5.79 lb/ft
6 ft to 12 ft	4.00 inch	9.11 lb/ft
12 ft to 19 ft	6.625 inch	18.97 lb/ft
19 ft to 23 ft	8.625 inch	28.55 lb/ft

C. Cantilevered Sliding Gates

1. Gate Frames: Fabricate chain link cantilever slide gates in accordance with ASTM F1184, Type II, Class 2, using 2 inch square aluminum members, ASTM B429 alloy and temper 6063-T6, weighing 0.94 lb/ft. Weld members together in one-piece frame integral with top track. Provide 2 truck assemblies for each gate leaf, except as indicated for gates larger than 30'.

Gates over 27' in a single opening shall be shipped in 2 parts and field spliced with special attachments provided by the manufacturer.

2. Internal Uprights: 2" x 2" aluminum members welded in gate frames at 8' on center, subdividing frame into panels.

3.

<u>Gate Leaf Sizes</u>	<u>Cantilever Support (Overhang)</u>
6 ft to 10 ft	6'-6"
11 ft to 14 ft	7'-6"
15 ft – 22 ft	10'-0"

For gate leaf sizes 23' to 30', weld an additional 2" square lateral support rail adjacent to top horizontal rail. Bottom rail shall consist of 2" x 4" aluminum member weighing 1.71 lb/ft.

<u>Gate Leaf Sizes</u>	<u>Cantilever Support (Overhang)</u>
23 ft to 30 ft	12'-0"

For gate leaf sizes 30' to 40', weld 2 top track/rails together forming dual enclosed track. Provide 2 truck assemblies for each track for each gate leaf, total 4 truck assemblies. Bottom rail shall consist of 2" x 4" aluminum member weighing 1.71 lb/ft.

Gate Frame Finish: Natural Aluminum

Chain Link Filler Finish: Aluminized – ASTM A491

4. Bracing: Provide diagonal adjustable length truss rods of 3/8" galvanized steel, in each panel gate frames.
5. Top track/rail: Enclosed combination one-piece track and rail, aluminum extrusion with weight of 3.72 lb/ft. Track to withstand reaction load of 2,000 lbs.
6. Truck Assembly: Swivel type, zinc die cast, with 4 sealed lubricant ballbearing rollers, 2 inches in diameter by 9/16" in width, and 2 side rolling wheels to ensure truck alignment in track. Mount trucks on top brackets using 7/8" diameter ball bolts with 1/2" shank. Truck assembly to withstand same reaction load as track, 2,000 lbs.
7. Gate hangers, latches, brackets, guide assemblies, and stops: Malleable iron or steel, galvanized after fabrication. Provide positive latch with provisions for padlocking.

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8. Bottom guide wheel assemblies: Each assembly shall consist of two, 4" diameter rubber wheels with oil impregnated bearings, straddling the bottom horizontal gate rail, allowing adjustment to maintain gate frame plumb and in proper alignment. Attach one assembly to each guide post.
9. Gate Posts:
 - a. For gates under 31'-0" galvanized steel 4" OD Schedule 40 pipe, ASTM F1083, weighing 9.1 lb/ft. Provide 1 latch post and 2 support posts for single slide gates and 4 support posts for double slide gates.
 - b. For gates 31'-0" and larger, 2 pairs of support posts for each leaf (dual) 4" OD Schedule 40 pipe, ASTM F1083, weighing 9.1 lb/ft. Posts connected by welding 6 inch x 3/8" plate between posts as shown on Drawings. Also one 4" latch post.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Verify areas to assure sufficient space to receive gate in open position, (gate and overhang).
- C. Ensure property lines and legal boundaries of work are clearly established.
- D. Construction will be in accordance with the manufacturer's guidelines established by the Chain Link Fence Manufacturing Institute (CLFMI).

3.2 CHAIN LINK FENCE FRAMING INSTALLATION

- A. Install chain link fence in accordance with ASTM F 567 and manufacturer's instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30° or more.
- C. Space line posts uniformly at 10' maximum on center. Permanent fence line posts to be bored and poured with concrete within 4" of finished grade. Temporary fence line posts to be driven in ground.
- D. Concrete set terminal and gate posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter 4 times greater than outside dimension of post, and depths approximately 6" deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36" below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour to within 4" of finished grade. Backfill for surface treatment material. For posts installed in bituminous concrete or concrete areas place concrete to finished grade and slope to direct water away from posts. Holes resulting from removal of existing post footings may be utilized for installation of posts as approved by the Owner's Representative.
- E. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- F. Bracing: Install horizontal pipe brace at mid-height for fences 6' and over, on each side of terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring posts remain plumb.
- G. Tension wire: Provide tension wire at bottom of fabric and at top, if top rail is not specified. Install tension wire before stretching fabric and attach to each post with ties. Secure tension wire to fabric with 12-1/2 gauge 0.0985" hog rings 24" oc.
- H. Top rail: Install lengths, 21'. Connect joints with sleeves for rigid connections for expansion/contraction.

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- I. Center Rails for fabric height 12' and over. Install mid rails between posts with fittings and accessories.

3.3 CHAIN LINK FABRIC INSTALLATION

- A. Fabric: Install fabric on security side and attach so that fabric remains in tension after pulling force is released. Leave approximately 2" between finish grade and bottom selvage. Attach fabric with wire ties to line posts at 15" on center and to rails, braces, and tension wire at 24" on center. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- B. Cables: Install cable systems shown on drawing. Reduce the slack in cable by anchoring and tightening the cable so that it will not move along or slide through the U-bolts. Spacing shown on drawings.
- C. Tension (stretcher) bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15" on center.

3.4 CHAIN LINK SWING GATE POST INSTALLATION

- A. Install gate posts in accordance with manufacturer's instructions.
- B. Concrete set gate posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have a diameter 4 times greater than the outside dimension of the post, and depths approximately 6" inches deeper than the post bottom. Excavate deeper as required for adequate support in soft or loose soils, and for posts with heavy lateral loads. Set post bottom 36" below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope away from posts. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
 1. Gate posts and hardware: Set keeper, stops, sleeves into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

3.5 CHAIN LINK SWING GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference.
- B. Attach hardware by means which will prevent unauthorized removal.
- C. Adjust hardware for smooth operation.

3.6 CANTILEVER SLIDE GATE FRAMING INSTALLATION

- A. Install gate posts in accordance with manufacturer's instructions.
- B. Concrete set gate posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have a diameter 4 times greater than the outside dimension of the post, and depths approximately 6" inches deeper than the post bottom. Excavate deeper as required for adequate support in soft or loose soils, and for posts with heavy lateral loads. Set post bottom 36" below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope away from posts. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

3.7 CANTILEVER SLIDE GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference.
- B. Attach hardware by means which will prevent unauthorized removal.
- C. Adjust hardware for smooth operation.

3.8 ACCESSORIES

- A. Tie wires: Bend ends of wire to minimize hazard to persons and clothing.

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- B. Fasteners: Install nuts on side of fence opposite fabric side for added security.
- C. Barbed wire: Uniformly space parallel rows of barbed wire on security side of fence. Pull wire taut and attach in clips or slots of each extension.

3.9 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: $\frac{1}{4}$ inch.
- B. Maximum Offset From True Position: 1 inch.
- C. Components shall not infringe adjacent property lines.

3.10 CLEANING

- A. Clean up debris and unused material, and remove from the site.

END OF SECTION

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LANDSCAPING

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Finish grade subsoil.
- B. Place, level, and compact topsoil. Preparation of seed bed.
- C. Application of hydroseed containing fertilizer, glue, mulch and grass seed in lawn areas.
- D. Broadcast application of erosion control seeding and mulch.

1.2 RELATED SECTIONS

- A. 02200 - Site Grading
- B. 02020 – Temporary Erosion and Sediment Control

1.3 PROTECTION

- A. Protect landscaping and other features remaining as final work.
- B. Protect existing structures, fences, roads, sidewalks, paving and curbs.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED MATERIALS - None

2.2 CONTRACTOR-PROVIDED MATERIALS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS

- A. Topsoil: Reused
- B. Topsoil: Imported, friable loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4 percent and a maximum of 25 percent organic matter.
- C. Hydroseed for lawn areas is to consist of a seed mixture as follows:
 - 40% Perennial Ryegrass
 - 20% Kentucky Bluegrass
 - 10% New Port Kentucky Bluegrass
 - 30% Penn Lawn Red Fescue
- D. Erosion Control Seed Mixture is to be 100% Perennial Ryegrass.
- E. Fertilizer shall have an analysis of 8-8-8 or 10-10-10 of Nitrogen, Phosphorus and Potassium and is to be used in the lawn area hydroseed application.
- F. Mulch shall be straw, hay or excelsior.
 - 1. Straw or hay mulch shall be held in place by a commercially available tackifier, or crimping/punching material approved by the Owner's Representative.
 - a. Emulsified Asphalt is not permitted.
 - b. Mulch Anchoring Tool:
 - i. Suitable unit having a series of flat, notched discs for punching and anchoring mulch in soil, or a regular farm disc weighted and set nearly straight as a substitute.
- G. Adhesive: Terr-Tack AR Mulch Adhesive.
- H. Erosion Control Blankets

1. Machine produced blanket with a consistent thickness evenly distributed straw or coconut fiber as specified. Unless otherwise specified on the Plans, the erosion control blanket shall have the following minimum properties:
 - a. Double net 100% straw blanket.
 - b. Top and bottom photodegradable polypropylene netting, 1.64 lbs/1,000 sf approximate weight.
 - c. 100% agricultural straw 0.5 lbs./syd.
 - d. Stitch spacing: 1.5 inches on center.
- I. Blanket Anchors: wood or other biodegradable net anchors at least 6 inches in length

PART 3 – EXECUTION

3.1 INSPECTION

- A. Verify site conditions and note irregularities affecting work of this section.
- B. Beginning work of this section means acceptance of existing conditions.

3.2 SUBSOIL PREPARATION

- A. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, in excess of 1 inch in size.
- B. Scarify subgrade to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.3 PLACING TOPSOIL

- A. Place the topsoil in areas scheduled for hydroseeding or erosion control seeding. Compacted topsoil thickness is to be 4" minimum.
- B. Use the topsoil in a relatively dry state. Place during dry weather.
- C. Fine grade the topsoil, eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade.
- D. Remove stones, roots, grass, weeds, debris, and foreign material while spreading.
- E. Spread topsoil around trees, plants, and building to prevent damage.
- F. Lightly compact placed topsoil.

3.4 PREPARATION

- A. Consult drawings indicating areas scheduled for hydroseed application and areas scheduled for erosion control seed and mulch application.
- B. Areas scheduled for hydroseeding or erosion control seeding shall be cleared of all weeds, roots and litter and the topsoil shall be loosened to a depth of 2" by discs, drags or other methods. Any large clods/clumps shall be either removed or broken down to a size below 2" in diameter.

3.5 PLACEMENT OF SEED MIXTURES AND MULCH

- A. Lawn Area Hydroseed Mixture:
 1. Fertilizer shall be applied at the rate required to furnish 300 pounds per acre.
 2. The grass seed mixture shall be sown uniformly at a rate of 220-250 pounds per acre.
 3. The mulch shall be applied at a rate of 1,500 pounds per acre with 30 pounds per acre of glue.

B. Erosion Control Seed and Mulch

1. The grass seed shall be sown uniformly at a rate of 60-70 pounds per acre.
2. Mulch shall be spread at a rate of 2 tons per acre. The mulch shall be loose enough to allow sunlight to penetrate but thick enough to shade the ground and prevent or reduce water or wind erosion. Terr-Tack AR Mulch Adhesive shall be applied with or over the mulch at a rate of 250 gallons per acre when mixed with straw mulch or 500 gallons per acre when applied over straw mulch.
3. During hydroseeding work, avoid overspray onto nearby equipment, pavement or buildings. Clean up and restore oversprayed areas.
4. Contractor to maintain all new lawn areas until project completion and/on acceptance by Owner's Representative.
5. If the seeded lawn becomes largely weeds after germination, kill the weeds using an environmentally approved weed killing product and reseed the affected lawn areas to produce lawn.
6. Repair damage to seeded areas resulting from erosion.

3.6 TURF ESTABLISHMENT

- A. Seeded areas shall be watered whenever excessive drying is evident during the period set for establishment. Watering shall be done in a manner that will prevent erosion due to the application of excessive quantities and the watering equipment shall be of a type that will prevent damage to the cultivated surfaces. The Contractor shall be responsible for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.
- B. Reseed and mulch areas larger than four (4) square inches for turf areas and 12 square inches for meadow or rough grass areas not having a dense, uniform, vigorous stand of grass acceptable to the Owner's Representative.
- C. Contractor to apply additional fertilizer on area to be reseeded.
- D. The establishment period shall extend for a period from the time of seeding until the seeded area has a uniform stand of grass acceptable to the Owner's Representative. The minimum period shall be 60 days.
- E. If after 60 days from the initial seeding a dense, uniform, vigorous stand of grass has not been established by the Contractor, the Contractor shall re-prepare and reseed all areas as necessary until turf and grasses are established in accordance with the specifications.

END OF SECTION

PART 1 – GENERAL**1.1 WORK INCLUDED**

- A. Construction of reinforced concrete, including formwork and accessories, to dimensions on the drawings.
- B. Installation of reinforced, plain, wire-mesh reinforced, steel fiber-reinforced, and plastic fiber-reinforced concrete slabs-on-grade and elevated floor slabs
- C. Expansion, control and construction joints at locations given on plan drawings.
- D. Concrete reinforcing complete with required supports, spacers, grounding rebar, and related accessories.
- E. Coordination of electrical grounding cable installation. Refer to Electrical drawings for locations and details.
- F. Curing of concrete.

1.2 RELATED SECTIONS

- A. Section 02224 – Backfilling/Trenching/Excavating

1.3 REFERENCES

- A. ACI Manual of Concrete Practice, Current Year's Edition
- B. All Applicable ASTM's

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301. Maintain copy of ACI 301 on site.
- B. Design, engineer, and construct formwork, shoring, and bracing to conform to the design and code requirements; resultant concrete to conform to the required shape, line, and dimensions.
- C. Installer Qualifications: A qualified installer who employs a project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- D. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- E. Testing Agency Qualifications: An independent agency, qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E329.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. 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.
 - 3. CCRL (Cement and Concrete Reference Laboratory) and AMRL (Aggregate and Materials Reference Laboratory) certifications are recommended, but not required.

- F. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- G. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."

1.5 ENVIRONMENTAL CONDITIONS

- A. When slabs are placed on ground, there should be no more than 30 °F difference between the temperature of the base and concrete at the time of placement, and all concrete contact surfaces should be above freezing point of water.
- B. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow, or when inclement weather is imminent.
- C. Follow concrete preparation, placement and control procedures and requirements in accordance with ACI 305 and ACI 306.
- D. Cold weather:
 - 1. Concrete placement should not commence when there is a chance of freezing temperatures occurring, unless adequate facilities for cold-weather protection have been provided.
 - 2. When average daily outdoor temperature is less than 40 degree F, cold weather concreting procedures shall apply. Average daily temperature is defined as average of highest and lowest temperature during period from midnight to midnight.
 - 3. Length of protection period for concrete placed during cold weather shall be determined by "Guide to Cold Weather Concreting", ACI 306R
 - 4. Combustion heaters should be vented and not be permitted to directly heat or dry the concrete.
 - 5. Concrete shall be protected from extremes in temperature as specified. During periods not defined as cold weather, but when freezing outdoor temperatures are foreseen or occur, concrete surfaces shall be protected against freezing for a minimum first 24 hours after placement. Continue protection and curing long enough, and at minimum temperature recommended by "Guide to Cold Weather Concreting", ACI 306R
 - 6. Discuss Cold Weather Concreting plan with Owner's Representative and Project Engineer prior to placing concrete.
- E. Hot Weather:
 - 1. When conditions of concrete temperature, air temperature, wind velocity, and relative humidity combine to cause flash set, excessively low slump, cold joints, plastic shrinkage cracking, or otherwise impair the quality of concrete, hot weather concreting procedures shall apply.
 - 2. When evaporation rate of bleed water is expected to approach the bleeding rate of the concrete, steps shall be taken to prevent plastic shrinkage cracking. Evaporation rate shall be determined by method shown in "Hot Weather Concreting", ACI 305R.
 - 3. An effort should be made to keep the temperature of the fresh concrete as low as practical. Temperature of concrete can be reduced by methods outlined in "Hot Weather Concreting", ACI 305R.

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4. Concrete surfaces should not be allowed to become surface-dry at any point during the transition
5. Concrete should also be protected against thermal shrinkage cracking due to rapid temperature drops, particularly during the first 24 hours. Thermal shrinkage cracking is associated with a cooling rate of more than 5°F (3°C) per hour, or more than 50°F (28°C) in a 24-hour period for concrete with a least dimension less than 12 in.
6. Discuss Hot Weather Concreting plan with Owner's Representative and Project Engineer prior to placing concrete.

1.6 TESTS

- A. Inspection and initial testing of concrete will be performed by testing agency at option of Owner's Representative and Project Engineer, paid for by Owner. Contractor to pay for all retests.
 1. Contractor to notify Owner's Representative and Project Engineer at least (2) full business days prior to placement of concrete.
- B. Unless modified at the discretion of the Owner's Representative, with Project Engineer's approval;
 1. (6) 4"x8" cylinders every third truck, or at the start of a new pour, or when time between trucks exceeds 1 hour
 - a. (2) 4x8" Cylinders to be broken per break, in accordance with ASTM C 39
 - b. Project engineer to indicate to contractor and testing agency when additional testing is required in the event of high early breaks
 2. (1) Slump test per batch of cylinders ASTM C 143
 3. (1) Air, Unit Weight, and Yield per batch of cylinder ASTM C 138
 4. (1) Temperature per batch of cylinders ASTM C 1064
 5. These results are to be turned in to Cons. Rep and Project Engineer within 1 business day
 6. Testing agency to hold onto spare cylinders for (90) days at which point, with Project Engineer and Owner's Representative's approval, cylinders can be disposed of

1.7 SHOP DRAWINGS

- A. Submit shop drawings of rebar locations and details, unless this requirement is waived during the pre-bid meeting. Prepare shop drawings in compliance with CRSI, ACI 318, and ACI SP-66. Use acceptable detailing practices and maintain consistency of shop drawings throughout the project.
- B. Reinforcing steel: Indicate bar sizes, spacings, location of reinforcing steel, bending and cutting schedules, and splice laps and locations.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
- D. Submit proposed mix design alternative for review prior to commencement of work.
- E. Submit drawings and mix design under the provisions of Section 01300.

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- A. Anchor bolt templates manufactured from metal as supplied by the equipment manufacturer, for installation of process vessels and compressors as noted on the drawings. Embedded items for dock levelers and truck restraints excluding conduit. Contact Owner's Representative when items are needed.

2.2 CONTRACTOR PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to complete work of this section and all supplemental heat sources.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I or III- Normal, Portland type. Use one brand and type of cement throughout project, unless noted otherwise.
- B. Fly Ash: ASTM C 618, Class C or F. Use one brand and mill source throughout project, unless noted otherwise.
- C. Slag Cement: ASTM C 989, Grade 100 or Grade 120 only. Use one brand and mill source throughout project, unless noted otherwise.
- D. Silica Fume: ASTM C 1240. Use one brand and source throughout project, unless noted otherwise.
- E. Coarse Aggregate: 100% crushed limestone; following ASTM C33.
- F. Fine Aggregate: Sand, following ASTM C33; sharp, clean, and free from dust, loam, dirt, vegetable matter, other foreign or deleterious matter and injurious amounts of organic impurities.
- G. Water: Potable, not detrimental to concrete.
- H. Air Entrainment: ASTM C260.
- I. Chemical: ASTM C494, as required for job site conditions.

2.4 CONCRETE MIX

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301 Method 1.
- C. Provide concrete to meet the following criteria, unless specified otherwise by the Project Engineer:

<u>Unit</u>	<u>Measurement</u>
Compressive Strength (28 day)	4500 psi
Aggregate Size (maximum)	1-1/2 inch
Air Entrainment	5 - 8 percent by volume
Slump 1. Consolidation by vibration:	4 inches maximum
2. Consolidation other than vibration:	5 inches

- D. Provide mix design to Project Engineer two business days prior to placing concrete. This requirement may be waived at Project Engineer's discretion.
- E. Add air-entraining agent to normal weight concrete mix for work exposed to exterior.
- F. Use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.
- G. Use of calcium chloride is prohibited.

- H. Use set retarding admixtures during hot weather only when approved by the Engineer.
- I. Submission of mix design to Owner's Representative and Project Engineer is required, unless noted otherwise by Project Engineer

2.5 REINFORCING STEEL AND REINFORCING ACCESSORY MATERIALS

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade billet steel deformed bars; uncoated finish.
- B. Stirrup steel: ANSI/ASTM A82, plain finish.
- C. Tie Wire: Minimum 16 gauge annealed type.
- D. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions. Do not use metal chairs. Use plastic chairs or concrete brick for concrete poured on grade.
- E. Per Project Engineer's design, the inclusion of a Type I or Type II Fiber meeting all criteria set forth by ASTM C 1116 may be used.
 - 1. Fibers must be mixed per manufacturer's requirements.
 - 2. Pre-Approved Steel Fibers, Alternatives must be approved by Project Engineer prior to inclusion in concrete mix design.
 - a. Dramix™ 3D, 2" long steel fibers with round end deformation cross section as manufactured and distributed by:
Bekaert Corporation - specialty steel wire
510 Collins Blvd.
Orrville, Ohio 44667
T +1 330- 683-5060
F +1 330-683 0446
 - b. Propex Concrete Systems 2" Novocon 1050 round wire with round deformation as manufactured and distributed by:
Propex Concrete Systems
1110 Market Street, Suite 300
Chattanooga, TN. 37402
T +1 800-621-1273
F+1 423-899-5005

2.6 ACCESSORIES

- A. Form materials: Conform to ACI 301, 347.
- B. Form release agent: material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
- C. Waterstops:
 - 1. Polyvinyl chloride (PVC), 6 inch split ribbed "dumbbell" profile, maximum possible lengths, preformed corner sections, heat welded jointing, minimum 50 psi tensile strength, minimum 150°F working temperature range; manufactured by Vynlex or equivalent.
 - 2. Volclay Waterstop RX
 - 3. For spill pond construction only:
 - a. For joints between retaining wall and footing: Flat Waterstop, Greenstreak HYDROTITE CJ1020® - expandable waterstop or equal.
 - b. For slab construction joints: Greenstreak RSS-060P® waterstop or equal.

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- D. Trench grating: Heavy duty cast-iron grates; size and model as noted on the drawings, type M2 grate, with related framing; as manufactured by East Jordan Iron Works or Neenah.
- E. Precast Drainage Trench: Polydrain Polyester Channel with 502 heavy duty ductile iron inlay slotted grate.
- F. Anchor Bolts: F1554 Grade 55 material, Hot-Dip Galvanized per ASTM A153 unless noted otherwise on the drawings: Furnish to the project site anchor bolts, complete with nuts and washers as required. Mark bolts per the shop drawings for bolt installation.
- G. Expansion Anchors: Hilti Kwik Bolt TZ or Hilti HIT HY 200 injection Adhesive anchor unless noted otherwise; diameters as indicated on the drawings; follow manufacturer's instructions and recommendations for installation. Substitutions only as submitted to and approved by Engineer.
- H. Joint Materials (Verify product use and materials with Owner's Representative and Project Engineer)
 - 1. One-part Sealant:
 - a. Dow Corning® DC 790 Silicone Building Sealant; color - match concrete
 - b. Sikaflex 15 LM® Sealant
 - c. For containment areas only: MasterSeal NP-1
 - 2. Backer rod: ASTM D-1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent; Ethafoam® as manufactured by the Dow Chemical Company.
 - 3. Joint Filler: 1/2 inch wide asphaltic filler, Ethafoam®, as manufactured by the Dow Chemical Company.

2.7 BONDING AGENTS

- A. SIKADUR 31 Hi-Mod
 - 1. Meets physical requirements of ASTM C-881 Types I, II & IV, Grade 3, Classes B & C.

2.8 CURING MATERIALS

- A. Water: Potable.
- B. Absorptive mat: Cotton fabric, clean, roll goods.
- C. Polyethylene film: 6 mil black or clear color.
- D. Burlap, Clean, free of debris.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing the concrete.

3.2 PREPARATION

- A. Perform work in accordance with ACI 301 and 318 codes except as amended by this section.
- B. The in-place density of the subgrade soils shall be at least 95% proctor, unless determined otherwise by Project Engineer.

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- C. The subgrade shall be moist at the time of concreting, and if necessary, shall be wetted in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.
- D. Verify requirements for concrete cover around reinforcement.

3.3 EXISTING CONCRETE

- A. Prepare previously placed concrete by cleaning with steel brush or high pressure water blast and applying bonding agent in accordance with the manufacturer's instructions.
- B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels, installed with Hilti RE 500- SD Epoxy Adhesive.

3.4 FORMWORK ERECTION

- A. Unless noted otherwise, all work shall be formed.
- B. Provide forms able to carry any expected loads imposed without being vertically or horizontally displaced.
- C. Do not remove forms and bracing until concrete has gained sufficient strength to carry its own weight, construction loads and design loads which are liable to be imposed upon it.
- D. Verify lines, levels, and measurement before proceeding with formwork.
- E. Hand trim sides and bottom of earth forms; remove loose dirt.
- F. Align form joints.
- G. Obtain approval before framing openings in structural members which are not indicated on drawings.
- H. Provide chamfer strips on exposed external corners of walls and piers. Provide rough form finish.

3.5 WATERSTOP

- A. Install waterstops continuous without displacing reinforcement. Heat seal PVC joints watertight where PVC is used.
- B. For spill construction only:
 - 1. Flat Waterstop, - 1 inch profile width, attached to cast-in-place concrete after form stripping with a bead of Dow Corning® DC 790 sealant. Use concrete nails to help hold waterstop in place during construction.
 - 2. Round Profile - used in construction joints in addition to backer rod and sealant.

3.6 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with the manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are effected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete and with no free standing water.

3.7 JOINTS

- A. Provide joints in locations shown on drawings.
- B. Submit any proposed modifications to joint location, layout, or construction details to the Owner's Representative for approval.

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- C. All joints to be sealed must be clean, dry and frost free. Blow out joints with clean, oil free compressed air just before installing backer rod.
- D. Install waterstop with no splices (preferred) or if not possible, use iron to melt and join at splice.
- E. Install the sealants against a closed cell, expanded polyethylene backer rod. Install backer rod at the proper depth for the sealant.
- F. Install sealant according to manufacturer's recommendations. Tool sealant to force it against joint surfaces and recess 1/4 inch below finished slab surface.
- G. Provide sealant bead width-to-depth ratio of 2:1 and a thickness from 1/4 inch minimum to 1/2 maximum.
- H. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw, and shall be completed within 24 hours before shrinkage stresses become sufficient to produce cracking.

3.8 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in, or passing through, concrete work.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate work of other sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts.
- D. Use anchor bolt template(s) supplied by the equipment manufacturer for placement of anchor bolts. Set one template above the pier and one at the top of the anchor bolts in order to maintain bolt alignment, spacing and plumbness.
- E. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, and positioned securely.
- F. Position recessed reglets for brick veneer masonry anchors to spacing and intervals specified in Section 04200.
- G. Install accessories in accordance with the manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- H. Install waterstops continuous without displacing reinforcement. Heat seal PVC joints watertight.
- I. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- J. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.9 REINFORCEMENT

- A. Place, support, and secure reinforcement against displacement.
- B. Locate reinforcing splices as shown in the drawings, or when they are not shown, locate at places of minimum stress.

3.10 PLACING CONCRETE

- A. Notify the Owner's Representative and Project Engineer a minimum of (2) business days prior to commencement of operations. Do not place any concrete without prior approval and inspection of rebar by the Owner's Representative and Project Engineer.

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- B. Ensure reinforcement, inserts, embedded parts, and formed joint fillers are not disturbed during concrete placement.
- C. Do not place concrete until Owner's Representative and Project Engineer have inspected anchor bolts for bond breaker and alignment.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Concrete shall be vibrated into place with appropriate equipment to ensure that all voids within the formwork are completely filled with fresh concrete.
- F. Apply a bonding agent to the existing concrete surfaces then new concrete will come in contact with.

3.11 COLD-WEATHER CONCRETING

- A. Install concrete work in accordance with ACI 301 and ACI 306 except as amended by this section.
- B. Procedures must be reviewed and agreed to by Owner's Representative and Project Engineer before placement.
- C. Supplemental heat shall be provided with steam heaters (live, low pressure steam), hot water circulation, electrical tracing, or insulated blankets. All required materials shall be furnished by the Contractor. Other methods must be approved by Project Engineer and Owner's Representative.
- D. Cold weather concreting procedures including production, transportation, placement, protection, curing, and temperature monitoring shall be submitted prior to onset of cold weather.
- E. Preparation:
 - 1. Snow, ice, and frost shall be removed from reinforcement and surfaces against which concrete is to be placed. Subgrade shall be free of frost before concreting begins. Concrete shall not be placed against embedment which is at temperature below freezing, and is sufficiently massive as to cause adjacent concrete to freeze. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35°F.
 - 2. Preparation before concrete is placed requires a temperature increase of the formwork, reinforcement, and other surfaces that will contact fresh concrete so the temperature of the freshly placed concrete will not decrease below the minimums as placed and maintained in the table above.
 - 3. If water or aggregate is heated above 100F, water shall be combined with aggregate in mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having temperature greater than 100F.
- F. Placing:
 - 1. Minimum concrete temperature as placed and maintained:

Least dimension of section (in.)	Minimum Temperature of concrete as placed and maintained during the protection period (°F)
< 12	55
12 to less than 36	50
36 to 72	45
> 72	40

G. Protection:

1. Materials and equipment required for protection shall be available at project site before cold weather concreting.
2. During the protection period, do not expose the concrete surface to air having a temperature more than 20 F above the minimum protection period temperatures.
3. During periods not defined as cold weather, but when freezing temperatures may occur, protect concrete surfaces against freezing for the first 24 hr after placing.
4. Heated Enclosure:
 - a. Enclosure shall be wind resistant and weather tight.
 - b. Supplemental heat shall be provided with steam heaters (low pressure, live steam). All heaters and hoses shall be furnished by the Contractor.
 - c. Heaters and ducts shall be arranged so as not to cause areas of overheating or drying of concrete surface.
5. Insulation:
 - a. Slabs not less than 12-in. thick placed on ground, elevated slabs, and walls may be protected by insulated forms and insulation blankets. Insulation shall be wind resistant and weather tight.
 - b. Insulation type and thickness shall be selected with due regard for concrete temperature, air temperature, and length of protection period in accordance with "Cold Weather Concreting" (ACI 306R). Special care shall be taken at corners and edges of structure. Insulation type, thickness, and "R" value shall be indicated in cold weather concreting procedures.
 - c. When minimum concrete temperature is not maintained, insulation shall be removed and immediately replaced by heated enclosure. Sufficient number of surface thermometers shall be furnished and installed as directed by Structural Engineer.
6. Curing:
 - a. If water curing is used, it shall be terminated at least 24 hours before concrete is exposed to freezing temperatures. Curing period shall be completed by non-water curing methods.
 - b. Cure and protect concrete against damage from freezing for a minimum period of 3 days, unless otherwise specified.

- c. Maintain the surface temperature of the concrete during that period in accordance with the Minimum concrete temperature as placed and maintained Table above.
- 7. Termination of protection:
 - a. The maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed

Least dimension of section (in.)	Maximum gradual decrease in surface temperature during any 24 hr. after end of protection (°F)
< 12	50
12 to less than 36	40
36 to 72	30
> 72	20

3.12 HOT-WEATHER CONCRETING

- A. Comply with ACI 305, ACI 308 and the following provisions during hot weather. Hot weather concreting procedures including production, transportation, placement, protection, and curing shall be submitted prior to onset of hot weather.
- B. Initiate evaporation control measures when the water evaporation rate from the free water surface is equal to or greater than 0.2lb/ft²/hr.
- C. Concrete Production and Delivery
 - 1. Type III cement is prohibited.
 - 2. Concrete ingredients shall be cooled before mixing or flake ice shall be substituted for all or part of mixing water as required, to reduce concrete temperature. Mixing shall continue until ice is completely melted.
 - 3. Delivery of concrete shall be scheduled so that concrete is deposited as soon as possible. Concrete shall be completely discharged within 1 hour after introduction of mixing water to cement.
- D. Preparation: Steel forms, reinforcement, and embedments shall be cooled by spraying with water immediately prior to concrete placement.
- E. Placing: Concrete shall be placed at lowest practicable temperature. Temperature of concrete as placed shall not cause difficulty from loss of slump, flash set, or cold joints and shall not exceed 90°F.(95°F per ACI 305.1-06). When temperature of reinforcement, embedments, or forms is greater than 120°F, use a fine mist of water to moisten the hot surfaces immediately before placing concrete. Remove standing water before placing concrete.
- F. Protection:
 - 1. Protect the concrete against thermal shrinkage cracking due to rapid drops in concrete temperature greater than 40°F during the first 24 hours of curing..

2. Plastic shrinkage cracking shall be minimized by fog spraying for minimum of 4 hours after placement, installing wind breaks, and beginning curing procedures as soon as practicable.
3. Forms shall be covered and kept moist.
4. Monitor site conditions to assess the need for evaporation control measures. Begin monitoring no later than 1 hr. before concrete placement and at intervals of 30 minutes from start, until curing protections measures are in place.

G. Curing:

1. Curing shall be performed by water methods only unless approved otherwise.
2. When use of waterproof sheet material is approved for hot weather concreting, material shall be pigmented white.
3. Forms shall be loosened as soon as practicable and water curing shall be used as specified.
4. Monitor site conditions to assess the need for evaporation control measures. Begin monitoring no later than 1 hr. before concrete placement and at intervals of 30 minutes from start, until curing protections measures are in place.

3.13 CONCRETE FINISHING

- A. Swivel steel trowel finish all interior slab surfaces and broom finish exterior concrete slab surfaces, unless noted otherwise on the drawings. Surfaces to be surface sealed or coated with chemical resistant coating to be trowel finished.
- B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at no more than 1/8 inch per foot (1 percent) nominal, or maintain level floor until the area immediately near floor drain and dish slab towards the drain at no more than 1/8 inch per foot (1 percent) nominal.
- C. Finish floor tolerances shall be Class B as defined in ACI 301; true planes within 1/4 inch in 10 feet, as determined by a 10 foot straightedge placed anywhere on the slab in any direction.

3.14 CURING AND PROTECTION

- A. Immediately after placement and finishing of fresh formed concrete, cover with plastic sheeting for curing until formwork removal or four days, whichever occurs first. Cure unformed or formed concrete after form removal with one of the products specified in Section 2.7.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for a period necessary for hydration of cement and hardening of concrete.
- D. Cure concrete for at least 7 days provided that the concrete surface temperature is a least 50 degrees F.
- E. Failure to comply with the curing requirements of this section shall be considered a major deviation of the contract requirements and shall be sufficient grounds to reject the work.
- F. No curing compounds are allowed except with Owner's Representative and Project Engineer's prior approval.

3.15 PATCHING

- A. Allow the Owner's Representative to inspect the concrete surfaces immediately upon removal of forms.

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- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Owner's Representative upon discovery.
- C. Patch imperfections as directed by the Owner's Representative in accordance with ACI 301.

3.16 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements of ACI 301. See Table 4.3.1 for allowed tolerances. Concrete exhibiting a poor finish, or inadequate strength, or discovered frozen before minimum curing time has past.
- B. Repair or replacement of defective concrete will be determined by the Owner's Representative.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of the Owner's Representative and Project Engineer for each individual area.

END OF SECTION

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PART 1- GENERAL

1.1 WORK INCLUDED

- A. Fabricate and erect precast concrete hollow core floor/roof planks.
- B. Provide connection plates, brackets and hangers.
- C. Grout plank joint keys
- D. Provide concrete fill around structural steel columns.
- E. Provide expansion joints between precast concrete plank and masonry walls.
- F. Provide concrete topping for precast concrete plank.
- G. Saw-cut control joints in concrete topping.

1.2 RELATED SECTIONS

- A. Section 01300 – Submittals
- B. Section 05120 - Structural Steel: Supporting steel and headers
- C. Section 05500 - Metal Fabrications: Embedded items
- D. Section 07270 – Firestopping
- E. Section 07900 - Joint Sealers: Caulking of butt joints of precast units at exposed underside of floor members

1.3 REFERENCES

- A. ACI 301 – Specifications for Structural Concrete for Buildings
- B. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
- D. ASTM A992, Standard Specification for Structural Steel Shapes
- E. ASTM A36 – Standard Specification for Carbon Structural Steel
- F. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- G. ASTM A416 - Standard Specification Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- H. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- I. ASTM C150 - Standard Specification for Portland Cement
- J. ASTM C94 - Standard Specification for Ready Mix Concrete
- K. ASTM C33 - Standard Specification for Concrete Aggregates
- L. AWS B2.1 - Standard for Welding Procedure and Performance Qualification
- M. AWS D1.1 - Structural Welding Code - Steel
- N. AWS D1.4 - Structural Welding Code - Reinforcing Steel
- O. PCI - Manual for the Design of Hollow Core Slabs

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- P. PCI JR-307 - Tolerances for Precast and Prestressed Concrete
- Q. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products
- R. PCI MNL-120 – PCI Design Handbook - Precast and Prestressed Concrete
- S. PCI MNL-123 - Design and Typical Details on Design of Connections for Precast Prestressed Concrete
- T. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete
- U. PCI MNL-126 - Manual For The Design of Hollow Core Slabs
- V. PCI - Design Handbook - Precast and Prestressed Concrete
- W. PCI - Tolerances for Precast and Prestressed Concrete
- X. UL - Underwriters' Laboratories Inc., Fire Resistance Directory
- Y. IBC – International Building Code, Latest Edition

1.4 DESIGN REQUIREMENTS

- A. Size components to withstand design loads per drawing(s) in a restrained condition.
- B. Maximum allowable deflection of roof planks under live load: $1/240$ span.
- C. Maximum allowable deflection of floor planks under live load: $1/360$ span.
- D. Design components to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.
- E. Grouted Keys: Capable of transmitting horizontal shear force per drawings.
- F. Utilize the PCI - Manual for the Design of Hollow Core Slabs and PCI - Design Handbook.

1.5 SUBMITTALS

- A. Submit drawings and design calculations with assumptions, loadings, and prestressing signed and sealed by a Professional Engineer licensed in the State of Michigan under provisions of Section 01300.
- B. Shop drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut and relationship to adjacent materials.
- C. Product data: Indicate standard component configuration, design loads, deflections, and cambers.
- D. Fabricator's erection instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.6 QUALITY ASSURANCE

- A. Design planks in accordance with the requirements of:
 - 1. PCI MNL-120 - Design Handbook
 - 2. PCI MNL-126 - Manual for the Design of Hollow Core Slabs
 - 3. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete
 - 4. ACI 318

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5. ACI 301

- B. Design connections in accordance with PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.
- C. Design plans under direct supervision of a professional engineer experienced in design of this work and licensed in the state of Michigan.
- D. Produce planks in accordance with requirements of PCI MNL-116. Maintain plant records and quality control program during production of precast planks. Make records available upon request.
- E. Perform work in accordance with the requirements of PCI MNL-116, PCI MNL-123, and PCI MNL-120.
- F. Maintain plant records and quality control program during production of precast planks. Make records available upon request.

1.7 QUALIFICATIONS

- A. Fabricator: Company specializing in manufacturing the work of this section with ten years of documented experience.
- B. Erector: Company specializing in erecting the work of this section with ten years of documented experience and approved by the fabricator.
- C. Design precast concrete members in accordance with PCI Manual for the Design of Hollow Core Slabs, under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Project Location.
- D. Welder: Qualify procedures and personnel within previous 12 months in accordance with AWS D1.1, AWS B2.1, and AWS D1.4.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
- B. Provide additional protection according to manufacturer instructions
- C. Protect members to prevent staining, chipping, or spalling of concrete.
- D. Lifting or handling devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation and erection.
- E. Mark each member with date of production and final position in structure.

PART 2-PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None

2.2 CONTRACTOR-PROVIDED PRODUCTS:

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 PERFORMANCE AND DESIGN CRITERIA

- A. Design components to withstand dead and live loads as noted on the plans.
- B. Design members exposed to weather to allow movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
- C. Design components to accommodate construction tolerances, deflection of other building structural members, and clearances of intended openings.

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2.4 FABRICATORS

- A. StresCore, Inc.: Manufacturers of Corefloor.
- B. Kerkstra Precast, Inc.: Manufacturers of Hollowcore.

2.5 PRECAST PLANK MATERIALS

- A. Concrete Materials: ACI 301.
- B. Tensioning steel tendons: ASTM A416 Grade 270 K, strength commensurate with member design.
- C. Reinforcing steel: ASTM A615, deformed steel bars
- D. Nonshrink grout: Nonmetallic, minimum compressive strength of 10,000 psi at 28 days.
- E. Cement grout: Minimum compressive strength of 4000 psi at 28 days with a 1:2 ½ cement : sand ratio by volume, with minimum water required for placement and hydration.

2.6 CONCRETE MIX FOR FILLING OPENINGS IN PLANK

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301 Method
- C. Provide concrete to the following criteria:

<u>Unit</u>	<u>Measurement</u>
Compressive Strength (28 day)	4000 psi
Aggregate Size (Maximum)	1-1/2 inch

2.7 CONCRETE TOPPING MATERIALS

- A. Cement: ASTM C150, Type I - Portland type.
- B. Fine and Coarse Aggregate: ASTM C33.
- C. Water: Potable.
- D. Do not use calcium chloride.

Provide concrete topping to the following criteria:

<u>Unit</u>	<u>Measurement</u>
Compressive Strength (28 day)	5000 psi
Aggregate Size (Maximum)	1/2 inch

2.8 ACCESSORIES

- A. Connecting and supporting devices:
 - 1. Materials: ASTM A36 carbon steel conforming to PCI MNL-123.
 - 2. Plates, angles, items cast into concrete, items grouted into masonry, items connected to steel framing members, and inserts: Prime painted
- B. Core hole end plugs: Round plastic core plugs of same diameter as openings in hollow core planks, as manufactured by:

KOROLATH of New England, Inc.
498 River Road
Hudson, MA 01749-02621
1-978-562-7366

- C. Hanger tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 pounds of dead load, pre-drilled to receive hanger.
- D. Backer Rod: Closed cell polyethylene; oversized 50 percent to joint width; self-expanding; Ethafoam® as manufactured by the Dow Chemical Company.
- E. Bearing pads: High density plastic, 1/8 inch thick, smooth on one side.
- F. Sill seal: Compressible glass fiber strips.
- G. Mineral Wool
- H. Joint Former: 1/2" wide Styrofoam® brand extruded polystyrene, as manufactured by The Dow Chemical Company.

2.9 FABRICATION

- A. Dimensions as indicated on drawings.
- B. Weld reinforcing in accordance with AWS D1.4.
- C. Embed anchors, inserts, plates, angles, and other items at locations indicated.
- D. Provide openings required by other sections at locations indicated.
- E. Cut exposed ends flush.

2.10 COMPONENTS

- A. Nominal thickness: As indicated on drawings.
- B. Nominal plank width: As indicated on drawings.

2.11 FINISHES

- A. Plant finish: Exposed-to-view surfaces may contain small surface holes caused by small air bubbles, minor chipping or spalling at edges or ends, without major discoloration.
- B. Connecting and supporting steel devices: Prime painted. Do not paint surfaces in contact with concrete or surfaces requiring field welding.

2.12 FABRICATION TOLERANCES

- A. Maximum variation from nominal dimensions:
 - 1. Width: 1/4 inch.
 - 2. Length: 1/2 inch.
 - 3. Thickness: 1/4 inch.
- B. Maximum variation from intended camber: 1/4 inch in 10 feet.
- C. Maximum out of square: 1/8 inch/10 feet, non-cumulative.
- D. Maximum misalignment of anchors, inserts, openings: 1/8 inch.
- E. Maximum bowing of members: 1/4 inch in 10 feet to a maximum of 3/8 inch.

PART 3-EXECUTION**3.1 EXAMINATION**

- A. Verify that site conditions are ready to receive work and field measurements are as indicated on shop drawings and drawings.
- B. Verify supporting structure is ready to receive work.
- C. Beginning of erection means erector accepts existing conditions.

3.2 COORDINATION

- A. Coordinate insertion of core hole end plugs with contractor performing masonry work.

3.3 PREPARATION

- A. Prepare support devices for erection and temporary bracing.

3.4 ERECTION

- A. Erect planks without damage to structural capacity, shape, or finish. Replace or repair damaged planks.
- B. Align and maintain uniform horizontal and end joints as erection progresses.
- C. Maintain temporary bracing in place until final connection is made. Protect planks from staining. Provide temporary lateral support to prevent bowing, twisting or warping of members.
- D. Install bearing pads and sill seal at bearing ends of planks as indicated.
- E. Adjust differential camber between planks to tolerance before final attachment and grouting.
- F. Adjust differential elevation between planks to tolerance before final attachment.
- G. Place sealant backer rod to underside of plank joints to prevent grout leakage.
- H. Grout plank joints and trowel smooth.
- I. Transition differential elevation of adjoining planks with grout to a maximum slope of 1:12.
- J. Secure units in place. Perform welding in accordance with AWS D1.1.

3.5 ERECTION TOLERANCES

- A. Erect to the following tolerances:
 - 1. Maximum variation from plan or location indicated on drawings: 1/4 inch in 10 feet and 3/8 inch in 100 feet, non-cumulative.
 - 2. Maximum offset from true alignment between members: 1/4 inch.
 - 3. Maximum variation from dimensions indicated on reviewed shop drawings and drawings: plus or minus 1/8 inch.
- B. Exposed joint dimensions: 3/8 inch plus or minus 1/4 inch.

3.6 PROTECTION OF FINISHED WORK

- A. Protect planks from damage caused by field welding with noncombustible shields.
- B. Protect planks from damage caused by erection operations.

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3.7 CLEANING

- A. Clean plant markings, weld marks, dirt, or blemishes from surface of exposed members.

3.8 HANGER INSERTION

- A. Insert hangers in plank joint keys per schedule on drawings.
- B. Temporarily anchor hangers to prevent movement during grouting operation.

3.9 CONCRETE FILL

- A. Erect wood formwork, sufficiently strong to resist load of wet concrete without excessive deflection, under precast concrete floor/roof plank. Do not attach formwork to underside of precast concrete floor/roof plank.
- B. Place concrete in void around and over structural steel column to level of precast concrete floor/roof plank.
- C. Medium broom finish concrete surfaces per ACI 301.
- D. Immediately after placement of concrete, protect concrete from premature drying, excessive hot or cold temperatures, or mechanical injury. Maintain minimal moisture loss at a relatively constant temperature for minimum of seven days for hydration of cement and hardening of concrete.
- E. Do not use curing compounds.
- F. Allow concrete to cure for 7 days before removing formwork.

3.10 SURFACE PREPARATION

- A. Vacuum or broom surfaces clean.
- B. Verify that precast concrete plank surfaces are clean, dry and do not contain petroleum by-products or other compounds detrimental to grout topping bond to substrate.

3.11 OPENINGS FOR CONCRETE TOPPING

- A. Erect formwork around edges of floor/roof openings.

3.12 EXPANSION JOINTS

- A. Insert core hole end plugs according to manufacturer's instructions.
- B. Place mineral wool or ETHA FOAM® between masonry wall and precast concrete plank.
- C. Place joint former to depth required on drawings. Temporarily anchor.

3.13 CONCRETE TOPPING

- A. Wet surface of precast concrete planks and eliminate any free standing water prior to commencement of topping placement.
- B. Place concrete topping to thickness as indicated on drawings.
- C. Trowel smooth via hand or machine methods.

3.14 CONCRETE TOPPING TOLERANCES

- A. Top Surface: Level to 1/8 inch in 10 feet.

3.15 CURING AND PROTECTION

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- A. Protect troweled surface from inclement weather and foot traffic for four (4) days.

3.16 CONTROL JOINTS

- A. Allow grout topping to cure for twelve (12) hours minimum, 24 hours maximum before commencing saw-cutting of control joints.
- B. Saw-cut control joints to the depth indicated on drawings.
- C. Clean-up dust and debris created by saw-cutting.
- D. Seal joints with DC 790 sealant.

END OF SECTION

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PRECAST CONCRETE WALL PANELS

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section includes the following:
 - 1. Fabricate and erect insulated and non-insulated, structural precast concrete wall panels.
 - 2. Provide connection plates, embedded plates and other embedded items.
 - 3. Grout wall panels and grout between top of gradewall and bottom of wall panel.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 03300 – Cast-In-Place Concrete for installing connection anchors in concrete.
- C. Section 03415 – Precast Concrete Planks
- D. Section 05120 – Structural Steel for furnishing and installing connections attached to structural-steel framing.
- E. Section 04200 – Unit Masonry for Mortar
- F. Section 05500 - Metal Fabrications
- G. Section 07270 – Firestopping
- H. Section 07900 – Joint Sealer
- I. Section 09900 – Painting

1.3 REFERENCES

- A. ASCE 7 – Minimum Design Loads for Buildings and Other Structures
- B. IBC – International Building Code
- C. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- D. ACI 301 – Specifications for Structural Concrete for Buildings
- E. ACI 318 – Building Code Requirements for Structural Concrete and Commentary
- F. ASTM A36 – Standard Specification for Carbon Structural Steel
- G. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- H. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
- I. ASTM A416 – Standard Specification Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- J. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- K. ASTM C33 – Standard Specification for Concrete Aggregates
- L. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- M. ASTM C144 – Standard Specification for Aggregate for Masonry Grout
- N. ASTM C404 – Standard Specification for Masonry Grout

- O. ASTM C150 – Standard Specification for Portland Cement
- P. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
- Q. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- R. ASTM C1218 – Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
- S. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- T. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- U. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
- V. ASTM A123 - Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from on Iron and Steel
- W. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- X. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc
- Y. AWS B2.1 – Standard for Welding Procedure and Performance Qualification
- Z. AWS D1.1 – Structural Welding Code – Steel
- AA. AWS D1.4 – Structural Welding Code – Reinforcing Steel
- BB. PCI Design Handbook – Precast and Prestressed Concrete
- CC. PCI Tolerances for Precast and Prestressed Concrete
- DD. PCI MNL 120 - PCI Design Handbook - Precast and Prestressed Concrete
- EE. PCI MNL 117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - 1. Loads:
 - a. Minimum Wind Load: As indicated on drawings
 - b. Wind Loads: As indicated on drawings
 - c. Grouted keys: Capable of transmitting horizontal shear force, per drawing.
 - 2. Design connections to maintain clearances at openings, to allow for fabrication and construction tolerances, and to accommodate building movements as follows:
 - a. Downward movement of 1/2 inch.
 - b. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

- C. Shop Drawings: Detail fabrication and installation of precast concrete wall units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
1. Indicate separate face and backup mixture locations and thicknesses.
 2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
 3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 4. Include plans and elevations showing unit location and sequence of erection for special conditions.
 5. Indicate location of each precast concrete unit by same identification mark placed on panel.
 6. Indicate relationship of precast concrete units to adjacent materials.
 7. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, and strength of units when modifying details or materials and maintain the general design concept.
 8. Comprehensive engineering analysis and design, signed, and sealed by the qualified professional engineer licensed in the State of Michigan responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast concrete.
 9. Indicate aesthetic intent including joints, reveals, and extent and location of each surface finish.
 10. Indicate sequence of erection.
- D. Samples: For each type of finish indicated on exposed surfaces of precast concrete units, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches .
1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
- E. Welding certificates.
1. Copies of certificates for welding procedure specifications (WPS) and personnel.
- F. Qualification Data:
1. Precast concrete panels shall be supplied by a manufacturer who is certified by the Prestressed Concrete Institute's Plant Certification Program prior to start of production of precast panels, and has a minimum of 10 (Ten) years experience producing and erecting panels
 2. Design, detailing, fabrication and erection of precast panels shall be under the direct supervision of a professional structural engineer licensed in the state of Michigan and shall conform to the following publications except as specifically indicated in the contract documents

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- a. Precast/Prestressed Concrete Institute (PCI) – PCI Design Handbook (Latest Version)
 - b. American Concrete Institute (ACI)
 - 1) ACI 308 - Structural Concrete for Buildings (Latest version)
 - 2) ACI 318 - Building Code Requirements for Reinforced Concrete (Latest version)
 - c. American Welding Society Structural Welding Code (Latest version D1.1)
- G. Material Test Reports: For aggregates, strengths and mix designs.
- H. Material Certificates: For the following items, signed by manufacturers:
- 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Bearing pads.
 - 4. Reinforcing materials and prestressing tendons.
 - 5. Insulation.
 - 6. Anchors.
- I. Source quality-control test reports.
- J. If design modifications are necessary to meet the performance requirements and field conditions, submit design calculations and drawings. Do not adversely affect the appearance, durability or strength of units when modifying details or materials and maintain the general design concept.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-and load bearing members.
- B. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project before erection of precast concrete and who can produce an Erectors' Post-Audit Declaration.
- C. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Participates in PCI's plant certification program and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units.
- D. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- E. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

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- G. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; AWS D1.4, "Structural Welding Code - Reinforcing Steel", and AWS D1.8, "Structural Welding Code – Reinforcing Steel."
- H. Sample Panels: After sample approval and before fabricating precast concrete units, produce a minimum of 1 sample panels approximately 16 sq. ft. in area for review by HSC Field Representative. Incorporate full-scale details of features, finishes, textures, and transitions in sample panels.
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in HSC EMTN documents."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Product handling requirements of PCI MNL 117 shall be followed at the plant and project site.
- B. Deliver precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
- C. Support units during shipment on nonstaining shock-absorbing material.
- D. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- E. Place stored units so identification marks are clearly visible, and units can be inspected.
- F. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
- G. Lift and support units only at designated points shown on Shop Drawings.

1.8 FURNISHING AND SEQUENCING OF ANCHORAGE ITEMS

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.9 WARRANTY

- A. Warranty of precast work, including anchorage, joint treatment and related components to be free from defects in materials and workmanship, including cracking and spalling.
- B. After erection, completed work will be weathertight, subject to terms of Article "Warranty of Construction" FAR Clause 52.246-21, except warranty period is extended to five years.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None.

2.2 CONTRACTOR-PROVIDED PRODUCTS – All materials, equipment, services and labor required to perform the work of this section.

2.3 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

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- B. Form Liners: Units of face design, texture, arrangement, and configuration to match those used for precast concrete design reference sample. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.4 REINFORCING MATERIALS

- A. Structural steel plates, angles and bars: ASTM A-36
- B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, use cement, of same type, brand, and mill source.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: To match design reference sample.
- C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- D. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
 - 1. Coloring Admixture: ASTM C979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable and non-fading.

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Carbon-Steel Plate: ASTM A 283.
- D. Welding Electrodes: Comply with AWS standards.
- E. Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123, after fabrication, or ASTM A153, as applicable, electrodeposition according to ASTM B633, SC 3, Type 1.

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1. Galvanizing Repair Paint: High-zinc dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20...

2.7 BEARING PADS

- A. Provide one of the following bearing pads for precast concrete units as recommended by precast fabricator for application:
 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi, ASTM D 412.
 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.

2.8 ACCESSORIES

- A. Reglets: Stainless steel, Type 304, felt or fiber filled, or with face opening of slots covered.
- B. Backer Rods: Closed cell polyethylene, oversized 50% to joint width, self expanding
- C. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast concrete units.
- D. Joint Sealant: Dow Corning 790 Silicone Building Sealant.
 1. Color: Match adjacent concrete color.

2.9 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

2.10 INSULATED PANEL ACCESSORIES

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Dow Isocast-R with square edges; with R-value of 9 and thickness of 1 1/2 inches unless otherwise indicated on drawings.
- B. Wythe Connectors: Glass-fiber and vinyl-ester polymer connectors manufactured to connect wythes of precast concrete panels.

2.11 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218.

- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi minimum.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.12 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pre-stressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and pre-stressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly chamfered.

2.13 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast concrete units as indicated on the Contract Drawings.
- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
 - 1. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

2. Place reinforcement to maintain at least 1-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
- E. Reinforce precast concrete units to resist handling, transportation, and erection stresses.
- F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- G. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- J. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- K. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete unit on a surface that will not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- M. Discard and replace precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.14 INSULATED PANEL CASTING

- A. Cast and screed supported wythe over mold.
- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Cast and screed top wythe to meet required finish.

2.15 FABRICATION TOLERANCES

- A. Fabricate precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

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- B. Fabricate architectural trim units such as sills, lintels, coping, cornices, quoins, medallions, bollards, benches, planters and pavers, with tolerances meeting PCI MNL 135.

2.16 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of precast concrete units to match approved sample panels and as follows:
 - 1. Interior Finish: Smooth Steel Trowel Finish.
 - 2. Exterior Finish: As-Cast Smooth – Grade B Finish.
 - 3. Provide surfaces free of excessive air voids, sand streaks and honeycombs.
- B. Finish exposed top and back surfaces of precast concrete units to match face-surface finish.
- C. Finish unexposed surfaces of precast concrete units by steel trowel.

2.17 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- C. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, pre-caster will employ an independent testing agency to obtain, prepare, and test CORES drilled from hardened concrete to determine compressive strength according to ASTM C 42.
 - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer.
 - 2. Cores will be tested in an air-dry condition.
 - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 - 4. Test results will be made in writing on same day that tests are performed, with copies to HSC Construction Representative, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

- D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting cast-in-place grade wall attains its design strength.
- D. Provide continues grouting at the base of the precast wall and foundation concrete wall.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast concrete units to supporting members and backup materials.
- B. Erect precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack-weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. Unless otherwise indicated, maintain uniform joint widths of 1/2 inch.
- C. Connect precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
 - 2. Install grout to seal and fill the space between the bottom of the wall panel and the top of the grade wall.
 - 3. Set grout at bottom of wall back from exterior face of panel 3/8-inch for sealant to be applied.
- D. Welding: Comply with applicable AWS D1.1, AWS D1.4 and AWS D1.8 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
 - 3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.

4. Remove, re-weld, or repair incomplete and defective welds.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 1. Where slotted connections are used, verify bolt position and snug fit. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
- F. Surface mounted anchors
 1. Where required to surface mount conduit or piping, use expansion or epoxy type anchors with maximum 1" embedment.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 4. Place sealant along the bottom exterior face side of the wall panel.
- D. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

3.4 ERECTION TOLERANCES

- A. Erect precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests, inspections and special inspections and prepare test reports.

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- B. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709.
- C. Testing agency will report test results promptly and in writing to Contractor and HSC Representative.
- D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- F. Report damaged panels immediately to HSC construction representative. Do not install damaged panel without approval from the HSC Field Representative.

3.6 REPAIRS

- A. Repair precast concrete units if permitted by HSC Field Representative. The HSC Field Representative reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- D. Remove and replace damaged precast concrete units when repairs do not comply with requirements.

3.7 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, firestopping material, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- D. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.
- E. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

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END OF SECTION

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PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Concrete masonry units.
- B. Mortar and grout for masonry.
- C. Reinforcement, anchorage, and accessories.
- D. Built-in items.
- E. Cut and fit for other sections of work.
- F. Construction of reinforced and unreinforced masonry walls, complete with bond beams, lintels, and insulation.
- G. Masonry wall insulation.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 01410 - Testing Laboratory Services
- C. Section 03415 - Precast Concrete Planks
- D. Section 05120 - Structural Steel
- E. Section 07620 – Sheet Metal Flashing and Trim
- F. Section 08111 - Standard Steel Doors and Frames
- G. Section 08331 - Overhead Coiling Doors
- H. Section 09900 - Painting

1.3 REFERENCES

- A. ACI 117 – Tolerances for Concrete Construction and Materials
- B. ACI 530 – Building Code Requirements and Specification for Masonry Structures
- C. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- D. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- E. ASTM A641 - Zinc-Coated (Galvanized) Carbon Steel Wire.
- F. ASTM A951 – Steel Wire for Masonry Joint Reinforcement.
- G. ASTM C90 - Load-Bearing Concrete Masonry Units.
- H. ASTM C94 - Ready-Mixed Concrete.
- I. ASTM C129 - Non-Load Bearing Concrete Masonry Units.
- J. ASTM C140 - Sampling and Testing Concrete Masonry Units and Related Units
- K. ASTM C144 - Aggregate for Masonry Mortar.
- L. ASTM C150 - Portland cement.
- M. ASTM C270 - Mortar for Unit Masonry.
- N. ASTM C387 - Packaged, Dry, Combined Materials for Mortar and Concrete.
- O. ASTM C404 - Aggregates for Masonry Grout.
- P. ASTM C476 - Grout for Masonry.

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- Q. ASTM C780 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- R. ASTM C1019 - Sampling and Testing Grout.
- S. ASTM C1314 - Compressive Strength of Masonry Prisms
- T. ASTM E119 - Fire Tests of Building Construction and Materials
- U. ICC IBC – International Building Code
- V. ASCE 7– Minimum Design Loads for Buildings and Other Structures

1.4 SUBMITTALS

- A. Submit literature for horizontal joint reinforcement, anchors and ties, pre-molded joint filler and accessory materials under provisions of Section 01300.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement and accessories.
- C. Design Data: Indicate required mortar strength, specified compressive strength of masonry, masonry unit assembly strength in all planes, and supportive test data.
- D. Design Data: Submit design mix when the property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.
- E. Mix Design for Grout: Include description of Types and proportions of ingredients.
- F. Test Reports:
 - 1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, air content, consistency and compressive strength.
 - 2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476. Test and evaluation reports must conform to ASTM C1019.
- G. Hot weather construction procedures
- H. Cold weather construction procedures
- I. Submit name of masonry unit supplier along with supplier specifications / certifications.
- J. When requested by the Owner's Representative, provide samples of masonry units at least one week prior to start of lay-up for approval.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with latest editions of ACI 530 Specification and Building Code Requirements for Masonry Structures or as specified herein.
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C1093 for testing indicated, as documented according to ASTM E548.
- C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

- E. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made **by Owner**. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
 - 1. Mortar Test (Property Specification): For each mix required, per ASTM C780.
 - 2. Grout Test (Compressive Strength): For each mix required, per ASTM C1019 for strength, and in accordance with ASTM C143 for slump.
 - 3. Prism Test: For each type of construction required, per ASTM C1314.
- F. Refer to Section 01410 for Contractor responsibilities when testing is performed.
- G. Take four (4) mortar and grout samples for each 30 cubic yard of mortar or grout or fraction thereof being placed each day. Take samples whenever a change in mix proportions, method of mixing or materials used occurs.
- H. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- I. Certification: Concrete Masonry Unit Test: For each type of unit required in accordance with ACI 530, per ASTM C140.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in undamaged condition.
- B. Deliver and handle units to prevent chipping, breaking, or other damage.
- C. Store products off ground.
- D. Protect masonry units from wetting by capillary action, rain, or snow.
- E. Protect products from mud, dust, or other materials and contaminants likely to cause staining or defects.
- F. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- G. Provide waterproof cover or other protection for sand to prevent rain and/or snow from affecting moisture content of mortar mix.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Follow preparation, placement and control procedures and requirements in accordance with latest edition of ACI 530 Building Code Requirements and Specification or as specified herein.
- B. Cold weather construction: Cold weather construction requirements apply when ambient air temperature is below 40° degrees F.
- C. Hot weather construction: Hot weather construction requirements apply when ambient air temperature exceeds 100° degrees F or ambient air temperature exceeds 90° degrees F and wind velocity exceeds 8 mph.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None

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2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.
- B. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland cement: ASTM C150, Type I, natural color and not have an alkali content of more than 0.1% when tested according to ASTM C 114.
- B. Mortar aggregate: ASTM C144, standard masonry type; washed natural sand free from frozen and foreign matter.
- C. Hydrated lime: ASTM C207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C91.
- F. Grout aggregate: ASTM C404
- G. Water: Potable.
- H. Do not use admixtures for work of this section.

2.4 MORTAR MIXES

- A. Mortar: ASTM C270, Type M or S using the performance specification.
- B. Pointing Mortar: ASTM C270, Type N using the performance specification.

2.5 GROUT MIXES

- A. Bond Beams and Cast-In-Place Lintels: 2500 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 using fine grout.
- B. Reinforced Masonry: 2500 psi strength at 28 days; 8-11 inches slump mixed in accordance with ASTM C476 using fine or course grout, depending on the size of the space to be filled.

2.6 CONCRETE MASONRY UNITS

- A. Hollow Load Bearing Block Units: ASTM C90, Grade N, Type I - Normal weight with a unit strength of 3750 psi to create a $f_m' = 2500$ psi when used with Type M or S mortar unless otherwise noted on drawings.
- B. Hollow Non-load Bearing Block Units: ASTM C129, Type I - Light weight with a unit strength of 1900 psi to create an $f_m' = 1500$ psi when used with Type M or S mortar. Use light weight only at locations identified on the drawings.
- C. Masonry Units:
 - 1. Provide masonry units that conform to ASTM C1386
 - 2. Nominal modular size of 16 inches x 8 inches high x thickness noted on drawings.
 - 3. Provide special units for 90 degree corners, bond beams and cast-in-place lintels.
 - 4. Use bullnose units at corners and door and window jambs.
 - 5. Manufacture concrete masonry units and associated mortar located on exterior walls and where exposed to the elements with an integral water repellent.

2.7 REINFORCEMENT AND ANCHORAGE

- A. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type by Dur-O-Wal or equal with single or double pair of side rods of standard weight, extra-heavy weight (3/16" side rods with 9 gage cross rods), or super heavy weight (3/16" side rods with 3/16" cross rods), or as required on plans. Out to out width of ladder or truss shall be 2" less than nominal dimension of masonry.
1. Provide joint reinforcement that conforms to ASTM A951.
 2. Ladder type reinforcement shall have two longitudinal wires. The third wire shall act as tie. Cross wires shall be spaced at 16 inch centers and shall not have moisture drip.
 3. Truss type reinforcement shall have two longitudinal wires. Cross wire intersections shall be located at 16 inch maximum centers.
 4. Joint reinforcement shall be manufactured with wire conforming to ASTM A1064.
 5. Longitudinal wires shall be deformed in conformance with requirements of ACI 530.1/ASCE 7.
 6. Interior Walls: Hot-dip galvanized, carbon steel.
 7. Exterior Walls: Hot-dip galvanized, carbon steel.
 8. Wire Size for Veneer Ties: 0.187-inch diameter.
 9. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 10. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
 11. Out-to-Out Width of ladder or truss shall be 2 inches less than nominal dimension of masonry.
 12. Finish: ASTM A 153 hot-dipped galvanized to Class B-2, 1.50 ounces/square foot
 13. Joint reinforcement which incorporates adjustable ties is not permitted.
 14. All masonry anchors to the structural beams and columns shall be adjustable.
- B. Reinforcing Steel: ASTM A615, 60 ksi yield grade, deformed billet bars, unprotected finish.
- C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148 inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- D. Strap Anchors: Per Masonry Anchor Schedule on drawings; hot dip galvanized to ASTM A641 Class 3 after fabrication.
1. Provide accessories to aid in proper placement.
- E. Channel Slot: Per Masonry Anchor Schedule on drawings; hot dip galvanized to ASTM A641 Class 3 after fabrication.
- F. Column Ties: Where indicated on drawings; hot dip galvanized to ASTM A82 with ASTM A641, Class 3 coating after fabrication.
- G. Joint Stabilizing Anchor: Per Masonry Anchor Schedule on drawings; hot dip galvanized to ASTM A641 Class 3 after fabrication.

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2.8 ACCESSORIES

- A. Contraction and Expansion Joints: per ACI 530
- B. Backer Rod: Closed cell polyethylene; oversized 50 percent to joint width; self-expanding; minimum 5/8 inch wide by maximum lengths
- C. Joint Sealant: DC790 Silicone Building Sealant, as manufactured by Dow Corning Corporation. Color to match finish paint
- D. Copper: ASTM B370, cold rolled; 24 oz/sq ft thick; natural finish.
- E. Grout Screen: MGS mortar/grout screen as manufactured by Hohmann & Barnard Inc, or equal.
- F. Cavity Insulation:
 - 1. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
 - 2. Core-fill-500 as manufactured by Tailored Chemical Products, Inc.
- G. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
- H. Cleaning solutions: Use potable water or detergents. Non-acidic, not harmful to masonry work or adjacent materials.
- I. Embedded Flashing: High-density polyethylene composition molded into a 0.0625 inch thick flashing pan. Provide BlockFlash by Mortar Net or equal. Provide embedded flashing at the base of concrete masonry exterior walls, above exterior openings, lintels and exterior bond beams or grouted core coursings.
- J. Bond Breaker Strips
- K. Provide asphalt-saturated organic roofing felt complying with ASTM D 226, Type I, No. 15 asphalt felt.
- L. Pre-molded Joint Material
 - 1. Control Joint Filler: Material shall conform to ASTM D1056, Class 2A1
 - 2. Shear Keys: Rubber conforming to ASTM D2000, M2AA-805 with minimum durometer hardness of 80 or PVC conforming to ASTM D2287, Type PVC 654-4 with minimum durometer hardness of 85.
 - 3. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (rubber or rubber-like material not necessarily resistant to oil), Grade 1 (deflection range 2 to 5 psi); compressible up to 35 percent.
 - 4. Preformed Control Joint Gaskets
 - a. Material: Polyvinyl chloride, ASTM D 2287, general purpose grade, Type PVC-65406.
 - i Durometer Hardness, A Scale: 85 to 94.
 - ii Specific Gravity (Nominal), 23 degree C: 1.35 to 1.39
 - iii Tensile Strength, Minimum: 2000psi
 - iv Volatile Loss at 106 degree C, Maximum Percent: Unspecified.
 - v Brittleness Temperature, Maximum Degree C: minus 30
 - b. Designed to fit standard sash block and to maintain lateral stability in wall.

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2.9 LINTELS

- A. Precast Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification. Type and size as indicated on drawings, 4000 psi strength at 28 days.
- B. Steel Lintels: ASTM A36 or ASTM A992, Material and size as indicated on drawing

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other sections of work are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Do not start masonry construction if the horizontal or vertical alignment of the foundation is out of plumb or line by one inch or more. Contact Owner's Representative immediately.
- E. Verify that the top surface of the concrete foundation is clean and free of laitance and that the aggregate is exposed before starting masonry construction.
- F. Verify that all masonry units are sound and free of cracks or other defects that interfere with the proper placing of the unit or impair the strength of construction.
- G. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing of Concrete Masonry Units:
 - 1. Bond: Running, unless noted otherwise on the drawings.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Tooled Concave.
- D. Placing And Bonding:
 - 1. Lay solid masonry units in full bed of mortar, with full head joints.
 - 2. Lay hollow masonry units with face shell bedding on head and bed joints.
 - 3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
 - 4. Remove excess mortar as Work progresses.
 - 5. Interlock intersections and external corners.
 - 6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

7. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
8. Cut mortar joints flush where wall tile or resilient base is scheduled.
9. Isolate masonry from vertical structural framing members with a movement joint as indicated on drawings.
10. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler as indicated on drawings.
11. Tool new masonry into existing masonry at new openings and patching old openings (UNO).

E. Joint Reinforcement And Anchorage:

1. Install horizontal joint reinforcement 16 inches o.c. (U.N.O.)
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 12 inches. Construct splice to contain one cross wire at each piece of reinforcement in the lap distance.
5. Completely embed joint reinforcement in mortar.
6. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position, complying with requirements in TMS 602/ACI 530.1/ASCE 6.
7. Embed anchors attached to structural steel members. Remove primer and finish paint on structural steel to receive anchors.
8. Weld anchors to structural steel columns as indicated on drawings.
9. Weld anchors to structural steel beams as indicated on drawings.
10. Prime welds and abrasions.
11. Fill cores containing anchor, reinforcing bar or other imbeds with grout.
12. Reinforce joint corners and intersections with strap anchors 16 inches oc.

F. Masonry Flashings:

1. Extend flashings horizontally through outer wythe at foundation walls, above lintels, under parapet caps and at bottom of walls and turn down on outside face to form a drip edge.
2. Turn flashing up minimum 8 inches and bed into mortar joint of masonry.
3. Lap end joints minimum 6 inches and seal watertight with sealant.
4. Turn flashing, fold, and seal at corners, bends, and interruptions.
5. Install galvanized drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
6. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

7. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- G. Lintels:
1. Install loose steel and precast concrete lintels over openings.
 2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated
 3. Reinforce unit masonry lintels per Masonry Lintel Schedule.
 4. Do not splice reinforcing bars.
 5. Support and secure reinforcing bars from displacement.
 6. Place and consolidate grout fill without displacing reinforcing.
 7. Allow masonry lintels to attain specified strength before removing temporary supports.
 8. Maintain minimum 8 inch bearing on each side of opening.
- H. Grouted Components:
1. Reinforce bond beam with 2 No. 5, 1 inch from bottom web. (U.N.O.)
 2. Lap splices bar diameters required by MSJC Code.
 3. Support and secure reinforcing bars from displacement.
 4. Place and consolidate grout fill without displacing reinforcing.
 5. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening full depth.
- I. Reinforced Masonry:
1. Lay masonry units with core vertically aligned clear of mortar and unobstructed.
 2. Place reinforcing, reinforcement bars, and grout as indicated.
 3. Splice reinforcement in accordance with MSJC Code.
 4. Support and secure reinforcement from displacement.
 5. Place and consolidate grout fill without displacing reinforcing.
 6. Place grout in accordance with MSJC Specification.
- J. Control And Expansion Joints:
1. Do not continue horizontal joint reinforcement through control and expansion joints.
 2. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
 3. Size control joint as indicated on drawings.
 4. Rake joint at exposed unit faces for placement of backer rod and sealant.

K. Built-In Work:

1. As work progresses, install built-in metal door and glazed frames, window frames, anchor bolts and other items to be built-in the work and furnished by other sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
4. Do not build in materials subject to deterioration.
5. Back paint H.M. frames with spray on automotive rust proofing (black bituminous) prior to installation of masonry.

L. Cutting And Fitting:

1. Cut and fit for chases, pipes, conduit, sleeves, and grounds. In non-bearing partition walls provide minimum 1" clearance between bottom of joists and CMU. Place bead of fire stop on each face between CMU and bottom joist chord. This requires a drawing detail. Coordinate with other sections of work to provide correct size, shape, and location.
2. Obtain the Owner's Representative's approval prior to cutting or fitting masonry work not indicated on drawings or where appearance or strength of masonry work may be impaired.

3.4 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- B. Provide uniformity of mix and coloration.
- C. Do not use antifreeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, retemper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures of 80°F (26°C), or 2-1/2 hours at temperatures under 50°F (10°C).

3.5 GROUT MIXING

- A. Transit Mixed: Mix concrete in accordance with ASTM C94.
- B. Site Mixed: Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476 fine or course grout.
- C. Provide uniformity of mix.
- D. Do not use antifreeze compounds to lower the freezing point of grout.

3.6 TOLERANCES**A. Erection**

1. Maximum Variation From Alignment of Pilasters: ¼ inch.
2. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
3. Maximum Variation from Plane of Wall: ¼ inch in 10 ft and ½ inch in 20 ft or more.

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4. Maximum Variation from Plumb: $\frac{1}{4}$ inch per story non-cumulative; $\frac{1}{2}$ inch in two stories or more.
5. Maximum Variation from Level Coursing: $\frac{1}{8}$ inch in 3 ft and $\frac{1}{4}$ inch in 10 ft; $\frac{1}{2}$ inch in 30 ft non-cumulative.
6. Maximum Variation of Joint Thickness: $\frac{1}{8}$ inch in 3 ft.
7. Maximum Variation from Cross Sectional Thickness of Walls: $\frac{1}{4}$ inch.
- B. Maximum Variation for Steel Reinforcement:
 1. Plus or minus $\frac{1}{2}$ inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
 2. Plus or minus 1 inch when the distance is between 8 and 24 inches.
 3. Plus or minus $1 \frac{1}{4}$ inch when the distance is greater than 24 inches.
 4. Plus or minus 2 inches from the location along the face of the wall.

3.7 CLEANING

- A. Section 01700 - Contract Closeout: Final cleaning.
- B. Remove excess mortar, mortar smears, and mortar droppings on a daily basis as work progresses.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.8 PROTECTION OF FINISHED WORK

- A. Provide protective boards at exposed external corners which may be damaged by construction activities.
- B. At day's end, cover unfinished walls to prevent moisture infiltration.
- C. Keep expansion joint voids and weeps clear of mortar.

3.9 SCHEDULE

- A. Install masonry units per this schedule:
 1. Normal weight block: Below grade, foundation walls, load bearing walls and non-fire rated walls.
 2. Light weight block: Fire rated walls and non-load bearing walls where noted on the drawings.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Fabricate and install structural steel framing members, with required bracing, welds, fasteners, and baseplates. Refer to the AISC "Code of Standard Practice", section 2.1.
- B. Furnish and install grout under the baseplates of structural steel columns.

1.2 RELATED SECTIONS

- A. Section 01050 - Field Survey Services
- B. Section 01300 - Submittals
- C. Section 01410 - Testing Laboratory Services
- D. Section 05210 - Steel Joists
- E. Section 05311 - Steel Floor and Roof Deck
- F. Section 05500 - Metal Fabrications
- G. Section 07250 - Fireproofing Coatings
- H. Section 09900 - Painting

1.3 REFERENCES

- A. ASTM A6 - General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
- B. ASTM A992 - Standard Specification for Structural Steel Shapes, Grade 50 (Wide Flange and WT Shapes)
- C. ASTM A572 - Standard Specification for High Strength Low Alloy Columbium-Vanadium Steel of Structural Quality
- D. ASTM A36 - Standard Specification for Carbon Structural Steel
- E. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B
- F. ASTM A123 - Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes
- G. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- H. ASTM F1554, Grade 55 - Standard Specification for Anchor Rods
- I. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000psi Tensile Strength
- J. ASTM A325 - Standard Specification for High Strength Bolts for Structural Steel Joints
- K. ASTM A490 - Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
- L. ASTM A500, Grade B - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- M. ASTM A501 - Standard Specification for Hot Formed Welded and Seamless Carbon Steel Structural Tubing

- N. ASTM A786 - Standard Specification for Rolled Steel Floor Plates
- O. AWS A2.0 - Standard Welding Symbols
- P. AWS D1.1 - Structural Welding Code
- Q. AWS QC1 - Standard for AWS Certification of Welding Inspectors
- R. AISC - Manual of Steel Construction, Allowable Stress Design, latest edition.
- S. AISC - Specification for Structural Joints Using ASTM A325 or A490 Bolts
- U. ASCE 7 - Minimum Design Loads for Buildings and Other Structures
- V. Occupational Safety and Health Administration, US Department of Labor (OSHA):
OSHA Construction Industry Standards: Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction.
- W. Steel Deck Institute (SDI), Design Manual - Composite Decks, Roof Decks and Cellular Metal Floor Deck with Electrical Distribution; Manual of Construction with Steel Deck.
- X. Steel Joist Institute (SJI): Recommended Code of Standard Practice for Steel Joists and Joist Girders.

1.4 SHOP DRAWINGS

- A. Prepare shop drawings in compliance with AISC. Use acceptable detailing practices and maintain consistency of shop drawings throughout the project.
- B. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners. Clearly distinguish between shop and field welds and bolts in all connections and details.
- C. Indicate connection details including field connection details on erection plans.
- D. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths.
- E. Allow adequate clearance between framing members for installation of appurtenances (e.g., louvers, door frames, etc.)

1.5 SHOP QUALITY CONTROL

- A. The Steel Fabricator shall be solely responsible for the quality control of all fabricator-supplied materials, installations, and workmanship, including those items or installations supplied by any of the Fabricator's subcontractors or suppliers.
- B. All work shall be subject to inspection. It is the Steel Fabricator's responsibility to request inspection prior to proceeding with further work that would make parts of work inaccessible for inspection. Steel Fabricator should inform the Owner's Representative on receipt of material so that heat numbers can be verified against mill test reports. Inspection by the Owner's Representative is not to be presumed to relieve in any degree the responsibilities of the Steel Fabricator. Any work or material that does not meet the requirements of the design drawings and specifications shall be repaired or removed and replaced solely at the Steel Fabricator's expense.
- C. The Steel Fabricator shall have a written Quality Assurance Program and Inspection Procedures document, which shall provide details of how compliance with the requirements of this specification and the design/shop/erection drawings shall be achieved.
- D. Welding procedures and individual welders shall be qualified in accordance with the

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requirements of AWS D1.1. The Fabricator's welding inspectors shall be qualified and certified as AWS Certified Welding Inspectors in accordance with the provisions of AWS D1.1 or AWS QC1.

- E. Certified mill test reports for each load of structural steel and each lot of high strength bolts shall be available for review by the Owner's Representative.

1.6 COORDINATION

- A. Furnish anchorage items to be embedded in concrete or attached to other construction without delaying the work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to complete the work of this section.

2.3 MATERIALS

- A. Structural Steel Members: ASTM A992, Grade 50 for W and WT shapes and ASTM A36 for plates, channels, angles, S and H shapes, all rolled from new steel billets.
- B. Structural Tubing: ASTM A500 Grade B.
- C. Steel Pipe: ASTM A53 Grade B.
- D. Overhead Crane Runways and/or Monorail Beams: Steel sections of size shown, selected for trueness of web and flange, prepared for tight joints and complete with removable end stops, bolts, plates, shims and fillers as detailed or required for a complete installation.
- E. Crane Rails: Carbon steel, ASCE rails per ASTM A2, Class A, No. 1 Rails, of size and weight indicated. Furnish rails with milled tight end joints suitable for crane service, with standard drilling, and with related accessories required, including two-bolt type fixed or floating rail clamps of forged or pressed steel, complete with ASTM A325 bolts, reversible fillers, and self-locking nut or nut and lock washer.
- F. Bolts: ASTM A325 or A490 unless noted otherwise of lengths required for thickness of members joined and for the type of connection. ASTM A325 bolts shall be hot dip galvanized per ASTM F2329.
- G. Heavy Hex Nuts, ASTM A563. Washer, ASTM F436. Nuts and washers hot dip galvanized per ASTM F2329.
- H. Anchor Rods:
 - 1. ASTM F1554 grade 55, or as noted on plans.
 - 2. Finish: Hot Dip galvanized per ASTM F2329 or as noted on plans.
 - 3. Shape: Straight or as noted on plans
 - 4. Plate Washers: ASTM A36
- I. Threaded Rods:
 - 1. ASTM A36, or as noted on plans.
 - 2. Finish: Hot-dip galvanized, or as noted on plans.
- I. Welding Materials: AWS D1.1; use specific type required for materials being welded.

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- J. Grout under base plates shall be "Masterflow 713 Plus", Non-shrink, nonmetallic, grout as manufactured by BASF Master Builders., Cleveland, Ohio, or "Hilti Multipurpose Grout" as manufactured by Hilti, Inc., Tulsa, Oklahoma, or Five Star Grout, or Owner approved equal. Grout product shall meet the performance requirements of ASTM C 1107

2.4 FABRICATION

- A. Fabricate structural steel members in accordance with AISC specifications, drawings and shop drawings.
- B. Refer to AISC "Code of Standard Practice", section 3.3: The plans will take precedence over this specification.
- C. Continuously seal joined members with welds.
- D. Shop weld or shop bolt bracing connections, where erection permits.
- E. Provide an erection seat where a beam 12 inches or more in depth frames into holes common to another beam differing in depth by 5 inches or more.

2.5 FINISH

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. For slip critical connections, clean the shop-contact surfaces to a Class A surface condition per "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- D. Painting, when required prior to erection: Surface blast preparation, one primer coat, and one finish coat are recommended as a minimum system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify anchor bolt placement, elevation and alignment prior to starting erection.
- C. Beginning erection means erector accepts existing conditions.

3.2 ERECTION

- A. Erect structural steel in accordance with AISC specifications.
- B. Refer to AISC "Code of Standard Practice", section 3.3: The plans will take precedence over this specification.
- C. Allow for erection loads and provide sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection, and installation of permanent bracing and grouting.
- D. Clean and strip primed steel items to bare metal where site welding is required.
- E. Field weld components indicated on shop drawings.
- F. Shim, level, and anchor to proper elevations.
- G. Do not field cut or alter any structural member without the approval of the Owner's Representative.

Grout under baseplates after columns are plumbed and prior to applying service loads.

3.3 SLIP-CRITICAL CONNECTIONS

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- A. Prior to bolting members, clean faying surfaces of defects, coatings, and contaminants that would prevent solid seating of the parts or that would interfere with the development of friction between the parts for slip-critical connections.
- B. Install high strength steel bolts per the referenced "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- C. Install bolt in properly sized hole and place a washer under the turned element.
- D. Tension each bolt by the "turn-of-nut tightening" method or the "alternate design bolt" method to an amount not less than stated for the type and size of bolt used.
- E. Tension the bolt assembly until the required tension is obtained. Do not loosen and reuse bolt assembly after it has been tensioned.

3.4 ALTERATIONS TO EXISTING STEEL

- A. Rework, remove, relocate and erect new and existing structural steel as indicated on plans and details.
- B. Before cutting or removing any steel member, brace and support the existing structure as required to temporarily support loads which may be imposed by the alteration work.
- C. Drill, or pierce and ream, new bolt holes as required for new connections. Match existing hole patterns whenever possible.
- D. Field measure existing construction as required for proper fabrication of the work and accurate fit of steel members. Field verify dimensions noted on the drawings.
- E. Accurately fabricate new steel members to conform to existing conditions and connect as specified.

3.5 ERECTION TOLERANCES

- A. Inspect framing for plumb of vertical members, level or slope of horizontal members, alignment and plane of vertical and horizontal members, and angle of intersection of members. Refer to the AISC "Code of Standard Practice," section 7.13, for safety protection.
- B. Maximum variation from plumb: 1/4 inch per story, non-cumulative.
- C. Maximum offset from true alignment: 1/4 inch.

3.6 ERECTION TOLERANCES - CRANE RUNWAYS

- A. Maximum variation from center-to-center spacing: 1/4 inch from indicated dimension.
- B. Horizontal misalignment: 1/4 inch per 50 feet of runway with a maximum of 1/2 inch total deviation.
- C. Vertical misalignment between crane rails and along crane rail measured at centerlines of columns: 1/4 inch per 50 feet of runway with a maximum of 1/2 inch total deviation.
- D. Retighten bolts 30 days after initial installation.

3.7 FIELD QUALITY CONTROL

- A. Perform field inspection under the provisions of AISC "Code of Standard Practice".
- B. In accordance with Section 01410, the Owner reserves the right to inspect all work as necessary.

END OF SECTION

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STEEL JOISTS

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Open web steel joists, joist girders and joist accessories with bridging, bracing, attached bearing plates, angles, anchors and accessories.

1.2 RELATED SECTIONS

- A. Section 01300 – Submittals
- B. Section 01410 - Testing Laboratory Services
- C. Section 04200 – Unit Masonry System
- D. Section 05120 - Structural Steel
- E. Section 05311 - Steel Floor and Roof Deck
- F. Section 05500 - Metal Fabrications
- G. Section 09900 - Painting

1.3 REFERENCES

- A. ASTM A36 - Standard Specification for Carbon Structural Steel
- B. ASTM A992- Standard Specification for Structural Steel Shapes (Wide Flange and WT shapes)
- C. ASTM A325 - Standard Specification for Structural Bolts, Steel, heat Treated, 120/105 ksi Minimum Tensile Strength
- D. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36,55,105-ksi Yield Strength
- E. AWS D1.1 - Structural Welding Code
- F. SJI - Standard Specifications for Open Web Steel Joists, K-Series
- G. SJI - Standard Specifications for Long span Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series.
- H. SJI - Recommended Code of Standard Practice for Steel Joists and Joist Girders.
- I. SJI Technical Digest # 9 - Handling and Erection of Steel Joists and Joist Girders.
- J. AISC - Manual of Steel Construction, latest edition.
- K. ASCE 7- Minimum Design Loads for Buildings and Other Structures, latest edition

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300.
 - 1. Prepare shop drawings in compliance with SJI and AISC. Use acceptable detailing practices and maintain consistency of shop drawings throughout the project.
 - 2. Prepare shop drawings under the supervision of a professional structural engineer experienced in design of this work and licensed in the state of project location.
 - 3. Indicate standard designations, configuration, sizes, spacing, and locations of joists.
 - 4. Show joist mark numbers, bridging, connections, attachments, joist leg extensions, camber, and bottom chord ceiling extensions as applicable.

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- B. Product Data: For each type of joist, accessory, and product indicated.
- C. Welding certificates.
- D. Manufacturer certificates.
- E. Bolt Mill Certificates

1.5 DESIGN CRITERIA FOR JOISTS AND JOIST GIRDERS

- A. Design joists and joist girders for loads as indicated on structural drawings, including net wind uplift loads and structural drift loads (if applicable).
- B. Design special joists (designated SP on the drawings) per load requirements as indicated on structural drawings.
- C. Design special joists for the following deflection criteria per SJI:
 - 1. Maximum Live Load Deflection: $L/240$ for roofs and $L/360$ for floors where L = span length, center to center of bearing, in inches.
- D. Provide joist girder bottom chord bracing to meet SJI slenderness ratio criteria. Do not develop continuity in the joist system with bracing unless continuity has been provided for in the joists.

1.6 CALCULATIONS

- A. Special Joists: Submit one (1) set of calculations stamped by a professional structural engineer experienced in the design of this work and licensed in the state of project location.

1.7 QUALITY ASSURANCE

- A. Perform work in accordance with SJI Standard Specifications, Load Tables, and Weight Tables, including headers and other supplementary framing.
- B. Maintain one copy of the project documents on site.
- C. Manufacturer Qualifications: A manufacturer certified by the Steel Joist Institute (SJI) to manufacture joists complying with SJI standard specifications and load tables.
- D. SJI Specifications: Comply with SJI's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, SJI's "Specifications") that are applicable to types of joists indicated.
- E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of SJI requirements.
- B. Store and protect products under provisions of SJI Technical Digest #9.
- C. Protect joists from distortion or damage. Store in an upright position.
- D. Store materials off ground on wood sleepers.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

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2.3 MATERIALS

- A. SJI Open Web Joists: K-series, longspan LH-series and deep longspan DLH-series.
- B. Bolts: ASTM A325; Type 1; Hot dipped galvanized.
- C. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Hot dipped galvanized
- D. Washers: ASTM F436; Type 1
 - 1. Finish: Hot dipped galvanized
- E. Anchor Rods: ASTM F1554; Grade 55, weldable
- F. Structural Steel for Supplementary Framing and Joist Leg Extensions: ASTM A36.
- G. Welding Materials: AWS D1.1, type required for materials being welded.

2.4 FABRICATION

- A. Fabricate steel joists in accordance with approved shop drawings and SJI Standard Specifications including headers and other supplementary framing.
- B. Fabricate joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members and with end and top-chord arrangements as indicated.
- C. Provide bottom and top chord extensions as indicated.
- D. Bearing:
 - 1. Provide sloped bearing ends where joist slope exceeds 1/4 inch in 12 inches.
 - 2. Provide bearing lengths per SJI requirements unless greater bearing lengths are shown on the drawings.

2.5 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal and diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- C. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.
- D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.6 FINISH

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces where field welding is required.
- C. SURFACE BLAST PREPARATION, PRIMING, AND SHOP FINISH PAINTING FOR STEEL JOISTS SHALL BE IN ACCORDANCE WITH STRUCTURAL STEEL PER PAINTING SECTION 09900.

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- D. Galvanizing for Bolts, Connectors, and anchors:
 - 1. Bolts, Nuts, and Washers: ASTM F2329
 - 2. Connectors and Anchors: ASTM A153

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning erection means erector accepts existing conditions.

3.2 ERECTION

- A. Erect steel joists in accordance with approved shop drawings, SJI Standard Specifications and SJI Technical Digest #9.
- B. Bear joists on supports in accordance with SJI Standard Specifications.
- C. During erection, provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment due to induced loads and stresses until completion of erection and installation of permanent bridging and bracing.
- D. Coordinate placement of anchors in masonry and concrete construction for securing bearing plates and angles.
- E. For K-series joists, after joist alignment and installation of bridging, field weld joist seat to bearing plates and structural steel supports with a minimum of two (2) 3/16 inch fillet welds one (1) inch long per SJI.
- F. For LH- and DLH- series joists and joists girders, after joist alignment and installation of bridging, field weld joist seat to bearing plates and structural steel supports with a minimum of two (2) 1/4 inch fillet welds two (2) inches long per SJI.
- G. Position and field weld joist chord extensions and wall attachments as detailed.
- H. Do not permit erection of decking until joists are braced, bridged, and secured.
- I. Do not field cut or alter any structural member without the approval from the Owner's Representative.

3.3 ERECTION TOLERANCES

- A. Erected Horizontal Sweep: Not to exceed $L/600$, where L is the joist span in inches.
- B. Erected Vertical Alignment: Not to exceed $D/48$, where D is the joist depth in inches.
- C. Maximum Offset from True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

END OF SECTION

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STEEL FLOOR AND ROOF DECK

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Steel roof deck and accessories.
- B. Steel Floor Composite Deck and accessories.
- C. Steel Floor Non-Composite Deck and accessories.
- D. All gutters, downspouts and flashings if roof deck will not be covered by roofing materials.

1.2 WORK NOT INCLUDED

- A. Installation of anchors for bearing plates and angles cast in concrete.
- B. Installation of anchors for bearing plates and angles embedded in masonry.

1.3 RELATED SECTIONS

- A. Section 01300 – Submittals
- B. Section 01410 - Testing Laboratory Services
- C. Section 05120 - Structural Steel
- D. Section 05210 - Steel Joists
- E. Section 05500 - Metal Fabrications
- F. Section 09900 - Painting

1.4 REFERENCES

- A. ASTM A36 - Standard Specification for Carbon Structural Steel
- B. ASTM A992 - Standard Specification for Structural Steel Shapes, Grade 50 (Wide Flange and WT Shapes)
- C. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process
- D. ASTM A1008 - Standard Specification for Steel, Sheet, Cold Rolled Sheet, Carbon, Structural
- E. AWS D1.1 - Structural Welding Code - Steel
- F. AWS D1.3 - Structural Welding Code - Sheet Steel in Structures
- G. SDI - Design Manual for Composite Decks, Form Decks, and Roof Decks
- H. SDI - Standard Practice Details
- I. SDI - Diaphragm Design Manual
- J. AISC - Manual of Steel Construction, current version
- K. AISI - Specification for the Design of Cold-Formed Steel Structural Members
- L. ASCE 7- Minimum Design Loads for Buildings and Other Structures, current version

1.5 SUBMITTALS

- A. Shop Drawings
 - 1. Submit shop drawings in accordance with Section 01300.
 - 2. Prepare shop drawings in accordance with SDI and AISC. Use acceptable detailing practices and maintain consistency of shop drawings throughout the project.

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STEEL FLOOR AND ROOF DECK

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3. Indicate decking plan, support locations, projections, openings, details, and accessories.
4. Indicate type of deck, shop finish, methods of attachment and edge details.
- B. Product Data
 1. Product Data: For each type of deck, accessory, and product indicated.
 2. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
 3. Product Certificates: For each type of steel deck, signed by product manufacturer.
 4. Welding certificates.
 5. Field quality-control test and inspection reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
 2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
- D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under SDI provisions.
- B. Store and protect products under SDI provisions.
- C. Store materials off ground with one end elevated on wood sleepers to provide drainage.
- D. Protect materials from the elements with a waterproof covering.
- E. Ventilate materials to avoid condensation.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on the drawings.

PART 2 - PRODUCTS

- 2.1 OWNER-PROVIDED PRODUCTS - None.
- 2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

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2.3 ACCEPTABLE MANUFACTURERS

- A. Vulcraft
- B. U.S. Steel Roof Deck
- C. Wheeling Corrugating Company
- D. Substitutions: Under provisions of Section 01300.

2.4 MATERIALS

- A. Sheet Steel: ASTM A653 or A1008 with minimum yield strength of 33,000 psi.
- B. Bearing Plates/Angles: ASTM A36.
- C. Welding Materials: AWS D1.1 and AWS D1.3.
- D. Steel Closure Strips, Ridge and Valley Plates, Flashing, Gutters, Downspouts and Related Accessories: 22 gauge sheet steel (minimum) of required profiles and sizes.
- E. Mechanical Fasteners (Deck to Structural Steel):
 - 1. Power actuated fasteners as manufactured by Hilti, Inc or approved equal. Minimum base steel thickness shall be 1/8-inch.
 - 2. Where roof deck will not be covered with roofing materials, fasteners shall be self-drilling screws with neoprene washers.
- F. Sidelap Fasteners (Deck to Deck):
 - 1. Self-drilling as manufactured by Hilti, Inc. or approved equal.
 - 2. Where roof deck will not be covered with roofing materials, neoprene washers must be used.
- G. The contractor may submit alternative fastening methods under Section 01300.

2.5 FINISH

- A. Finish: Galvanizing to requirements of ASTM A653 coating Class G60.
- B. Accessories shall be shop pre-coated with Kynar 500 finish, medium bronze or color as noted on the drawings.
- C. WHERE CALLED FOR, UNDERSIDE OF STEEL FLOOR AND ROOF DECK SHALL ALSO BE PRIMED AND FINISH PAINTED PER PAINTING SECTION 09900.

2.6 FABRICATION

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, minimum 20 gauge sheet steel, 1-1/2 inches high, fluted profile, 3 span, lapped joints (Type B, wide rib).
- B. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated on drawings.
- C. Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 30, with the minimum section properties indicated on drawings.
- D. If the steel deck manufacturer is to design the deck, design steel decking in accordance with SDI "Design Manual for Composite Decks, Form Decks, and Roof Decks."

1. Design for a maximum working stress of 20,000 psi.
 2. Do not exceed the maximum yield strength of the steel divided by 1.65. This stress may be increased by 33% for temporary concentrated loads provided the deck required is not less than that required for the specified uniform load.
 3. Deflection of deck: Not to exceed 1/240 of span.
 4. Section Properties Used in Determining Stress and Deflection: Calculated in accordance with latest edition of SDI "Design Manual for Floor Decks and Roof Decks".
- E. Fabricate deck in lengths to have three (3) continuous spans or more whenever possible.
- F. Fabricate sheets to lap a minimum of 2 inches over supports at ends.
- G. Lap joints required where roof pitch changes due to the deck support elevations.
- H. Fabricate roof sump pans of 14 gauge galvanized sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches, watertight.
- I. Provide 6 inch closure strip of same gauge as deck where changes in deck direction occur.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning erection means erector accepts existing conditions.
- C. Remove from site all deck units that are bent, warped, or damaged in any way which would impair the strength and appearance of the deck. Replace at no cost to the Owner.

3.2 INSTALLATION (WELDED FASTENERS)

- A. Welded fasteners shall not be used unless specifically requested by the Owner.
- B. Erect metal decking in accordance with manufacturer's instructions, approved shop drawings, and SDI Design Manual for Composite Decks, Form Decks, and Roof Decks.
- C. Bear decking on masonry and concrete support surfaces with 4 inch minimum bearing. Align and level.
- D. Bear decking on steel supports with 1-1/2 inch minimum bearing. Align and level.
- E. Attach ridge and valley plates and steel cant strips directly to the steel deck where shown on the drawings to provide a finish surface for the application of insulation and roofing.
- F. Penetrate all layers of deck material at end laps with weld material. Provide adequate fusion to the supporting members. Weld in accordance with AWS D1.3.
- G. Unless otherwise noted on the plans, fasten deck to supports and side laps per the following:
 1. Deck to steel support members: 12" o.c. minimum (36/4).
 2. Deck ends at building perimeter: 6 inches o.c. (36/7 minimum)
 3. Deck end laps: 12 inches o.c. (36/4 minimum).
 4. Deck edges at building perimeter and deck side laps: Fasten deck units with spans greater than 5 feet at midspan or at 36 inch intervals, whichever is smaller.

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- H. At end of deck or where changes of deck direction occur, fasten each flute. Furnish and install adequate closures and fasten to both sides at 12 inches o.c., unless otherwise noted on drawings.
- I. Fasten accessories to supports or deck at 6 inches o.c. maximum and at all corners and ends.
- J. Position roof sump pans with large flange bearing on top surface of deck. Fasten at each deck flute.
- K. To contain wet concrete, install stops at deck edges upturned to top surface of slab. Provide stops of sufficient strength to remain stationary under wet concrete without distortion.
- L. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- M. Avoid concentrated loads and impact loads during erection and construction. Provide plank for deck in all traffic areas to prevent damage to units prior to pouring of slab.

3.3 INSTALLATION (MECHANICAL FASTENERS)

- A. Erect metal decking in accordance with manufacturer's instructions, approved shop drawings, and SDI Design Manual for Composite Decks, Form Decks, and Roof Decks.
- B. Bear decking on masonry and concrete support surfaces with 4 inch minimum bearing. Align and level.
- C. Bear decking on steel supports with 1-1/2 inch minimum bearing. Align and level.
- D. Attach ridge and valley plates and steel cant strips directly to the steel deck where shown on the drawings to provide a finish surface for the application of insulation and roofing.
- E. Mechanically fasten deck to supports and side laps per drawings.
- F. Unless otherwise noted on the plans, fasten deck to supports and side laps per the following:
 - 1. Deck to steel support members: 12" o.c. minimum
 - 2. Deck ends at building perimeter: 12 inches o.c. (36/4 minimum)
 - 3. Deck end laps: 12 inches o.c. (36/4 minimum).
 - 4. Deck edges at building perimeter and deck side laps: Fasten deck units with spans greater than 5 feet at midspan or at 36 inch intervals, whichever is smaller.
- G. At end of deck or where changes of deck direction occur, fasten each flute. Furnish and install adequate closures and fasten to both sides at 12 inches o.c.
- H. Fasten accessories to supports or deck at 6 inches o.c. maximum and at all corners and ends.
- I. Position roof sump pans with large flange bearing on top surface of deck. Fasten at each deck flute.
- J. To contain wet concrete, install stops at deck edges upturned to top surface of slab. Provide stops of sufficient strength to remain stationary under wet concrete without distortion.
- K. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- L. Avoid concentrated loads and impact loads during erection and construction. Provide plank for deck in all traffic areas to prevent damage to units prior to pouring of slab.

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3.4 CONSTRUCTION LOADS

- A. Construction Loads: Refer to SDI specifications and commentaries for steel floor and roof deck.
- B. For heavier construction loads, reduce allowable unshored spans accordingly by installing temporary shoring.
- C. When required, temporarily shore composite steel floor deck units in accordance with the deck manufacturer's Shoring Tables. Design shoring in accordance with local and state building code regulations.
- D. Leave shoring in place until the concrete flooring attains a minimum of 75% of the concrete design compressive strength.
- E. Avoid concentrated loads and impact loads during erection and construction. Provide plank for deck in all traffic areas to prevent damage to units prior to pouring of slab.

3.5 FIELD QUALITY CONTROL

- A. In accordance with Section 01410, the Owner reserves the right to inspect all work as necessary.

END OF SECTION

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METAL FABRICATIONS

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Shop fabricated and erect ferrous metal items. Refer to the AISC "Code of Standard Practice", section 2.2.
- B. Grating and floor plate.
- C. Pipe and tube railings, balusters, and mountings.
- D. Toe plate.
- E. Stairs and handrails.
- F. Process column platforms.
- G. Equipment and pipe supports.
- H. Ladders, gate barriers, and attachments.
- I. Furnish embedded steel fabrications for concrete and masonry (e.g., lintels, bearing plates, deck bearing angles and plates, pipe bollards, channel door frames etc.)
- J. Furnish and install grout under base plates and bearing plates as indicated on the design drawings.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 01410 - Testing Laboratory Services
- C. Section 05090 – Metal Fastenings
- D. Section 05120 - Structural Steel
- E. Section 05210 - Steel Joists
- F. Section 05311 - Steel Floor and Roof Deck
- G. Section 09900 – Painting

1.3 REFERENCES

- A. AISC - Manual of Steel Construction, current edition
- B. AISC - Manual of Steel Construction, Specifications for Structural Steel Buildings
- C. AISC – Specification for Structural Joints using A 325 or A490 Bolts
- D. ASTM A36– Standard Specification for Carbon Structural Steel
- E. ASTM A992 - Standard Specification for Structural Steel Shapes (Wide Flange and WT shapes)
- F. ASTM A786 - Standard Specification for Rolled Steel Floor Plate
- G. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- H. ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature service
- I. ASTM A123 - Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes
- J. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel

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Hardware

- K. ASTM F1554, Grade 55 - Standard Specification for Anchor Rods
- L. ASTM A325 - Standard Specification for High Strength Bolts for Structural Steel Joints
- M. ASTM A500, Grade B - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- N. ASTM A786 - Standard Specification for Rolled Steel Floor Plates
- O. ANSI / NAAMM MBG 531– Metal Bar Grating Manual
- P. AWS A2.0 - Standard Welding Symbols
- Q. AWS D1.1 - Structural Welding Code –Steel
- R. AWS D1.3 - Structural Welding Code – Sheet Steel
- S. AWS QC1 – Standard for AWS Certification of Welding Inspectors

1.4 SHOP DRAWINGS

- A. Prepare shop drawings in compliance with AISC. Use acceptable detailing practices and maintain consistency of shop drawings throughout the project.
- B. Indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
- C. Include erection drawings, elevations, and details where applicable.
- D. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.5 QUALIFICATIONS

- A. Prepare shop drawings under the supervision of a professional structural engineer experienced in design of this work and licensed in the state of project location.

1.6 GRATING PENETRATION DRAWINGS

- A. Prepare drawings showing locations of all known penetrations. Identify such locations on structural steel plan drawings.
- B. Allow 1 inch minimum clearance around penetrations unless otherwise noted on the drawings.
- C. All openings in grating shall be split and banded with ¼ "toe plate projected 4" above grating.
- D. Submit grating penetration drawings for review. Identify new steel members that are required to support grating that has lost structural support due to cutting or burning penetrations.
- E. Openings and penetrations not shown on the structural drawings will be provided by other trades.

1.7 STORAGE AND HANDLING

- A. All materials shall be stored and handled to avoid damage.
- B. Damaged or deteriorated materials shall be removed from the premises and replaced at the contractor's expense

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

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2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to complete the work of this section.

2.3 MATERIALS

- A. Steel Sections: ASTM A36 or ASTM A992, rolled from new steel billets.
- B. Bolts, Nuts, and Washers: ASTM A325 or ASTM A490 (type N unless otherwise noted) heavy-hex structural, hot dipped galvanized to ASTM F2329 of lengths required for thickness of members joined and for the type of connection.
- C. Anchor Rods: ASTM F1554 Grade 55 or as noted on plans, hot dipped galvanized to ASTM F2329.
- D. Post Installed Anchors: Hilti Kwik Bolt TZ, Hilti HY 70 for masonry or Hilti HIT HY 200 injection Adhesive anchor unless noted otherwise; diameters as indicated on the drawings; follow manufacturer's instructions and recommendations for installation. Substitutions only as submitted to and approved by Engineer.
- E. Welding Materials: AWS D1.1; type required for materials being welded.
- F. Metal Grating: ANSI / NAAMM MBG 531, 1-1/4 inch x 3/16 inch bearing bars at 1-3/16 inch centers with cross rod at 4 inch centers unless otherwise noted on the plans. Hot-dip galvanize per ASTM A123 unless otherwise noted on the plans.
- G. Stair Treads: 1-1/2 inch x 14 gauge Grip Strut serrated grating, hot-dipped galvanized per ASTM A123. See design drawings for tread width and length.
- H. Floor Plate: 1/4 inch (minimum), raised lug plate, medium pattern. Verify thickness with design drawings.
- I. Posts and rails: ASTM A53 Grade B, Schedule 40 steel pipe.
- J. Toe plate: 1/4 inch x 4 inch steel bar.
- K. Splice connections: Butt welded.
- L. Ladders: ASTM A53 Grade B, Schedule 40 steel pipe.
- M. Safety Cages: ASTM A36 steel flat bars.
- N. Safety Gates: "Intrepid Safety Gates" (281) 479-8301, 2305 S. Battleground Road, La Porte, TX 77571-9475.
- N. Grout under base plates shall be "Masterflow 713 Plus", Non-shrink, nonmetallic, grout as manufactured by BASF Master Builders., Cleveland, Ohio, or "Hilti Multipurpose Grout" as manufactured by Hilti, Inc., Tulsa, Oklahoma, or Five Star Grout, or Owner approved equal. Grout product shall meet the performance requirements of ASTM C 1107

2.4 FABRICATION

- A. Field verify dimensions as applicable prior to fabrication.
- B. Refer to AISC "Code of Standard Practice", section 3.3: The plans will take precedence over this specification.
- C. Fit and shop assemble fabrications in largest practical sections for delivery to site.
- D. Fabricate items with joints tightly fitted and secured.
- E. Grind hand contact surfaces smooth (e.g., top rail of handrail).
- F. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- G. Accurately fit components required for anchorage of landings, ladders, and railing to each

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other and to building structure.

- H. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- I. Continuously seal joined members with welds in accordance with AWS D1.1 or AWS D1.3.
- J. Fabricate grating and floor plate in largest practical sections.
- K. Fabricate grating and floor plate flat and square with ends bearing a minimum of 1 inch on supporting members.
- L. Fabricate grating so that bearing bars go in the direction of the shortest span, unless otherwise noted on the design drawings.
- M. All openings in grating shall be split and banded.
- N. Edges of removable grating panels shall be banded.
- O. Space grating and floor plate a minimum of 1/4 inches from vertical steel sections.
- P. Fabricate each panel of grating to be continuous between supports. Do not splice grating to form a panel. Avoid single span panels wherever possible.
- Q. Provide 1/4 inch x 4 inch steel toe plate around all penetrations through floor plate. Provide 1/4 inch x 5 inch steel toe plate around all penetrations through grating. Allow 1 inch clearance around penetrations, unless otherwise noted on drawings.
- R. Bolt stair treads to stringers with two 3/8" dia. (minimum) galvanized bolts per end of tread. Provide flat washers under both the bolt head and nut.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning erection means erector accepts existing conditions.

3.2 PREPARATION

- A. Obtain the Owner's Representative's approval prior to field cutting, burning or welding or making adjustments not shown on erection drawings, including cutting of grating and floor plate.

3.3 ERECTION

- A. Erect items plumb and level, accurately fitted, free from distortion or defects detrimental to appearance or performance.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain true alignment until completion of erection, installation of permanent attachments, and grouting under bearing and base plates.
- C. Clean and strip primed steel items to bare metal where site welding is required.
- D. Field weld components indicated on erection drawings in accordance with AWS D1.1 or AWS D1.3. Clean and chip all welds. Remove slag and burrs leaving hand contact surfaces smooth.
- E. Mechanically fastened joints shall be butted tight, flush, and hairline.
- F. Erect grating and floor plate in accordance with the manufacturer's instructions and

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erection drawings.

- G. Grating touch up: Touch-up surface coating damage and abrasions and modifications using paint compatible with galvanized steel (i.e. ZINC IT cold galvanizing).
- H. Bearing surfaces must be smooth, level, free of burrs, bridging, welds, and other irregularities.
- I. Attach grating and floor plate to supports without warp or deflection.
- J. If grating is required to be welded to steel members, weld the third bearing bar from each side of the panel at each end support with a 3/16 inch fillet weld x 3/4 inch long. Weld the middle bar at each intermediate support with a 3/16 inch fillet weld x 3/4 inch long.
- K. If grating clips are required to secure grating, attach grating to beams with "GRATE-FAST" GALVANIZED SADDLE CLIPS WITH GRADUATED CLAMPS in accordance with the manufacturer's instructions and erection drawings. Minimum of 4 clips per panel.
- L. If floor plate is required to be welded to steel members, stitch weld (2" @ 12" o.c. both sides and ends as applicable) each panel of floor plate to each support unless otherwise noted.
- M. If floor plate clips are required to secure floor plate, attach floor plate with floor plate clips in accordance with the manufacturer's instructions and erection drawing. Submit clip manufacturer's data for approval under Section 01300.
- N. Shim, level, and anchor fabrications to proper elevations.
- O. Do not field cut or alter structural members without approval of the Owner's Representative.
- P. Cap and seal weld all open ends of structural tubing and pipe.
- Q. Erect support steel of adequate strength under all grating that has lost structural support due to cutting or burning penetrations required by the erection drawings. Provide grating support plates as required at columns, base plates and pipe supports.
- R. Attach toe plate or banding at edges of grating with 1/8 inch fillet welds at every third bearing bar.
- S. At grating penetrations toe plate, banding or pipe sleeves shall be load-carrying and attached with 3/16" fillet welds 3/4" long at each bearing bar per ANSI/NAAMM MBG 531.
- T. Where toe plate is parallel to bearing bars, attach with 1/8" fillet weld 1" long, top and bottom at 12" on center.
- U. Do not splice grating between supports.
- V. Where grating penetrations are abandoned, grating shall be replaced between adjacent supports. Do not splice grating or cover plate at opening.

3.4 ERECTION TOLERANCES

- A. Maximum variation from plumb: 1/4 inch
- B. Maximum offset from true alignment: 1/4 inch

3.5 FIELD QUALITY CONTROL

- A. Perform field inspection under the provisions of AISC "Code of Standard Practice".
- B. In accordance with Section 01410, the owner reserves the right to inspect all work as necessary.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Structural floor, wall and roof framing with dimension lumber
- B. Wood blocking for walls and roof curbs.
- C. Concealed wood blocking and supports for toilet accessories, cabinets, surface mounted fixtures and equipment.
- D. Preservative treatment.
- E. Fire-retardant treatment
- F. Plywood backing panels
- G. Building paper
- H. Exterior gypsum sheathing

1.2 RELATED SECTIONS

- A. Section 06200 - Finish Carpentry
- B. Section 09260 - Gypsum Board

1.3 REFERENCES

- A. APA – The Engineered Wood Association
- B. AWWA - (American Wood Protection Association) U1
- C. NFPA - National Forest Products Association
- D. SPIC - Southern Pine Inspection Bureau
- E. WWPA - Western Wood Products Association
- F. FS-TT-W-571 Federal Specifications
- G. IBC – International Building Code

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300.

1.5 QUALITY ASSURANCE

- A. Perform Work according to:
 - 1. Lumber Grading Agency: Certified by DOC PS20
 - 2. Wood Structural Panel Grading Agency: Certified by APA – the Engineered Wood Association.
 - 3. Lumber: DOC PS 20
 - 4. Wood Structural panels: DOC PS 1 or PS 2.
- B. Surface-Burning Characteristics:
 - 1. Fire-Retardant-Treated materials: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each preservative-treated and fire-retardant-treated material.

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PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS

- A. Roof top curb furnished by owner and installed by contractor unless indicated in the drawings.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 WOOD PRODUCTS, GENERAL

- A. Lumber DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory marks each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
 - 4. Provide lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Wood Structural Panels:
 - 1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
 - 2. Oriented Strand Board: DOC PS 2.
 - 3. Comply with "Code plus" provisions in APA Form No. E30R, "Engineered Wood Construction Guide".
- C. Lumber for miscellaneous light framing: Spruce-Pine Fir species, standard grade, maximum moisture content of 19 percent, for exterior applications.

2.4 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA U1, Commodity specification A-Sawn Products of F-Wood Composites. Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain no colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Application: treat indicated items and the following:
 - 1. Wood nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing, flashing, vapor barriers, and water proofing.
 - 2. Wood sills, blocking, furring and similar concealed members in contact with masonry or concrete.

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3. Wood framing members that are less than 18 inches above the ground in unexcavated areas.

4. Wood floor plates that are installed over concrete slabs-on-grade.

2.5 FIRE-RETARDANT-TREATED MATERIALS

A. General: Chemically treated and pressure impregnated. Comply with performance requirements in IBC and AWWA U1.

1. Flame spread: 25 or less when tested according to ASTM E84 and showing no evidence of significant progressive combustion when test is continued for an additional 20 minutes.

2. Use exterior type for exterior locations and where indicated.

3. Use Interior Type A, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. Fire-retardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for wood structural panels before use.

2.6 DIMENSION LUMBER FRAMING

A. General: Of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

A. Non-Load-Bearing Interior Partitions: Construction No. 2 or better grade of any type of the following species:

1. Mixed southern pine; SPIB.

2. Eastern softwoods; NELMA.

3. Northern species; NLGA.

4. Western woods; WCLIB or WWPA

B. Framing Other Than Non-Load-Bearing Interior Partitions: Construction No. 2 or better grade and any of the following species:

1. Hem-fir (north); NLGA and Hem-fir; WCLIB or WWPA.

2. Southern pine; SPIB.

3. Douglas fir-larch, WCLIB or WWPA, Douglas fir-south; WWPA and Douglas fir-larch (north); NLGA.

4. Spruce-pine-fir; NLGA and Spruce-pine-fir (south); NELMA, WCLIB, or WWPA.

5. Where is indicated in the architectural drawings.

C. Exposed Interior Framing Indicated to Receive a Stained or Natural Finish: Provide material hand-selected for uniformity or appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.

2. Species and Grade: Hem-fir (north), Select Structural grade; NLGA.

3. Species and Grade: Southern pine, [Select Structural] [No. 1} grade; SPIB.

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4. Species and Grade: Spruce-pine-fir, [Select Structural] [No. 1] grade; NLGA.
5. Species and Grade: Hem-fir; Select Structural grade; WCLIB or WWP.
6. Species and Grade: Spruce-pine-fir (south), Select Structural [No. 1] grade; NeLMA, WCLIB or WWP.
7. Marked with APA trademark indicating thickness, grade and compliance with APA standard

2.7 SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
- B. Oriented-Strand-Board Wall Sheathing: Exposure I, Structural I sheathing.
- C. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177.
 1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corp.
 2. Type and Thickness: Type X, 5/8 – inch thick.
- D. Plywood Roof Sheathing: Exterior, Structural I sheathing.
- E. Oriented-Strand-Board Roof Sheathing: Exposure I, Structural I sheathing.

2.8 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Furring.
- B. For items of dimension lumber size, provide construction or No. 2 or better grade lumber with 19 percent maximum moisture content of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine, No. 2 grade; SPIB.
 2. Eastern Softwoods, No. 2 Common grade; NELMA.
 3. Northern species, No. 2 Common grade; NLGA.
 4. Western woods, Construction or No. 2 Common grade; WCLIB or WWP.

2.9 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Building Paper: Asphalt-saturated organic felt complying with ASMT D 226, Type I (No. 15 asphalt felt), unperforated.
- C. Sheathing Tape: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing as recommended by sheathing manufacturer for use with type of sheathing required.

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- D. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 or ASTM D-3498 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers

2.10 ACCESSORIES

- A. Nails, spikes, and staples: Hot-dipped galvanized for exterior locations, high humidity locations, and treated wood; plain finish for interior locations, size and type to suit application.
- B. Bolts, complying with ASTM A307, nuts, washers, lags, and screws: Medium carbon steel; size and type to suit application; hot-dipped galvanized for treated wood exterior locations, high humidity locations, and treated wood; plain finish for other interior locations.
- C. Fire Retardant: AWP A Treatment C20 (lumber) and AWP A C27 (plywood) exterior and interior chemically treated and pressure impregnated.
- D. Wood Preservative: Pressure Treatment. AWP A Treatment CI using water borne preservative with 0.25 percent retainage; 0.40 - 0.60 for ground contact.
- E. Use exterior type for exterior locations and where indicated.
- F. Use interior type A, high temperature (HT) for enclosed roof framing, where indicated.
- F. Identify fire-resistant treated wood with appropriate classification marking, of testing and inspecting agency acceptable to authorities having jurisdiction

2.11 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than ½-inch nominal thickness.

2.12 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified.
 - 1. Where rough carpentry is exposed to weather, is ground contact, pressure preservatives treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: NES NER 272.
- C. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A563 (ASTM A 563 M) hex nuts and, where indicated, flat washers.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Roof curb openings, except where prefabricated curbs are provided, form corners by alternating lapping side members.
- B. Set members level and plumb, in correct position.
- C. Extend studs to roof joists as necessary or brace for lateral stability.
- D. All wall opening framing: Install double studs at all wall opening jambs.
- E. Construct members of continuous pieces of longest possible lengths.
- F. Space framing at 16 inches on center for standard applications, 24 inches (max) on center for nonload bearing wall separation on top of existing masonry wall.

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- G. Blocking: Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, and hardware.
- H. Framing standard: Comply with AF and PA's "Details for Conventional Wood Frame Construction". Unless otherwise indicated.
- I. Do not splice structural members between supports, unless otherwise indicated.
- J. Apply building paper horizontally with 2-inch overlap and 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails. Cover upstanding flashing with 4-inch overlap.
- K. Apply sheathing tape to joints between sheathing panels and at items penetration sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SFX) from weather. If, despite protection, inorganic boron treated wood becomes wet, apply EPA-Registered Borate treatment. Apply Borate solution by spraying to comply with EPA-Registered label.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Special fabricated cabinet units
- B. Plastic laminated faced counter tops
- C. Cast plastic countertops
- D. Cabinet hardware
- E. Flush wood paneling and wainscots.
- F. Wood base.
- G. Granite countertop and wall base.
- H. Shelving and clothes rods.
- I. Shop finishing of interior woodwork.

1.2 RELATED SECTIONS

- A. Section 06100 - Rough carpentry: Wood blocking for accessory support.
- B. Section 09260 - Gypsum Board Systems: Sheet steel reinforcing for internal wall reinforcement.

1.3 REFERENCES

- A. ANSI A135.4 - Basic Hardboard
- B. ANSI A208.1 - Mat Formed Wood Particleboard
- C. AWI (Architectural Woodwork Institute) - Quality Standards
- D. BHMA A156.9-03 - Cabinet Hardware
- E. FS MMM-A-130 - Adhesive, Contact
- F. HPMA (Hardwood Plywood Manufacturer's Association) HP - American Standard for Hardwood and Decorative Laminates
- G. NEMA (National Electric Manufacturer's Association) LD3 - High Pressure Decorative Laminates
- H. NHLA (National Hardwood Lumber Association)
- I. PS 1 - Construction and Industrial Plywood
- J. PS 20 - American Softwood Lumber Standard
- K. WIC (Woodwork Institute of California) - Manual of Millwork
- L. ASTM E84 - Surface Burning Characteristics of Building Materials
- M. BHMA A156.11-04- Cabinet locks.
- N. BHMA A156.16-02- Auxiliary hardware.
- O. ANSI Z124.3 - American National Standard for Plastic Lavatories.
- P. ISSFA-2 - Classification and Standards for Solid Surfacing Material; International Solid Surface Fabricators Association.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300.

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- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit two samples of each solid surfacing and plastic laminate (where indicated).

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Premium Quality Manufacturers Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.6 DELIVERY, STORAGE AND PROTECTION

- A. Cover counter top with cardboard to prevent from scratching or damaging the surface during construction or postpone installation.
- B. Coordinate with Owners Representative on storage locations if required.
- C. Protect units from moisture damage.
- D. Do not deliver woodwork until painting and similar operations that could damage wood work have been completed in areas.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Material and equipment conditions affecting products on site.
- B. During and after installation of work of this section, maintain the same temperature and humidity conditions in building spaces as will occur after occupancy.
- C. Do not deliver or install wood work until building is enclosed, wetwork is complete, and HVAC System is operating and will maintain temperature between 60 and 90 degrees F, and relative humidity between 43 and 70 percent during the remainder of the construction period.

1.8 Coordination

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 8 Section "Door Hardware" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED MATERIALS – None

2.2 CONTRACTOR-PROVIDED MATERIALS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS

- A. Softwood Lumber: PS 20; graded in accordance with AWI Premium; average moisture content of 6% soft maple or popular species.
- B. Wood Particleboard: Standard, composed of wood chips, medium density, made with high waterproof binders of grade to suit application; pre-finished melamine faces (white, almond, gray and black) $\frac{3}{4}$ " thickness. Minimum thickness $\frac{5}{8}$ ".

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- C. Hardboard: ANSI A135.4; pressed wood fiber with resin binder, tempered grade, 1/4 inch thick, smooth two sides.

2.4 MANUFACTURERS - PLASTIC LAMINATE

- A. Manufacturers:
 - 1. Formica Corporation
 - 2. Wilsonart
 - 3. Nevamar Corporation
 - 4. Substitutions: Refer to Section 01300.

2.5 LAMINATE MATERIALS

- A. Plastic Laminate: AWI 0.050 inch. General purpose quality; color, pattern and surface texture as noted on the drawings and as selected by the Owner.
- B. Laminate Backing Sheet: 0.020 inch backing sheet grade, undecorated plastic laminate.

2.6 SOLID SURFACE MATERIALS

- A. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
- B. Flat Sheet Thickness: 1/4 inch, minimum.
- C. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISSFA-2 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
- D. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with ANSI Z124.3.
- E. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
- F. Color and Pattern: To be selected from manufacturer's full line.
- G. Manufacturers:
 - 1. DuPont: www.corian.com.
 - 2. Formica Corporation: www.formica.com.
 - 3. Wilsonart International, Inc: www.wilsonart.com.
 - 4. Substitutions: See Division 1 - Product Requirements.
- H. Other Components Thickness: 1/2 inch, minimum.
- I. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; radius edge; use marine edge at sinks.
- J. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.7 ACCESSORIES

- A. Adhesive: FS MMM-A-130 contact adhesive. Type recommended by laminate manufacturer to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins and Screws: Of size and type to suit application.

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- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Plastic material for cut-outs. Color to match or compliment counter.

2.8 HARDWARE

- A. Shelf Standards and Rests: Formed steel channels and rests, cut for fitted rests spaced at 1 inch centers; chrome finish (Knappe and Vogt 255 and 256) or drilled 32mm for chrome steel pins.
- B. Shelf Brackets: Formed steel brackets, formed for attachment with lugs; chrome finish.
- C. Drawer and Door Pulls: "U" shaped pull, aluminum with satin finish or continuous pulls.
- D. Catches: (Magnetic) Stanley SP41 or self closing hinges.
- E. Drawer Slides: Galvanized steel construction, ball bearings separating tracks, full extension type. (Knappe and Vogt 1429).
- F. Hinges: Knuckle disappearing type, steel with satin finish. (Grass 1203 series). Self-closing 170 opening except where restricted.
- G. Waste Recycle Bins: Plastic disposal bins sized to fit cabinet as manufactured by "Rubbermaid".
- H. Kot Board Trays: submit for approval
- I. Cabinet Locks: ANSI A156.11 Verify with owner.

2.9 FABRICATION

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fit shelves, doors and exposed edges with plastic edging. Use one piece for full length only.
- C. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- D. Door and Drawer Fronts: 3/4 thick; flush style.
- E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel edges.
- G. Interior Woodwork Grade: Unless otherwise indicated, provide premium-grade interior woodwork complying with referenced quality standard.
- H. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- I. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- J. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for following:
 - 1. Corners of cabinets and edges and edges of solid-wood (lumber) members $\frac{3}{4}$ inch Thick or Less: 1/16 inch.
 - 2. Edges of rails and similar members more than $\frac{3}{4}$ inches thick: 1/8 inch.

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3. Corners of cabinets and edges of solid-wood (lumber) members and rails: 1/16 inch.
- K. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to project site. Disassemble components only as necessary for shipment and installation. Where necessary for filling at site, provide ample allowance for scribing, trimming, and fitting.
 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial filling. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- L. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of openings in countertops with a coat of varnish.
- M. Install glass to comply with applicable requirements in Division 8 Section "Glazing". For glass in wood frames, secure glass with removable stops.

2.10 FINISHES

- A. Sand Work smooth and set exposed nails and screws
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.
- D. Finish Work according to AWI premium grade.

2.11 SOLID SURFACING FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- D. Wall-Mounted Counters: Provide aprons, brackets, and braces as indicated on drawings, finished to match.

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2.12 MOISTURE CONTENT

- A. Moisture content of lumber and millwork at time of delivery to site.
 - 1. Interior finish lumber, trim, and millwork 1 1/4 inch or less in nominal thickness: 12 percent on 85 percent of pieces and 15 percent on the remainder.
 - 2. Exterior treated or untreated finish lumber and trim 4 inches or less in nominal thickness: 15 percent.
 - 3. Moisture content of other materials shall be in accordance with the standards under which the products are produced.

2.13 FIRE RETARDANT TREATMENT

- A. Fire-Retardant Treatment: Chemically treated and pressure impregnated, having flame spread of 25 or less when tested according to ASTM E 84 and showing no evidence of significant progressive combustion when test is continued for an additional 20-minute period, exterior type.
- B. Deliver fire-retardant-treated materials cut to required sizes. Minimize field cutting.
- C. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings.
- D. Each piece of treated material shall bear identification of the testing agency and shall indicate performance with such rating of flame spread and indicate performance in accordance with such rating of flame spread and smoke developed.
- E. Fire Resistant Hardwood Plywood:
 - 1. Core: Fire retardant treated softwood plywood.
 - 2. Hardwood face and back veneers untreated.
 - 3. Factory seal panel edges, to prevent loss of fire retardant salts.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of existing conditions before starting work.
- B. Verify adequacy of backing and support framing.
- C. Verify location and sizes of utility rough-in associated with work of this section.
- D. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.2 INSTALLATION

- A. Set and secure casework in place; rigid, plumb and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
- D. Install to tolerance of 1/8 inch in 96 inches for level and plumb.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinet and counter bases to floor using appropriate angles and anchorages.

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- G. Mechanically fasten back splash to countertops with brackets or silicone adhesives at 16 inches on center.
- H. Provide cutouts for plumbing fixtures, inserts, outlet boxes, fixtures and fittings. Verify locations of cutouts from on-site dimensions.

3.3 ADJUSTING

- A. Section 01700 - Contract Closeout: Adjust installed work. Test installed work for rigidity and ability to support loads.
- B. Adjust and align moving or operating parts to function smoothly and correctly.
- C. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

3.4 SOLID SURFACE MATERIALS

- A. Fabricate components by machine to achieve shape and configuration.
- B. Radius corners and edges.
- C. Cure components prior to shipment, except sheet materials requiring site handling.
- D. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- E. Seal joint between back/end splashes and vertical surfaces.
 - 1. Where indicated use rubber cove molding.
 - 2. Where applied cove molding is not indicated use specified sealant

3.5 CLEANING

- A. Division 1 - Contract Closeout: Clean installed work.
- B. Mechanically fasten back splash to countertops with brackets or silicone adhesives at 16 inches on center.
- C. Provide cutouts for plumbing fixtures, inserts, outlet boxes, fixtures and fittings. Verify locations of cutouts from on-site dimensions.
- D. Clean casework, countertops, shelves, hardware, fillings and fixtures.

3.6 SCHEDULES

- A. Refer to drawings for details and items not specifically scheduled.

END OF SECTION

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PART 1- GENERAL

1.1 WORK INCLUDED

- A. Insulation systems:
 - 1. Foam-plastic board insulation
 - 2. Fiberglass-free batt insulation.
 - 3. Fiberglass blanket insulation.
 - 4. Mineral-wool blanket insulation.
 - 5. Spray-applied cellulosic insulation.
 - 6. Vapor retarders.

1.2 RELATED SECTIONS

- A. Section 03450 – Precast Wall Panels
- B. Section 04200 – Unit Masonry System
- C. Section 07421 – Insulated Composite Metal Siding
- D. Section 07553 – EPDM Roofing Insulation and Accessories

1.3 REFERENCES

- A. ASTM E 84 Surface Burning Characteristics of Building Materials
- B. ASTM E 136 Combustion Characteristics
- C. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
- D. ASTM C 553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- E. ASTM E 736 Standard Test Method for Cohesion/Adhesion of Sprayed Fire-resistive Materials Applied to Structural members
- F. ASTM C 739 Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation
- G. ASTM E 759 Standard Test Method for Effect of Deflection on Sprayed Fire-resistive material Applied to Structural Members
- H. ASTM C 1149 Standard Specification for Self-Supported Spray Applied Cellulosic Thermal Insulation
- I. ASTM E 1042 Standard Classification for Acoustically Absorptive Materials Applied by Trowel or Spray
- J. ASTM D 4397 Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

1.4 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01300.
- B. Product Data: For each type of product indicated submit manufacturer information on product characteristics, performance criteria and limitations.
- C. Manufacturer Instructions: Instructions on installation requirements, including storage and handling procedures.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics of Insulation Installed in Concealed Locations:
 - 1. Foam Plastic Insulation: Maximum 75/450 flame-spread/smoke-developed index when tested according to ASTM E84.

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2. Other Insulation: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- B. Surface Burning Characteristics of Insulation Installed in Exposed Locations:
 1. Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

PART 2 – PRODUCTS

- 2.1 OWNER PROVIDED PRODUCTS - None.
- 2.2 CONTRACTOR PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.
- 2.3 FOAM-PLASTIC BOARD INSULATION
 - A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - B. Manufacturer: Dow Chemical Company
 - C. Minimum Type IV, 25 psi.
 - D. Thickness: As indicated on drawings.
 - E. Edge: Square.
- 2.4 FIBERGLASS-FREE BATT INSULATION
 - A. Manufacturer: Dow Chemical Company.
 - B. Type: SafeTouch faced fiberglass-free insulation batt with maximum flame-spread and smoke- developed indexes of 25 and 450, respectively, per ASTM E 84. Where indicated on drawings, Thickness: Full depth of stud wall cavity.
- 2.5 FIBERGLASS BLANKET INSULATION
 - A. Manufacturers: Subject to compliance with requirements.
 1. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 - B. Thickness: Full depth of stud wall cavity.
 1. Unfaced, Fiberglass Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Where indicated on drawings,
 2. Reinforced-Foil-Faced, Fiberglass Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene. Where indicated on drawings,
 3. Foil-Faced, Fiberglass Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene. Where indicated on drawings,
- 2.6 MINERAL-WOOL BLANKET INSULATION

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- A. Manufacturers: Subject to compliance with requirements.
 - 1. Fibrex Insulations Inc.
 - 2. Roxul Inc.
 - 3. Thermafiber.
- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. For placement in fire barrier walls. See drawings for rated wall assembly locations.

2.7 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Manufacturers: Subject to compliance with requirements.
 - 1. International Cellulose Corporation (ICC)
 - 2. Approved Equal
- B. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C 1149, Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications),
- C. K-13 Spray on fire retardant, thermal and acoustic insulation as manufactured by ICC, Houston, Texas, 800.444.1252 to achieve R-11 minimum thermal resistance and field tested bond strength per ASTM E 736 not less than 600 times its weight, with a Class 1, Class A flame spread rating per ASTM E 84, UL 723 and NFPA 255, with maximum flame spread and smoke developed indexes of 5 and 5 respectively, per ASTM E 84

2.8 VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 10 mils thick, with maximum permeance rating of 0.13 perm.
- B. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft., with maximum permeance rating of 0.1317 perm and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively, per ASTM E 84.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - A. Raven Industries Inc.; DURA-SKRIM 2FR.
 - B. Reef Industries, Inc.; Griffolyn T-55 FR.
- C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- D. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- E. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

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- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical footing and foundation wall surfaces, set insulation units mechanically fastened in accordance with manufacturer's written instructions where required by field conditions use manufacturer's recommended adhesive applied in accordance with manufacturer's written instructions.
- B. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- C. Where shown on drawings for horizontal surfaces under slabs, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
- B. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Division 04 Section "Unit Masonry."

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Fiberglass, Fiberglass-free or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
- D. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
- E. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
- F. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

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- G. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- H. For framed construction, install blankets according to ASTM C 1320.
- I. Vapor-Retarder-Faced blanket.

3.5 INSTALLATION OF SPRAY APPLIED INSULATING MATERIALS

- A. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
- B. Miscellaneous Voids: Install manufacturer recommended foam or insulation in miscellaneous voids and cavity spaces where required to prevent gaps in the insulation system.

3.6 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
- B. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
- C. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
- D. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
- E. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.7 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
- C. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.
- D. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
- E. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- F. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

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- G. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.8 CLEANING

- A. Clean work under provisions of Section 01700.
- B. For spray product applications, remove excess spray from adjacent surfaces by moderate use of solvent acceptable to the spray product manufacturer. Use materials not harmful to product finish as recommended by spray product manufacturer.
- C. Clean affected areas of all insulation installation debris.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish all equipment, materials, labor and services including staging, rigging, protective covers, tools, and clean-up for applying SFRM.
- B. Shop and Field applied SFRM coatings.
 - 1. Intumescent Mastic SFRM
 - 2. Thin-Film Intumescent SFRM
 - 3. Cementitious SFRM
- C. Apply top coating if required.
- D. Touch-up SFRM applications affected by other trades.

1.2 RELATED SECTIONS

- A. Section 05120 - Structural Steel
- B. Section 07270 - Firestopping
- C. Section 09900 - Painting

1.3 DEFINITIONS

- A. SFRM: Sprayed fire-resistive material.
- B. Concealed: Fire-resistive materials applied to surfaces that are concealed from view behind other construction when the Work is completed.
- C. Exposed: Fire-resistive materials applied to surfaces that are exposed to view when the Work is completed including those that are accessible through suspended ceilings, in elevator shafts and machine rooms, in mechanical rooms, in air-handling plenums, and identified as such on Drawings.

1.4 REFERENCES

- A. ASTM E 605 - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members
- B. ASTM E 736 - Cohesion/Adhesion of Sprayed Fire-Resistive Material Applied to Structural Members
- C. ASTM E 859 - Air Erosion of Sprayed Fire-Resistive Material Applied to Structural Members
- D. ASTM E 761 - Compressive Strength of Sprayed Fire-Resistive Material applied to Structural Members
- E. ASTM E 759 - Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
- F. ASTM E 760 - Effect of Impact on Bonding of Sprayed Fire Resistive Material Applied to Structural Members
- G. ASTM E 937 - Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members
- H. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- I. ASTM E 119 - Standard Methods of Fire Tests of Building Construction and Materials
- J. ASTM E 84 - Surface Burning Characteristics of Building Materials

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- K. ASTM E 136 - (Noncombustibility) Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
- L. ASTM D2240 – Durometer Hardness (Shore D Only)
- M. ASTM D2794 – Resistance of Organic Coating to the Effects of Rapid Deformation (Impact)
- N. ASTM D4060 – Abrasion Resistance of Organic Coatings by the Taber Abraser
- O. ASTM D4541 – Pull-Off Strength of Coatings Using Portable Adhesion Testers
- P. AWCI 12-A, "Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials"
- Q. FM Global Approval – Intumescent coatings for the protection of structural steel beams and columns
- R. UL 1709, "Rapid rise Fire Tests of Protection Materials for Structural Steel"
- S. AWCI Technical Manual 12-B "Standard Practice for the Testing and Inspection of Field Applied Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide", Latest Edition.
- T. Material manufacturer's current published information.
- U. Steel Structures Painting Council (SSPC) Surface Preparation Standards.

1.5 SYSTEM DESCRIPTION

- A. Applied (Sprayed-On) Fireproofing Systems: Provide UL fire rated assemblies to the hourly ratings shown on the plans.
- B. Air Erosion: Maximum 0.025 gram/sq. ft allowable weight loss of fireproofing when tested in accordance with ASTM E859.
- C. Corrosion: No contribution to corrosion of steel test panels when tested in accordance with ASTM E937.
- D. Mold Resistance: Material to show resistance to fungi growth when tested in accordance with ASTM C665 requirements for fungi resistance of insulation or ASTM G21.
- E. Fire test reports of fireproofing application to substrate materials, including primers, similar to Project conditions, conducted in conformance to ASTM E84 and ASTM E119.

1.6 SUBMITTALS

- A. Submit a letter or certificate from the SFRM manufacturer declaring that the applicator is factory-trained and qualified to apply the SFRM system specified and that the applicator's equipment is acceptable for the installation of the SFRM system.
- B. Shop Drawings: Structural framing plans indicating the following:
 - 1. Locations and types of surface preparations required before applying SFRM.
 - 2. Thickness Schedule: Provide schedule indicating material to be used, building elements to be protected with spray-applied fireproofing, hourly rating, and minimum material thickness needed to achieve required fire-resistance ratings of structural components and assemblies, and appropriate references
 - 3. Extent of SFRM for each construction and fire-resistance rating, including the following:
 - a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.

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- b. Treatment of SFRM after application.
- c. Qualification Data: For Installer, manufacturer and testing agency.
- d. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating the following:
 - i. Materials have been tested for bond with substrates.
 - ii. Materials have been verified by SFRM manufacturer to be compatible with substrate primers and coatings.
 - iii. Interpretation of test results and written documentation for primers and substrate preparation needed for adhesion.
- e. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed SFRM.
- f. Research/Evaluation Reports: For SFRM.
- g. Field quality-control test and special inspection reports.
- h. Warranties: Special warranties specified in this Section.
- C. Submit Material Safety Data Sheets (MSDS) for each component of primer, SFRM and top coating to the Owner's Representative. Keep a copy on site and available for review by all personnel.
- D. Submit a list of solvents to be used on the job to the Owner's Representative for approval by the Industrial Hygiene Department prior to the start of work.

1.7 MOCK-UP

- A. Apply the required SFRM to a six (6) foot length of W10X49 or similar size column (for 4-sided applications) and beam (for 3-sided applications) to serve as a guide to the design detail and as acceptance criteria for surface appearance.
- B. This mock-up may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Do not begin the application of SFRM until the Owner's Representative has approved the satisfactory samples.

1.8 QUALITY CONTROL

- A. All SFRM products shall be FM approved.
- B. Applicator: Company specializing in applying the work of this section with a minimum of five (5) years documented experience and certified by the manufacturer.
- C. Do not apply SFRM without the Owner's Representative and/or designated inspector present, unless authorized by Owner's Representative.
- D. Supply assistance to the Owner's Representative and/or designated inspector as required in order to perform inspection and testing.
- E. Pre-installation Meeting: Conduct a meeting at the Project site one week prior to commencing of the work or as requested by Owner's Representative complying with the requirements in Division 1. Review methods and procedures related to SFRM including, but not limited to, the following:
 - 1. Review products, exposure conditions, design ratings, restrained and unrestrained conditions, calculations, densities, thick nesses, bond strengths, and other performance requirements.

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2. Review and finalize construction schedule and verify sequencing and coordination requirements.
 3. Review weather predictions, ambient conditions, and proposed temporary protections for SFRM during and after installation.
 4. Review surface conditions and preparations.
 5. Review field quality-control testing procedures.
- F. Submit copies of the following Quality Control Logs to the Owner's Representative on a daily basis:
1. Environmental Conditions
 2. Coating material component batch number and location on structure
 3. SFRM Measurement Log

1.9 CERTIFICATIONS

- A. Upon completion of the work, provide a certificate of conformance stating that the application of SFRMs comply with the SFRM manufacturer's Application Manual (Latest Edition) and the Project Documents.

1.10 DELIVERY AND STORAGE

- A. Deliver the SFRM material to the shop/job site in factory sealed containers with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to areas designated by the Owner's Representative.
- B. Store material in accordance with the SFRM manufacturer's written documentation.
- C. Store the material out of direct sunlight, in a sheltered building where the temperature is maintained between 60° F and 90° F.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is 50 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.
1. In enclosed areas, ventilation shall not be less than 4 complete air exchanges per hour.
- C. Relative humidity shall not exceed 75% throughout the total period of application and drying for the intumescent fire resistive material, and must not exceed 75% throughout the application and drying for the protective decorative topcoat.

1.12 COORDINATION

- A. The steel fabricator shall designate on each piece of steel indicated to receive SFRMs the member size (i.e. W21x36, L4x4x1/4, etc.).
- B. The steel fabricator shall clearly indicate limits of member masking (or block out) where SFRM exterior applications are to be applied. This area shall be field applied after steel is erected and conditions are suitable for application.
- C. Coordinate work with the steel fabrication and erection contractor.

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- D. Coordinate work with contractors performing other trades which might affect quality of SFRM application and scope of this work.

1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
- B. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2- PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 ACCEPTABLE PRIMER MANUFACTURERS

- A. Primer as recommended by SFRM manufacturer's written documentation. Apply per SFRM manufacturer's written documentation.

2.4 SPRAY-ON CEMENTITIOUS FIREPROOFING

- A. To be used at interior locations only as identified on the drawings
 - 1. Isolatek International: CAFCO 300 for beams CAFCO 400 for columns
 - 2. Grace Fireproofing Products: Monokote MK-6 or Monokote Z-106/G
 - 3. Southwest Fireproofing: Type 5GP

2.5 INTUMESCENT FIREPROOFING

- A. Interior
 - 1. Carbolite Company Fireproofing Products Div: Fire Film III
 - 2. Isolatek International: CAFCO SprayFilm WB 3
- B. Exterior
 - 1. International Paint Inc.: Chartek 1709® - PREFERRED
 - 2. Carbolite Company Fireproofing Products Div.: Thermolag 3000
 - 3. Pitt-Char® XP (Manufactured by PPG)
- C. Repair
 - 1. The following coatings shall be acceptable only for patching and repair of existing fireproofing installations using these or previous generations of these materials:
 - a. Albi-Clad® 800 (Manufactured by Albi, Division of Stanchem)

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- b. Chartek® Type VII is completely compatible with Chartek® Type III and may be used for patching and repair of existing Type III installations

2.6 SFRM THICKNESS

- A. It is the SFRM contractor's responsibility to determine the SFRM thickness required to satisfy the fire-resistance ratings indicated on the drawings.

2.7 ACCESSORIES

- A. Reinforcing Mesh: Mesh reinforcement of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of SFRM. Include pins and attachment.
- B. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by SFRM manufacturer.
- C. Topcoat: Type recommended by manufacturer's written documentation for each SFRM over concealed or exposed applications.
- D. Sealant: Dow Corning® 790 as manufactured by Dow Corning Corporation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Verify that concrete work on steel deck has been completed.
- C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work are completed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Start of work indicates acceptance of the substrate per the SFRM manufacturer's substrate acceptance criteria and these specifications.
 - 1. Upon commencement of interior fire proofing application, contractor shall take steps necessary to ensure uninterrupted work and to cause as little delay as possible in the work of other trades.
- F. Prior to interior fire proofing application, contractor shall examine building or area for weather tightness. Proceed with application only after unsatisfactory conditions have been corrected.

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3.2 SUBSTRATE SURFACE PREPARATION REQUIREMENTS

- A. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers.
- B. If flash rusting occurs or if cleaned surfaces become wet or otherwise contaminated prior to painting or SFRM, reclean.
- C. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM
- D. For exposed applications, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of SFRM. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.
- E. Cover other work subject to damage from fallout or over spray of fire-resistive materials during application.

3.3 PRIMER INSTALLATION REQUIREMENTS

- A. Prime steel surfaces on same day as sand blasting, prior to formation of rust bloom.
- B. Mix, apply, and cure primer per the primer manufacturer's written documentation.
- C. Calibrate film gauge using datum from blasted substrate.
- D. Test the wet film thickness for the paint system during application with a Nordson wet film gauge, or equal. Reject non-conforming areas.
- E. Test the dry film thickness for the cured paint system for its specified range using a calibrated Mikro-Test film gauge. Reject non-conforming areas.
- F. Inspect the cured paint system for film defects. Reject areas where runs, sags, embedded debris, voids, over spray, mud cracking, inadequate cure, or lack of adhesion occur.
- G. Repair primer, if necessary. Cure primer fully per primer manufacturer's time-temperature curing curves prior to the application of SFRM materials.

3.4 MASKING

- A. Mask-off (or block out) steel surfaces which will not require SFRM. Protect from over spray per the manufacturers recommendations and the Owner's requirements.
- B. Remove the masking before the SFRM is completely cured.
- C. Wrap anchor bolts to prevent coating of threads.
- D. Interior SFRM shall be field applied. No masking (or block out) of steel connections is required.

3.5 REINFORCING FABRIC INSTALLATION

- A. Install reinforcing fabric, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written documentation for conditions of exposure and intended use. Securely attach fabric to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by SFRM manufacturer. Attach accessories where indicated or required for secure attachment of fabric to substrate.

3.6 ENVIRONMENTAL CONDITIONS

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- A. Determine the surface temperature, dew point, and relative humidity with a psychrometer per ASTM E 337 immediately prior to the coating application.
- B. Measure ambient at the beginning of each shift and every four hours thereafter, during working hours, unless a sudden change in weather warrants new measurements.
- C. Maintain a daily log recording these conditions, including the time when the ambient were taken.
- D. Do not apply SFRM materials when moisture is present on substrate.
- E. Do not apply SFRM materials when ambient temperature is below 50° F.
- F. Do not apply SFRM materials until steel substrate temperature is 5° F above the dew point.
- G. Do not apply SFRM materials when ambient temperature is above 90° F.
- H. Do not apply SFRM materials when relative humidity is above 75%.
- I. Provide ventilation at enclosed areas to receive SFRMs. Coordinate location and obtain approval of ventilation equipment with Owner's Representative.

3.7 SFRM APPLICATION

- A. Comply with SFRM manufacturer's written documentation for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- B. Sequence the work in conjunction with placement of hangers, equipment supports and electrical components.
- C. Test compressed air cleanliness prior to the coating application by directing air onto white blotter paper for a minimum of 60 seconds at the beginning of each batch.
- D. Do not use contaminated compressed air until the air cleanliness has been restored as determined by a satisfactory blotter test per the SFRM manufacturer's written documentation.
- E. Use only coating material components with the correct product designation per manufacturer's written documentation.
- F. Use each coating material component within its shelf life.
- G. Record each where coating material component batch number is used on the structure in a log.
- H. Mix, apply, and cure the SFRM materials in accordance with the SFRM manufacturer's written documentation.
- I. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.
- J. Spray apply SFRM to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.
- K. Feather SFRM to masked (or block out) areas to allow sufficient room for steel erection; masked (or block out) areas can be engineered and achieved as low as 10% for shop application.

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- L. Apply SFRM at minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies where indicated.
- M. .Apply SFRM at minimum thicknesses needed to achieve required fire-resistance ratings of primary equipment supports, where indicated.
- N. Apply SFRM on columns on 4 sides, per the manufacturer's design and recommendations.
- O. Apply SFRM on beams on 3 sides, with the top of the top flange left smooth and clean of SFRM, per the manufacturer's design and recommendation.
- Q. Measure the thickness of wet SFRM during application in accordance with ASTM E 605 and record in log. Take four random measurements for each member or four measurements for each 50 lineal feet at the following locations:
 - 1. Beams: Take measurements on the bottom flange face, each web side, and each edge.
 - 2. Columns: Take measurements on both flange faces, each web side, and each edge.
- R. Reject non-conforming areas.
- S. If the dry film thickness is questioned, test with a Mikro-Test III Model S10 thickness gauge or by boring a hole and measuring with a probe device. Reject non-conforming areas.
- T. Roll all surfaces prior to the drying of the surface film in order to remove unsightly drippings or surface irregularities per SFRM manufacturer's Application Manual (Latest Edition).
- U. Hand trowel or spray small patchwork or damaged areas per the SFRM manufacturer's written documentation.

3.8 APPLICATION, EXPOSED SFRM

- A. Apply exposed intumescent mastic fire-resistive coatings in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition.
- B. Finish: Even, spray-textured finish produced by lightly rolling flat surfaces of fire-protected members before fire-resistive material dries, to smooth out surface irregularities and to seal in surface fibers.

3.9 3.9 SFRM OF FIELD CONNECTIONS

- A. Apply SFRM to properly prepared steel surfaces. Solvent clean all exposed surfaces per SSPC-SP1.
- B. Powerbrush free edges of cured SFRM to insure good knitting between existing SFRM and new SFRM.
- C. Refer to SFRM Manufacturers written documentation for best practices.
- D. Apply SFRM such that a good bond is developed between previously applied SFRM and new SFRM per the manufacturer's written documentation.

3.10 SFRM CURING

- A. Cure the SFRM material to the SFRM manufacturer's time-temperature curves and other manufacturer's recommendations prior to commencing any other work of this section.
- B. Measure the hardness of the SFRM with a Shore D durometer in accordance with ASTM D 2240. Reject non-conforming areas.

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- C. Measure adhesion with an Elcometer in accordance with ASTM D4541. Reject non-conforming areas.
- 3.11 3.11 SEALING BEAMS, COLUMNS AT-SFRM INTERFACES
 - A. Apply sealant between properly cured SFRM and steel substrate to prevent water infiltration if necessary per manufacturer's requirements.
- 3.12 3.12 INSPECTION
 - A. Examine the SFRM material and reject areas where cracks, voids, spalls, and any exposure of the steel substrate or reinforcement occurs.
 - B. Compare the SFRM material to the approved test column and/or beam for similarities in appearance and finish, with corners rounded and smooth. Reject non-conforming areas.
 - C. Compare the finished appearance of SFRM with the mock-up sample for conformance to acceptance criteria. Reject non-conforming areas.
 - D. In addition to continuous Wet Film Thickness checks performed by applicator during application, the installed SFRM shall be inspected by a qualified independent testing laboratory for thickness in accordance with the AWCI Technical Manual 12-B "Standard Practice For The Testing and Inspection Of Field Applied Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide", Latest Edition, before application of the topcoat.
 - E. The results of the above tests shall be made available to all parties at the completion of each area and approved prior to the application of topcoat.
 - F. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
 - G. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
 - H. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.
- 3.13 TOP COATING APPLICATION
 - A. Apply approved top coating per the SFRM manufacturer's written documentation after SFRM has successfully passed inspection, keeping within the allowable limits of temperature, humidity and moisture range.
 - B. Test the wet film thickness of the overcoat during application. Reject non-conforming areas.
 - C. Examine the overcoat for any film defects and reject areas where over spray, runs, sags, pinholes, holidays, inadequate cure, lack of adhesion, or nonuniform color.
 - D. Test the dry film thickness with an electronic dry film thickness gauge. Reject non-conforming areas.
- 3.14 CLEANING, PROTECTING, AND REPAIRS
 - A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material over spray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

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- B. Protect SFRM, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.
- C. Coordinate application of SFRM with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect SFRM and patch any damaged or removed areas.
- D. Repair or replace work that has not successfully protected steel.

END OF SECTION

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SFRM COATINGS

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Environmental Conditions Log - Project

Date	Time	Initials	Surface Temperature	Ambient Temperature	Dew Point	Relative Humidity

Notes:

1. Do not apply SFRM materials when moisture is present on substrate.
2. Do not apply SFRM materials when ambient temperature is below 50^m F.
3. Do not apply SFRM materials unless steel substrate temperature is at least 5^m F above the dew point.
4. Do not apply SFRM materials when ambient temperature is above 90^m F.
5. Do not apply SFRM materials when relative humidity is above 85%.

Submitted By: _____

Date Submitted: _____

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SFRM COATINGS

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SFRM Measurement Log - Project

Date	Initials	Member No.	Thick. 1	Thick. 2	Thick. 3	Thick. 4	Hardness	Adhesion	Location
		1							
		2							
		3							
		4							
		5							
		6							
		7							
		8							
		9							
		10							
		11							
		12							
		13							
		14							
		15							
		16							
		17							
		18							

Notes:

1. Measure the thickness of wet SFRM during application in accordance with ASTM E 605.
2. Take four random measurements for each member or four measurements for each 50 lineal feet at the following locations:
Beams: Take measurements on the bottom flange face, each web side and each edge.
Columns/Braces: Take measurements on both flange faces, each web side and each edge.
3. Measure the hardness of the SFRM with a Shore D durometer in accordance with ASTM D 2240.
4. Measure adhesion with an elchometer in accordance with ASTM D 4541.

Submitted By: _____

Date Submitted: _____

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FIRESTOPPING

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Firestopping through-penetrations of fire rated assemblies.
- B. Firestopping joints in fire rated assemblies.
- C. Firestopping tops of fire rated walls.
- D. Smoke sealing at joints between floor slabs and exterior walls.
- E. Smoke sealing penetrations and joints of smoke partitions.

1.2 RELATED SECTIONS

- A. Section 04200 – Unit Masonry System
- B. Section 07900 – Joint Sealers

1.3 REFERENCES

- A. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
- C. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
- D. FM (Factory Mutual Engineering Corporation) - Fire Hazard Classifications.
- E. UL (Underwriters Laboratories, Inc.) - Fire Resistance Directory. (Latest Edition)
- F. UL 263 (Underwriters Laboratories, Inc.) - Fire Tests of Building Construction and Materials.
- G. UL 723 (Underwriters Laboratories, Inc.) - Test for Surface Burning Characteristics of Building Materials.
- H. UL 1479 (Underwriters Laboratories, Inc.) - Fire Tests of Through-Penetration Firestops.
- I. Inspection Requirements: ASTM E2174, "Standard Practice for On-site Inspection of Installed Fire Stops."
- J. Michigan Building Code
- K. NFPA 101 - Life Safety Code.
- L. NFPA 70 - National Electric Code.

1.4 DEFINITION:

Firestopping: (Through Penetration Protection System). A sealing material or assembly placed in spaces between penetrations through walls, floors, and roof deck in the building materials to arrest the movement of fire, smoke, heat and hot gases through fire rated construction.

1.5 SUBMITTALS

- A. Submit under the provisions of Section 01300 - Submittals.
- B. Product Data: Submit data on product characteristics, performance and limitation criteria and material safety data sheets.
- C. Schedule: Provide a schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- D. Manufacturer's Installation Instructions: Submit preparation and installation instructions.

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- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements and applicable code requirements, per ASTM E814 tests for systems not listed by FM or UL, proposed for use.
- F. Engineering Judgments: For conditions not covered by UL listed designs, provide judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 QUALIFICATIONS

- A. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
 - 1. Smoke Barrier Joints Air Leakage: Maximum 5 cfm per foot (0.00775 m³/s/m) at 0.30 inches water gage (7.47 Pa) pressure differential.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

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- B. Maintain 60 degrees F temperature before, during, and for a minimum of 3 days after installation of materials.
- C. Provide ventilation in areas to receive solvent cured materials.
- D. Follow these requirements unless stricter requirements are necessary per the manufacturer's instructions.

1.10 COORDINATION

- A. Coordinate work with contractors performing other trades which might affect quality of firestopping application and scope of this work.
- B. Do not cover up fire-resistive joint system installations that will become concealed behind other construction (including floor cover plates) until it has been inspected and approved.

1.12 WARRANTY

- A. Firestopping work subject to the terms of the Article "Warranty of Construction", Division 1, except extend the warranty period to five years.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS

- A. Hilti, Inc., Plano, Texas

800-879-8000

www.us.hilti.com

- B. Provide products from the manufacturer; *no substitutions will be accepted.*

2.4 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E 814 or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating for each separate assembly.
- B. Product Description:
 - 1. Hilti FS 657 Fire Block
 - 2. Hilti FS-ONE MAX High Performance Sealant
 - 3. Hilti CP-601s Silicone Joint & Penetration Firestop Sealant
 - 4. Hilti CP 637 Firestop Mortar
 - 5. Mineral Wool
 - 6. Additional Hilti products as required for necessary UL system.
- C. Specific Application at HSC
 - 1. Fire Block is preferred method where practical.
 - 2. Provide flush and finished surface on both sides of wall and floors.

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3. Exposed face of all Fire Block to be coated with CP-601s silicone sealer (indoor and outdoor).
4. FS-ONE MAX caulk to be used to seal openings less than ½" and with filler in places where filler material is needed. Caulk/filler to be used to fill a maximum opening of 1".
5. Filler material may be mineral wool or pieces of Fire Block.
6. CP 637 Firestop Mortar to be used for pipe or conduit openings greater than 1".
- D. The rating of the firestops shall be equal to or greater than the fire-rated wall, floor or roof assembly.
- E. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E 814 which is equal to the time rating of construction being penetrated.
- F. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction being penetrated.
- G. Through-Penetration Firestop Systems: Comply with the following requirements in providing system components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating firestops under conditions of service and application, based on testing and field experience.
 1. Accessories: Provide the following components for each firestopping system as needed to install fill materials and to comply with "System Performance Requirements" paragraph:
 - a. Permanent forming/damming/backing materials including the following:
 - i. Semirefractory fiber (mineral wool) insulation.
 - ii. Ceramic fiber.
 - iii. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - iv. Fire-rated form board.
 - v. Joint fillers for joint sealants.
 - b. Temporary forming materials.
 - c. Substrate primers.
 - d. Collars
 - e. Steel Sleeves.
 2. Fill materials: Provide through-penetration firestop systems composed of the fill materials indicated below:
 - a. Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.
 - b. Intumescent Putty: Nonhardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compound.
 - c. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.
 - d. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant.
- H. Fire-Resistive Elastomeric Joint Sealants: Chemically curing, elastomeric sealants of base polymer indicated complying with ASTM C 920 requirements and requirements specified in this Section applicable to fire-resistive sealants.

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1. Sealant Colors: Provide selections made by Architect from a manufacturer's full range of standard colors for products of type indicated.
 2. Single-Component, Neutral-Curing, Silicone Sealant: Type S; Grade NS; Class 25; exposure-related, use NT, and joint-substrate-related uses M, G, A, and (as applicable to joint substrates indicated) O.
 - a. Additional capability, when tested per ASTM C 719, to withstand the following percentage changes in joint width as measured at time of installation and still comply with other requirements of ASTM C 920:
 - i. 50 percent movement in both extension and compression for a total of 100 percent movement.
 3. Single-Component, Nonsag, Urethane Sealant: Type S; Grade NS; Class 25; and uses NT, M, A and (as applicable to joint substrates indicated) O.
- I. Mortar as specified in Section 04200 where permitted by applicable code.

2.5 ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: As required per manufacturer's instructions and UL listed designs which allow for future penetration installations at oversize openings and where noted on drawings.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive firestopping. Coordinate with mechanical piping and electrical trades.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- B. Remove incompatible materials which may affect bond.
- C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- D. Install backing and/or damming materials as required to arrest liquid material leakage.
- E. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- F. Do not proceed until unsatisfactory conditions have been corrected.

3.3 APPLICATION

- A. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration materials.
 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

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2. Consult with mechanical engineer and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 3. Protect materials from damage on surfaces subjected to traffic.
- B. Install material at fire rated construction perimeters and openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping as indicated on drawings.
 - C. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved and as required for compliance with required fire ratings.
 - D. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating and to uniform density and texture in accordance with UL Fire Resistance Directory.
 - E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
 - F. Place intumescent coating in sufficient coats to achieve rating required.
 - G. Remove dam material after firestopping material has cured per manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

- A. Inspect installed firestopping for compliance with specifications and submitted schedule.
- B. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- C. Keep areas of work accessible until inspection by applicable code authorities.
- D. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- E. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect the finished work.
- B. Protect adjacent surfaces from damage by material installation.

3.7 SCHEDULE OF COMMON FIRESTOP SYSTEMS

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Schedule of joint firestop systems. Basis of design: Hilti, Inc.

Joint Type	F-Rating (Hr)	Hilti Basis of Design UL System	
		Joint Width Less than or Equal to 2"	Joint Width Greater than 2" Less than or Equal to 6" ⁴
Concrete (Floor to Floor)	1	FF-D-1012, FF-D-1013 ¹	FF-D-1012, FF-D-1013
	2	FF-D-1012, FF-D-1013 ¹	FF-D-1012, FF-D-1013
	3	FF-D-1011, FF-D-1026 ¹	FF-D-1011, FF-D-1026
	4	FF-D-1047	FF-D-1125
Concrete (Edge of Floor Slab to Wall)	1	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	2	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	3	FW-D-1011	FW-D-1011, FW-D-1021
	4	FW-D-1047	FW-D-1092
Concrete or Block Wall to Flat Concrete Floor (Top-of-Wall)	1	N/A**	N/A**
	2	HW-D-0097 ¹	HW-D-1009
	3	HW-D-1008 ¹ , HW-D 0268	HW-D-1008
	4	HW-D-1042	HW-D-1103
Concrete or Block Wall to Concrete Over Fluted Metal Deck (Top-of-Wall)	1	HW-D-0098	N/A**
	2	HW-D-0080, HW-D-0081, HW-D-0098	HW-D-1037
	3	N/A**	N/A**
	4	HW-D-0294	N/A**
Gypsum Wall to Flat Concrete Floor (Top-of-Wall)	1	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
	2	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
	3	HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
Gypsum Shaft Wall to (Top-of-Wall)	2	HW-D-0342 (FLAT CONCRETE) HW-D-0541, HW-D-0542 (CONCRETE OVER METAL DECK)	N/A**
Gypsum Shaft Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0023	N/A**
	2	BW-S-0023	N/A**
Gypsum Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0001, BW-S-0002, BW-S-0039	N/A**
	2	BW-S-0001, BW-S-0002, BW-S-0039	N/A**
Gypsum Wall to Concrete Over Fluted Metal Deck (Top-of-Wall)	1	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-0292, HW-D-0295, HW-D-538*	HWD-1011, HWD-1012, HW-1020
	2	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-292, HW-D-0295, HW-D0538*	HW-D-1011, HW-D-1012, HW-D-1020
	3	HW-D-0292, HW-D-0295	HWD-1011, HWD-1012, HW-1020
	4	HW-D-0292, HW-D-0295	N/A**
Concrete (Wall to Wall)	2	WW-D-0017, WW-D-0082	WW-D-1080, WW-D-1084
	3	WW-D-1011 ¹ , WW-D-0032	WW-D-1011
	4	WW-D-1047	WW-D-1128
Gypsum to Concrete (Wall to Wall)	1	WW-D-0040	N/A**
	2	WW-D-0040	N/A**

* SEE NOTE 3 ** CONTACT HILTI FOR CURRENT UL-CLASSIFIED SYSTEM OR ENGINEERING JUDGMENT DRAWING: 800-879-8000

NOTES:

1. CLASSIFIED SYSTEMS FOR 2" - 6" WIDE JOINTS MAY BE USED FOR JOINTS 2" WIDE AND LESS.
2. CONFIRM THAT MOVEMENT CAPABILITIES OF THE SELECTED UL SYSTEM MEETS OR EXCEEDS THE SPECIFIED MOVEMENT RANGE OF THE PARTICULAR JOINT.
3. SYSTEMS MARKED WITH ASTERIK (*) ARE SUITABLE FOR TOP-OF-WALL JOINTS WHERE THE FLUTED METAL DECK HAS SPRAY-ON MONOKOTE MK-6/HY FIREPROOFING.
4. VERIFY ALLOWABLE JOINT WIDTH ON SPECIFIC UL SYSTEM DRAWING.

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FIRESTOPPING

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Schedule of through penetration firestop systems. Basis of design: Hilti, Inc

CONCRETE FLOORS			CONCRETE OR BLOCK WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM
CIRCULAR BLANK OPENINGS	1	F-A-0006, C-AJ-0055, C-AJ-0090	CIRCULAR BLANK OPENINGS	1	C-AJ-0055, C-AJ-0090
	2	F-A-0006, C-AJ-0055, C-AJ-0090		2	C-AJ-0055, C-AJ-0090
	3	F-A-0006, C-AJ-0055, C-AJ-0086,		3	C-AJ-0055, C-AJ-0086
SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, F-A-1028, F-A-1017	SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, W-J-1067, W-J-1020
	2	C-AJ-1226, F-A-1028, F-A-1017		2	C-AJ-1226, W-J-1067, W-J-1020, W-J-1248
	3	C-AJ-1226, F-A-1017		3	C-AJ-1226, W-J-1041, W-J-1068
	4	C-BJ-1037, C-BJ-1034		4	C-BJ-1034, C-BJ-1037, W-J-1041, W-J-1042, W-J-1068
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	1	F-A-2053, F-A-2025, C-AJ-2109, C-AJ-2098, C-AJ-2271, C-AJ-2167,	SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	1	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342
	2	C-AJ-2098, C-AJ-2271, C-AJ-2167, C-BJ-2021, C-AJ-2371, C-AJ-2342		2	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342
	3	F-A-2054, C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342		3	C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342
	4	C-BJ-2016, C-AJ-2017		4	W-J-2057, W-J-2091
SINGLE/CABLE BUNDLES	1	F-A-3007, C-AJ-3095, C-AJ-3180, C-AJ-3283	SINGLE/CABLE BUNDLES	1	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167
	2	F-A-3007, C-AJ-3095, C-AJ-3334, F-A-3060		2	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167, W-J-3189
	3	F-A-3007, C-AJ-3095, C-AJ-3285		3	C-AJ-3095, C-AJ-3180, W-J-3167
CABLE TRAY	1	C-AJ-4034, C-AJ-4035		4	W-J-3050
	2	C-AJ-4034, C-AJ-4035	CABLE TRAY	1	W-J-4027, C-AJ-4034, C-AJ-4035
	3	C-AJ-4034, C-AJ-4035		2	W-J-4027, C-AJ-4034, C-AJ-4035
SINGLE INSULATED PIPES	1	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5091, C-AJ-5090, C-AJ-5048		3	C-AJ-4034, C-AJ-4035
	2	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5091, C-AJ-5090		4	W-J-8007
	3	F-A 5016, C-AJ-5090, F-A-5018	SINGLE INSULATED PIPES	1	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
	4	C-BJ-5006		2	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, F-A-6002, C-AJ-6036		3	C-AJ-5090, C-AJ-5061
	2	C-AJ-6006, C-AJ-6017, F-A-6042, C-AJ-6036		4	C-BJ-5006, W-J-5028
	3	C-AJ-6006, C-AJ-6017	ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, C-AJ-6036
MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	1	C-AJ-7046, C-AJ-7051, C-AJ-7084		2	C-AJ-6006, C-AJ-6017, C-AJ-6036
	2	C-AJ-7046, C-AJ-7051, C-AJ-7085		3	C-AJ-6006, C-AJ-6017
	3	C-AJ-7046, C-AJ-7051		1	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	N/A**	N/A**		2	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
	N/A**	N/A**	MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	3	C-AJ-7046, C-AJ-7051
MIXED PENETRANTS	1	C-AJ 8099, C-AJ-8056, C-AJ-8143		1	W-J-7029, W-J-7124
	2	C-AJ-8099, C-AJ-8056, C-AJ-8143		2	W-J-7091, W-J-7112, W-J-7124
	3	C-AJ-8099, C-AJ-8056		1	C-AJ 8099, C-AJ 8056, W-J 8007, C-AJ 8143
	4	C-AJ-8095		2	C-AJ 8099, C-AJ 8056, W-J 8007, C-AJ 8143
			MIXED PENETRANTS	3	C-AJ 8041, C-AJ 8056, W-J 8007, C-AJ 8099
				4	C-AJ 8095, W-J 8007

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GYPSUM WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM
METAL PIPES OR CONDUIT	1	W-L-1054, W-L-1058, W-L-1164, W-L-1506
	2	W-L-1054, W-L-1058, W-L-1164, W-L-1506
	4	W-L-1110, W-L-1111, W-L-1165
NON-METALLIC PIPE OR CONDUIT	1	W-L-2078, W-L-2075, W-L-2128
	2	W-L-2078, W-L-2075, W-L-2128
	4	W-L-2184, W-L-2245
SINGLE OR BUNDLED CABLES	1	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	2	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	3	W-L-3385, W-L-3277
	4	W-L-3139, W-L-3334
CABLE TRAY	1	W-L-4011, W-L-4019, W-L-4081
	2	W-L-4011, W-L-4019, W-L-4081
	4	W-L 8014
INSULATED PIPES	1	W-L-5028, W-L-5029, W-L-5047
	2	W-L-5028, W-L-5029, W-L-5047
	4	W-L-5073
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	W-L 7017, W-L-7040, W-L-7042, W-L-7155
	2	W-L-7040, W-L-7042, W-L-7155
INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	W-L-7059, W-L-7153, W-L-7156, W-L-7151
	2	W-L-7059, W-L-7153, W-L-7156, W-L-7151
MIXED PENETRANTS	1	W-L-1095, W-L-8013
	2	W-L-1095, W-L-8013
	4	W-L-8014

END OF SECTION

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TRANSLUCENT PANEL SYSTEM

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Preformed fiber reinforced plastic (FRP) siding system for walls.
- B. Preformed fiber reinforced plastic (FRP) roofing panels.
- C. Anchors, brackets, and attachments.
- D. Flashings to adjoining work.
- E. Perimeter and siding panel side lap sealant.

1.2 RELATED SECTIONS

- A. Section 05311 – Steel Floor & Roof Deck
- B. Section 07465 – Metal and Insulated Composite Siding
- C. Section 07620 - Sheet Metal Flashing and Trim

1.3 REFERENCES

- A. ASTM E 72 - Strength of Panels for Building Construction
- B. ASTM E 84 Surface Burning Characteristics of Building Materials
- C. FM 4880 Corner Fire Test (when FM approval is required)
- D. ASTM D 2583 Indentation Hardness of Rigid Plastics
- E. ASTM D 696 Coefficient of Linear Thermal Expansion of Plastics
- F. ASTM D 1494 Diffuse Light Transmission Factor of Reinforced Plastics Panels

1.4 SYSTEM DESCRIPTION

- A. System to provide for expansion and contraction within system components caused by a cycling temperature range of 170°F without causing detrimental effects to system or components.
- B. Design and size wall and roof panels for the spans shown on the drawings to withstand loads caused by snow, hail, and wind. Design and size roof panels to withstand occasional maintenance team traffic.
- C. Compliance with structural parameters shall be demonstrated by large scale, ASTM Test Method E-72 for positive and negative loads as established by governing building code.
- D. System to accommodate without damage to system or components or deterioration of perimeter seal, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads and deflection of structural support framing.

1.5 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01300.
- B. Shop Drawings: Indicate dimensions, panel layout, flashing, closure and trim details, construction details, material details including manufacturer's information on siding, fasteners, flashing, configured composition closure strips, etc., method and pattern of anchorage, method and sequence of installation and location of closure strips and sealant installations.

1.6 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on the drawings.

PART 2 - PRODUCTS**2.1 OWNER-PROVIDED PRODUCTS - None****2.2 CONTRACTOR-PROVIDED PRODUCTS**

A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS**A. SIDING PANELS**

1. TUFF SPAN fire retardant fiber reinforced plastic (FRP) panel as manufactured by Enduro Composites, Houston, Texas.
 - a. Profile: 4.2" pitch by 1.06" depth (4.2 Corrugation). Unless otherwise noted.
 - b. Glass fiber reinforcements shall be continuous, straight, and bi-directional (along the length and width of unit). Glass content shall be 30% minimum by weight for FM Approved materials.
 - c. Resin type shall be premium grade: Isophthalic polyester, UV stabilized Vinyl Ester, UV stabilized. Material shall be protected from UV rays by: UV stabilized resin or UV acrylic polymer coating, factory applied with minimum .4 mil dry film thickness.
 - d. Material shall be: Class I Flame Spread of 25 or less per ASTM E 84, UL listed, Factory Mutual Approved.
 - e. Finish shall be embossed top, smooth bottom.
 - f. Color shall be Translucent White or manufacturer's standard as selected by owner.
 - g. FRP Flashing and Trim Accessories shall be of thickness, dimensions, and profile required for a complete installation.
2. RFM Series fire retardant fiber reinforced plastic panel with exterior "C/W" barrier protection coating as manufactured by Resolite FRP Composites, Moscow, TN
 - a. Panels shall have the UL Label and a flame spread of 25 or less, FM approved.
 - b. Color: Translucent White unless noted otherwise, or color by Owner's representative from manufacturer's standards.
 - c. Panel Weight: Minimum to satisfy loading conditions noted on the plans.
 - d. Profile: 4.2" pitch by 1 1/16" depth (4.2 Corrugation) unless otherwise noted.

B. ROOFING PANELS

1. TUFF SPAN walkable fire retardant FRP roofing panels as manufactured by Enduro Composites, Fort Worth, Texas or approved equal.
 - a. Profile/Series shall be manufacturer's standard to satisfy roof condition detailed.

Glass fiber reinforcements shall be continuous, straight, and bi-directional (along the length and width of the unit). Glass content shall be a minimum of 30% by weight FM Approved materials.
 - b. Resin type shall be premium grade: Isophthalic polyester, UV stabilized Vinyl Ester, UV stabilized. Material shall be protected from UV rays by:

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UV stabilized resin or UV acrylic polymer coating, factory applied with minimum .4 mil dry film thickness.

- c. Material shall have Class I Flame Spread of 25 or less per ASTM E 84, UL listed, Factory Mutual Approved
 - d. Finish shall be embossed top, smooth bottom.
 - e. Color shall be Translucent White or manufacturer's standard as selected by owner.
2. RFM series translucent fire retardant walkable fiberglass reinforced plastic roof panel manufactured by Resolite FRP Composites, Moscow, TN
- a. Panels shall have the UL Label and a flame spread of 25 or less, FM Approved.
 - b. Interior and exterior surface C/W barrier
 - c. Color: Translucent White unless noted otherwise, or color by Owner's representative from manufacturer's standards.
 - d. Panel Weight: Minimum to satisfy loading conditions noted on the plans.
 - e. Profile: Manufacturer's standard to satisfy roof condition detailed.
- C. All panels shall have the FM Label.
- D. Substitutions: Items of same function and performance if approved by Owner's Representative per Division 1 of this specification.

2.4 FABRICATED COMPONENTS AND SIDING ACCESSORIES

- A. FRP Flashing and Trim Accessories shall be of thickness, dimensions, and profile required for a complete installation per drawings.
- B. Trim Pieces
 - 1. Corner trim, jamb trim, profiled closures, caps, flashings: 20 gage galvanized sheet metal prefinished with shop applied Kynar 500 coating per Section 07620 of this specification,
 - 2. Battens, Cover Strips, Cover Plates, and Integral Flashings: Extruded aluminum type and size to suit location and application and to rigidly secure panels in place.
- C. Fasteners: Stainless steel; sizes as needed; minimum 14 gage for both hex head fasteners with bonded neoprene/stainless steel washer, and Grommet type fasteners with bonded neoprene/stainless steel washer for side lap fastening. Structural fasteners shall be (300/316) stainless steel with seal washers installed per manufacturer's guidelines. Panel side lap fasteners shall be stainless steel SB2 grommets installed per manufacturer's guidelines.
- D. Closure Strips: Configured horizontal and vertical closure strips manufactured from EPDM composition to match siding profile.
- E. Sealants: Dow Corning 795 clear Silicone Sealant installed to achieve weather, moisture, and air tightness requirements. Sealant tape for side and end laps of opaque panels shall be 3/32 in. thick non-shrink/non-hardening butyl tape.

2.5 FABRICATION

- A. Fabricate sections true to shape, accurate in size, square, and free from distortion or defects including coating defects. Form pieces in longest practical lengths.

- B. Rigidly fit and secure joints and corners. Make joints and connections flush, hairline, and weatherproof.

PART 3 - EXECUTIONS

3.1 INSPECTION

- A. Verify openings and adjoining materials are ready to receive work of this section. Confirm that other items to be installed in the walls and roof scheduled for panel installation are installed in proper sequence relative to panel installation. For example: Installation of wall mounted exhaust fans and intake louvers may need to be completed prior to siding installation.
- B. Beginning of installation means panel contractor accepts existing conditions.

3.2 PREPARATION

- A. Coordinate dimensions, tolerances, and method of attachment with other work.

3.3 INSTALLATION

- A. Install system in accordance with the manufacturer's instructions.
- B. Use the method of attachment to structure that permits sufficient adjustment to accommodate construction tolerances and irregularities.
- C. Provide alignment attachments and shims required to permanently fasten system to building structure.
- D. Align assembly free of warp or twist. Maintain assembly dimensional tolerances, and align with adjacent work.
- E. Locate end joints over supports. End lap is to be a minimum of 6 inches.
- F. The coated side of panels are to be installed so that they are on the exterior of the finished assembly.
- G. All exposed trim edges shall be broken and returned bent to eliminate sharp edges a minimum of 1/2".
- H. Install a continuous bead of sealant in all panel side laps per manufacturer's instructions. Seal and place closure strips to prevent weather penetration at bottom, top and side perimeters of siding. Maintain neat appearance.

3.4 TOLERANCES

- A. Maximum Variation from Plane: 1/16" every three feet maximum or 1/4" per 100 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/8".
- C. The alignment of all structural steel girts and other supports shall be examined by the erecting Contractor before commencing installation. Any misalignment of such steel or arrangements not within the usual AISC tolerance shall be reported to the Owner's Representative and erection shall begin only after such necessary corrections have been made.

3.5 CLEANING

- A. Clean work under provisions of Division 1.
- B. Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

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- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to the sealant manufacturer. Use materials not harmful to panel finish.
- D. Remove drill shavings from girts immediately after drilling.

END OF SECTION

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Preformed metal siding system for walls and soffits with exposed fasteners, insulation and liners.
 - 2. Preformed metal panel system for walls and soffits, with insulation, liners and concealed fasteners.
 - 3. Metal siding for walls, soffits and fascia with exposed fasteners.
 - 4. Related flashings and accessory components
 - 5. Fasteners, tethers and related components for explosion release system where described on the drawings.

1.2 RELATED SECTIONS

- A. Section 05120 - Structural Steel
- B. Section 06100 – Rough Carpentry
- C. Section 07620 - Sheet Metal Flashing and Trim
- D. Section 07611 – Sheet Metal Roofing
- E. Section 07900 – Joint Sealants
- F. Section 07210 – Insulation Systems

1.3 SYSTEM DESCRIPTION

- A. Metal Siding System: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weather tight wall system.
- B. Insulated Composite Metal System: Preformed and pre-finished composite metal building system of vertical profile with subgirt framing assembly; shop pre-assembled and field installed

1.4 REFERENCES

- A. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- B. ANSI/ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- C. ANSI/ASTM A755 - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
- D. ANSI/ASTM D1621 - Compressive Properties of Rigid Cellular Plastics.
- E. ANSI/ASTM D1622 - Apparent Density of Rigid Cellular Plastics.
- F. ASTM E 283 – Standard Test Method for Determining Rate of Air Leakage
- G. ASTM E331 – Standard Test Method for Water Penetration
- H. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements
- I. ASTM E84 - Surface Burning Characteristics of Building Materials
- J. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

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- K. ASTM C920 – Elastomeric Joint Sealants
- L. ASTM E119 - Standard Test Method for Fire Tests of Building Construction and Materials
- M. FM - Factory Mutual Corporation, Testing of Explosion Vent Systems
- N. ASTM C209 – Standard Test Methods for Cellulosic Fiber Insulating Board
- O. SMACNA – Arch Sheet Metal Manual, Latest Edition
- P. IBC – International Building Code, Latest Edition
- Q. AISI S100 – Cold Formed Steel Design Manual, Latest Edition
- R. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check
- S. AAMA 501 – Methods of Test for Exterior Walls

1.5 PERFORMANCE

- A. Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with the latest edition of the adopted governing code, but not less than design pressure of 25 lb/sq ft. up to 100 ft. in height.
- B. Maximum Allowable Deflection of Panel:
 - 1. Metal Siding: L/180
 - 2. Metal Panels: L/240
- C. Movement: System to accommodate the movement of components without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal temperature ranges. System to accommodate the tolerances of the structure.
- D. Drainage: Accommodate positive drainage for moisture entering or condensation occurring within panel system to exterior.
- E. Air seal: Provide continuity of air barrier seal at building enclosure elements with air seal materials.
- F. Thermal barrier: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials.

1.6 SUBMITTALS

- A. Submit shop drawings and product data under the provision of Division 1.
- B. Shop Drawings: Indicate dimensions, layout, flashing, joints, closure and trim details, construction details, method of anchorage, method and sequence of installation, and interface with adjacent materials.
- C. Product Data: Panel profile characteristics and dimensions, and structural properties; assembled panel structural capabilities; for fire resistant-rated assemblies, show assembly rating is maintained.
- D. Design Data: Design calculations and analysis stamped by a professional engineer as required by owner.
- E. Samples: Submit two samples of siding 12 X 12 inch in size illustrating finish color, sheen, and texture.
- F. Manufacturer's Installation Instructions: Special handling criteria, installation sequence, and cleaning procedures.
- G. Explosion release system: Submit one of the following for product verification.
 - 1. Factory Mutual approval with documentation.

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2. Shop drawings and design calculation stamped by a professional engineer licensed in the state of installation.

- H. Fire Rating: Submit product literature bearing U.L, ASTM or NFPA approval for fire rating as described on the drawings.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with AISI standards.
- B. Installer: Company specializing in performing the work of this section with minimum 5 years experience or as approved by manufacturer.
- C. Fire Rated Construction: ASTM E119 fire rated to meet the fire rating as described on construction documents.
- D. Surface Burning Characteristics: Maximum 25/40 Flame spread/ smoke developed index when tested according to ASTM E84

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Division 1.
- B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- C. Stack pre-finished material to prevent twisting, bending, or abrasion; and to provide ventilation. Slope metal sheets to ensure drainage.
- D. Prevent contact with materials which may cause discoloration or staining.

1.9 FIELD MEASUREMENTS

- A. Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.10 COORDINATION

- A. Coordinate Work with installation of air barrier seals, firestopping, windows, doors, louvers, and adjacent components and materials.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period:
 - a. Metal Siding: Two years from date of substantial completion.
 - b. Metal Panels: Five years from date of substantial completion.

PART 2 - PRODUCTS

2.1 OWNER PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services and labor required to perform the work of this section

2.3 ACCEPTABLE PRODUCTS

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- A. Metal Siding:
 - 1. Flexospan Siding: www.flexospan.com
 - a. Product: Flexbeam
 - 2. Fabral Metal Wall & Roof System: www.fabral.com
 - a. Product: Hefti-Rib 1
 - 3. Industrial Building Panels: www.ibpcustompanels.com
 - a. Product: Ribline 405
 - 4. Morin Corporation: www.morincorp.com
 - a. Product: Y-36
 - 5. Centria: www.centria.com
 - a. Product: Style-Rib
- B. Metal Panels
 - 1. Centria: www.centria.com
 - a. Product: Versawall - Factory Foamed Panel System
 - 2. Metl-Span: www.metlspan.com
 - a. Product: 7.2 Insul-Rib
 - 3. ATAS International: www.atas.com
 - a. Product: Isoleren
- C. Fire-Rated Metal Panels
 - 1. Kingspan: www.kingspanpanels.us
 - a. Product: MF Fire Rated
 - 2. Centria: www.centria.com
 - a. Product: Versasheild MW
 - 3. Metl-Span: www.metlspan.com
 - a. Product: ThermalSafe
 - 4. Comply with FM Global requirements for fire-rated construction
- D. Substitutions: Under provisions of Division 1.

2.4 EXTERIOR PANELS

- A. Metal Siding
 - 1. Pre-coated Galvanized Steel: Grade A, G90 zinc coating;
 - 2. Exterior Sheet: Minimum 20 gage pre-coated steel stock with lapped edges, filled with sealant.
- B. Metal Wall Panels
 - 1. 22 gage ASTM A 653 G-90 galvanized steel or ASTM A 792, Class AZ50 coating designation structural quality, Grade 40 aluminum zinc coated steel structural quality
 - 2. Panel Coverage: Widest panel available from manufacture.
 - 3. Joints: Double tongue and groove with factory-applied air and vapor seal.

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- C. Explosion Release Panels
 - 1. Metal and insulated metal composite panels.

2.5 LINER PANELS

- A. Metal Siding:
 - 1. Pre-coated Galvanized Steel, Grade D, G90
 - 2. Minimum 20 gage, 1 3/8 inch deep, 24 inches wide, Profiles (unless noted otherwise):
 - a. Flexospan: FL-24 liner panel
 - b. Fabral: LP-15 liner panel
 - c. Industrial Building Panels: 124 liner panel
 - d. Centria: L2 liner panel
 - e. Morin: L-24-5F liner panel
 - 3. Minimum 20 gage. Finish exterior and interior face shall be factory painted
 - 4. Exterior Sheet: Minimum 20 gage pre-coated steel stock with lapped edges.
- B. Metal Panels:
 - 1. Minimum 22 gage thick. ASTM A 653 G-90 galvanized steel structural quality or ASTM A 792, Class AZ50 coating designation, Grade 40 aluminum zinc coated steel structural quality
 - 2. Panel Coverage: Widest panel available from manufacture.

2.6 ACCESSORIES

- A. Metal Siding
 - 1. Closure Strips and Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
 - 2. Anchors: Galvanized steel
 - 3. Sealants: Manufacturer's standard type suitable for use with installation of system; none staining, non-skinning, non-shrinking, non-sagging and ultra-violet and ozone resistant.
 - 4. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized in accordance with ANSI/ASTM A153; fastener cap same color as exterior panel.
- B. Metal Panels
 - 1. Insulation: Foamed-in-place closed cell urethane modified isocyanurate foam type, minimum 2 inches thick. For fire rated metal panels, insulation core shall be Mineral Wool.
 - 2. "R" value minimum meeting latest adopted edition of ASHRAE 90.1 – Energy Standard for Buildings.
 - 3. Surface Burning Characteristics: Flame spread 15, smoke developed 50-130 in accordance with ASTM E84.
 - 4. Gaskets: Manufacturer's standard type suitable for use with panel system, permanently resilient.

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5. Sealants: Manufacturer's standard type suitable for use with installation of panel system.
 6. Fasteners: Manufacturer's standard type to mechanically attach panels to supports using concealed clips or fasteners to suit application steel, hot dip galvanized.
 7. Field Touch-up Paint: As recommended by panel manufacturer.
 8. Bituminous Paint for dissimilar materials: Asphalt base.
- C. Explosion Release: Provide latest FM approved explosion relieving fasteners/ devices as required to meet the design pressure release value:
1. Aluminum bolts with a necked down cross section area
 2. Lightweight panels with corrosion resistant hinge at one end and strike plate on the other.
 3. Magnetic releases to be calibrated to within 10% of the design release pressure.
 4. Explosion-venting wall panel tethers
 5. FM approved collapsing washers

2.7 COMPONENTS

- A. Soffit Panels: 22 gage minimum pre-coated G90 galvanized steel, lapped edges.
- B. Sub Girts: 18 gage steel, profile as required to attach panel system to building structural frame. Thickness as required to support specified loads within specified deflection limitations.
- C. Flashing, Trim, Closure Pieces, Caps: Provide as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, end walls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same material, thickness and finish system as adjacent metal wall panels brake formed to required profiles.
- D. Internal and External Corners: Same material, thickness and finish as exterior sheets; profile to suit system; brake formed to required angles.
- E. Expansion Joints: Same material, thickness, and finish as exterior sheets; manufacture's standard brake formed type, of profile to suit system. Exposed fasteners same finish as panel system.

2.8 FABRICATION

- A. Form sections true to shape, accurate in size, square and free from distortion or defects.
- B. Form pieces in longest practical lengths.
- C. Fabricate internal and external corners in one continuous piece with minimum 6 inch returns and seal.
- D. Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- E. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

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- F. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- G. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.
- H. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form no expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
 - a. Size as recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.9 FINISH

- A. Exterior and interior face shall be factory painted.
- B. Painted products shall be packaged so they will be protected from normal abuse during shipment and job storage.
- C. Touch up any damaged surfaces with factory supplied paint. Field Touch-up Paint: As recommended by panel manufacturer.
- D. Color:
 - 1. Interior: Manufacturer's standard interior white
 - 2. Exterior: Color selected by Owner from manufactures standard line of colors. Recommended colors:
 - a. Flexospan: #320 Parchment
 - b. Fabral: Standstone
 - c. Morin: Sandstone
 - d. Industrial Building Panels: Sandstone
 - e. Centria: #133 Sandstone
- E. Exterior Coating Systems:
 - 1. For Severe chemical exposure (minimum quantities may be required):
 - a. Flexospan: Flexshield
 - b. Fabral: System which includes 4 mils (minimum) of vinyl plastisol - submit for Owner approval prior to bid award.

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- c. Morin: Flurothane V
- d. Industrial Building Panels: System which includes 4 mils (minimum) of vinyl plastisol - submit for Owner approval prior to bid award.
- e. Centria: Versacor Elite PF
- 2. For moderate chemical exposure:
 - a. Flexospan: Kynar 500®/Hylar 5000®
 - b. Fabral: Kynar 500®/Hylar 5000®
 - c. Industrial Building Panels: Kynar 500®
 - d. Centria: Flourofinish®
 - e. Morin: Valshield
- 3. Foamed-Insulation-Core Metal Wall Panels:
 - a. Finish: Embossed, striated

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.
- C. Beginning installation means siding contractor accepts existing conditions.

3.2 INSTALLATION

- A. Install metal siding system on walls and soffits in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with cementitious materials and dissimilar metals or corrosive substrates with bituminous paint or as recommended by metal wall panel manufacturer. Allow to dry prior to installation.
- C. Fasten siding to structural supports; aligned, level and plumb. Space fasteners maximum 24 inches on center either horizontally or vertically to suit application or as directed by manufacturer.
- D. Locate end joints over supports. End lap minimum 6 inches minimum.
- E. Install expansion and control joints where indicated.
- F. All exposed trim edges shall be broken and return bent to eliminate sharp edges, minimum ½ inch.
- G. Install explosive release fasteners per manufacturer's directions.

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- H. Seal and place closure strips and gaskets to prevent weather penetration. Maintain neat appearance.
- I. Provide pipe sleeves, closures, and gaskets at pipe penetrations as shown on the drawings.

3.3 TOLERANCES

- A. Maximum offset from true alignment between adjacent members butting or in line: 1/16 inch.
- B. Maximum variation from plane or location indicated on drawings: ¼ inch.
- C. The alignment of all structural steel girder and other supports shall be examined by the erecting contractor before commencing installation. Any misalignment of such steel or arrangements not within the usual AISC tolerance shall be reported to the Owner's Representative and erection shall begin only after such necessary corrections have been made.

3.4 CLEANING

- A. Clean work under provision of 01700.
- B. Remove site cuttings from finish surfaces.
- C. Clean and wash pre-finished surfaces with mild soap and water, rinse with clean water.
- D. Remove and dispose protective films from siding panels and accessories.
- E. Clean metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- F. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install EPDM sheet roofing system, including:
 - 1. Roofing manufacturer's requirements for the specified warranty.
 - 2. Preparation of roofing substrates.
 - 3. Wood nailers for roofing attachment.
 - 4. Insulation.
 - 5. Cover boards.
 - 6. EPDM membrane roofing.
 - 7. Flashings.
 - 8. Walkway pads.
 - 9. Other roofing-related items specified or indicated on the drawings or otherwise necessary to provide a complete weatherproof roofing system.
- B. Comply with the published recommendations and instructions of the roofing membrane manufacturer and the required details to obtain the manufacturer's warranty.
- C. Commencement of work by the Contractor shall constitute acknowledgement by the Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer.

1.2 RELATED SECTIONS

- A. Section 03470– Cast-in-place Concrete: Structural concrete roof decks.
- B. Section 05311 – Steel Floor and Roof Deck.
- C. Section 06100– Rough Carpentry: Roof blocking installation requirements.

1.3 REFERENCES

- A. American Society of Civil Engineers (ASCE) – ASCE 7 – Minimum Design Loads for Buildings and Other Structures, Current Revision.
- B. ASTM International (ASTM):
 - 1. ASTM C 208 – Standard Specification for Cellulose Fiber Insulating Board.
 - 2. ASTM C 578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 3. ASTM C 1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 4. ASTM D 41 – Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - 5. ASTM D 412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - 6. ASTM D413- Rubber property-Adhesion to Flexible Substrate.
 - 7. ASTM D471- Rubber Property- Effect of liquid.
 - 8. ASTM D518- Rubber Deterioration- Surface Cracking.

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9. ASTM D746- Brittleness Temperature of Plastic and Elastomers by Impact.
 10. ASTM D1149- Rubber Deterioration- Surface Ozone Cracking in a Chamber.
 11. ASTM D1204- Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature.
 12. ASTM D 624 – Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 13. ASTM D 816 – Standard test Methods for Rubber Cements.
 14. ASTM D 4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 15. ASTM D 4637 – Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
 16. ASTM E 96 – Standard Test Methods for Water Vapor Transmission of Materials.
- C. Factory Mutual (FM Global):
1. Approved Guide.
 - a. Factory Mutual Standard 4470 – Approval Standard for Class 1 Roof Covers.
 - b. Loss Prevention Data Sheets 1-28, 1-29.
- D. International Code Council (ICC):
1. International Building Code (IBC)
- E. National Roofing Contractors Association (NRCA) – Low Slope Roofing and Waterproofing Manual, Current Edition.
- F. Underwriters Laboratories (UL):
1. TGFU R1306 – “Roofing Systems and Materials Guide”.
 2. UL-790 – Standard Test Method for Fire Tests of Roof Coverings.

1.4 SUBMITTALS

- A. Product Data:
1. Provide membrane manufacturer's printed data sufficient to show that all components of roofing system, including insulation and fasteners, comply with the specified requirements and with the membrane manufacturer's requirements and recommendations for the system type specified; include data for each product used in conjunction with roofing membrane.
 2. Where UL or FM requirements are specified, provide documentation that shows that the roofing system to be installed is UL-Classified or FM-approved, as applicable; include data itemizing the components of the classified or approved system. Include insulation attachment pattern and perimeter/corner dimensions.
- B. Tapered insulation fabrication layout
- C. Specimen Warranty: Submit prior to starting work.
- D. Installer Qualifications: Letter from manufacturer attesting that the roofing installer meets the specified qualifications.
- E. Pre-Installation Notice: Copy to show that manufacturer's required Pre Installation Notice (PIN) has been accepted and approved by the manufacturer.

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F. Executed Warranty.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Roofing installer shall have the following:

1. Current Firestone Master Contractor status or equivalent.
2. Fully staffed office within 100 miles of the job site.
3. At least five (5) years experience in installing specified system.
4. Capability to provide payment and performance bond to building owner.

B. Pre-Installation Conference: Before start of roofing work, Owner and authorized representatives shall hold a meeting to discuss the proper installation of materials and requirements to achieve the warranty.

1. Require attendance with all parties directly influencing the quality of roofing work or affected by the performance of roofing work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.
- B. Store materials clear of ground and moisture with weather protective covering.
- C. Keep combustible materials away from ignition sources.

1.7 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.

1.8 WARRANTY

A. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.

B. Warranty: Firestone 15 year Red Shield Limited Warranty (or equivalent) covering membrane, roof insulation, and membrane accessories.

1. Limit of Liability: No dollar limitation.
2. Scope of Coverage: Repair leaks in the roofing system caused by:
 - a. Ordinary wear and tear of the elements.
 - b. Manufacturing defect in Firestone brand materials.
 - c. Defective workmanship used to install these materials.
 - d. Damage due to winds up to 55 mph.
3. Not Covered:
 - a. Damage due to winds in excess of 55 mph.
 - b. Damage due to hurricanes or tornadoes.
 - c. Hail.
 - d. Intentional damage.
 - e. Unintentional damage due to normal rooftop inspections, maintenance, or service.

PART 2 – PRODUCTS**2.1 OWNER PROVIDED PRODUCTS – none****2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services and labor required to perform the work of this section.****2.3 MANUFACTURERS****A. Acceptable Manufacturer – Roofing System:**

1. Firestone Building Products Co., Carmel, IN. www.firestonebpco.com.
2. Manufacturer of Insulation and Cover Boards: Same manufacturer as roof membrane.

B. Requests for substitutions will be considered in accordance with provisions of Division 1.**2.4 ROOFING SYSTEM DESCRIPTION****A. Roofing System:**

1. Membrane: Ethylene Propylene Diene Monomer (EPDM).
2. Thickness: As specified elsewhere in this section.
3. Membrane Attachment: Fully adhered.
4. Comply with applicable local building code requirements.
5. Provide assembly having Underwriters Laboratories, Inc. (UL) Class A Fire Hazard Classification.
6. Provide assembly complying with Factory Mutual Corporation (FM) Roof Assembly Classification, FM DS 1-28 and 1-29, and meeting minimum requirements of FM 1-90 wind uplift rating in the field/perimeter and 1-120 in the corners.

B. Insulation:

1. Total R Value: per thickness requested
2. Maximum Thickness: as determined by roof footprint.
3. Maximum Board Thickness: 2 inches; use as many layers as necessary; stagger joints in adjacent layers.
4. Sealing of the gaps between each plank will be required to eliminate pressure from the building area below
5. Tapered: Slope as indicated; provide minimum R-value at thinnest point; place tapered layer on bottom. The contractor will be responsible to develop a detailed tapered insulation design that will provide crickets around the roof curbs and that will be pitched to provide positive drainage.
6. Base Layer: Polyisocyanurate foam board, non-composite.
 - a. Attachment: Mechanical fastening.
7. Intermediate Layer(s): Polyisocyanurate foam board, non-composite.
 - a. Attachment: Mechanical fastening or adhesive. See project Summary of Work.

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C. Insulation Cover Board:

1. Type: Gypsum-based board, 1/2 inch thick.
2. Attachment: Mechanical fastening or adhesive. See project Summary of Work.

D. Crickets: Tapered insulation of same type as specified for top layer; slope as indicated.

2.5 EPDM MEMBRANE MATERIALS

A. Roofing and Flashing Membrane: Synthetic single-ply membrane composed of Ethylene Propylene Diene Monomer (EPDM) with the following properties:

1. Thickness: 0.060 inch, minimum.
2. Nominal Thickness Tolerance: Plus/minus 10 percent.
3. Sheet Width: Provide the widest available sheets to minimize field seaming.
4. Acceptable Product: RubberGard Non-Reinforced Low Slope Fire Retardant EPDM Membrane Firestone. Associated materials shall be called for using the Firestone product as a basis.
5. Color: Black unless specified otherwise on the drawings. White over clean rooms or low temperature rooms. Refer to Summary of Work.

B. Membrane installation: Position membrane over approved substrate without stretching. Lap edges minimum 6"; allow membrane to relax for ½ hour prior to splicing or flashing.

C. Membrane Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.

D. Flashing Membrane: Self-curing, non-reinforced membrane composed of nonvulcanized EPDM rubber, complying with ASTM D 4811 Type II, and with the following properties:

1. Thickness: 0.055 inch.
2. Acceptable Product: RubberGard EPDM Form Flash by Firestone, or approved equal.
3. Membrane must be attached to roof deck at perimeter of each roof level, curb flashing, skylight, expansion joint and roof penetration in accordance with manufacturer detail.

E. Self-Adhesive Flashing Membrane: Semi-cured 45 mil EPDM membrane laminated to 35 mil EPDM tape adhesive; QuickSeam Flashing by Firestone or approved equivalent.

F. Pre-Molded Pipe Flashings: EPDM, molded for quick adaptation to different sized pipes; Firestone EPDM Pipe Flashing or approved equivalent.

G. Self-Adhesive Lap Splice Tape: 35 mil EPDM-based, formulated for compatibility with EPDM membrane and high-solids primer; QuickSeam Splice Tape by Firestone.

H. Splice Adhesive: Synthetic polymer-based, formulated for compatibility with EPDM membrane and metal surfaces; SA-1065 Splice Adhesive by Firestone.

I. Bonding Adhesive: Neoprene-based, formulated for compatibility with EPDM membrane and wide variety of substrate materials, including masonry, wood, and insulation facings; Bonding Adhesive BA-2004T by Firestone or approved equivalent.

J. Adhesive Primer: Synthetic rubber based primer formulated for compatibility with EPDM membrane and tape adhesive; QuickPrime Plus by Firestone or approved equivalent.

K. Seam Edge Treatment: EPDM rubber-based sealant, formulated for sealing exposed

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edges of membrane at seams; Lap Sealant HS by Firestone or approved equivalent.

- L. Pourable Sealer: Two-part polyurethane, two-color for reliable mixing; Pourable Sealer by Firestone.
- M. Water Block Seal: Butyl rubber sealant for use between two surfaces, not exposed; Water Block Seal by Firestone or approved equivalent.
- N. Metal Plates and Strips Used for Fastening Membrane and Insulation: Steel with Galvalume coating; corrosion-resistance meeting FM 4470 criteria.
- O. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches wide by 0.10 inch thick; Firestone Termination Bar by Firestone or approved equivalent.
- P. Roof Walkway Pads: EPDM, 0.30 inch thick by 30 by 30 inches with EPDM tape adhesive strips laminated to the bottom; QuickSeam Walkway Pads by Firestone or approved equivalent.

2.6 ROOF INSULATION AND COVER BOARDS

- A. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam with black glass reinforced mat laminated to faces, complying with ASTM C 1289 Type I Class 1, with the following additional characteristics:
 - 1. Thickness: As indicated elsewhere in this section.
 - 2. Size: 48 inches by 96 inches, nominal.
 - 3. R-Value (LTTR):
 - a. 1.0 inch Thickness: 6.0, minimum.
 - b. 1.25 inch Thickness: 7.5, minimum.
 - c. 1.5 inch Thickness: 9.0, minimum.
 - d. 1.75 inch Thickness: 10.5, minimum.
 - e. 2.0 inch Thickness: 12.1, minimum.
 - f. 3.0 inch Thickness: 18.5, minimum.
 - g. 4.0 inch Thickness: 25.0, minimum.
 - 4. Compressive Strength: 20 psi when tested in accordance with ASTM C 1289.
 - 5. UL-Classified and FM-approved for direct to steel or concrete deck applications.
 - 6. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents.
 - 7. Acceptable Product: ISO 95+ GL Polyisocyanurate Insulation by Firestone.
 - 8. Comparable products by Owens-Corning, Celotex, or an approved equal are acceptable per EPDM manufacturer and installer approval.
- B. Gypsum-Based Cover Board: Non-combustible, water resistant gypsum core with embedded glass mat facers, complying with ASTM C 1177/C 1177M, and with the following additional characteristics:
 - 1. Size: 48 inches by 96 inches, nominal.
 - 2. Thickness: As indicated elsewhere in this section.
 - 3. Surface Water Absorption: 2.5 g, maximum, when tested in accordance with ASTM C 473.

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4. Spanning Capability: Recommended by manufacturer for following minimum flute spans:
 - a. 1/2 inch minimum thickness.
5. Surface Burning Characteristics: Flame spread of 0, smoke developed of 0, when tested in accordance with ASTM E 84.
6. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
7. Factory Mutual approved for use with minimum FM 1-90 rated roofing assemblies.
8. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D 3273 for minimum of 4 weeks.
9. Acceptable Product: Georgia-Pacific DensDeck Prime Roof Guard or approved equivalent.
- C. Insulation Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.
- D. Adhesive for Insulation Attachment: Type as required by roof membrane manufacturer for roofing system and warranty to be provided; use only adhesives furnished by roof membrane manufacturer.

2.7 METAL ACCESSORIES

- A. Metal Roof Edging and Fascia: Continuous metal edge member serving as termination of roof membrane and retainer for metal fascia; watertight with no exposed fasteners; mounted to roof edge nailer.
 1. Wind Performance:
 - a. Membrane Pull-Off Resistance: 100 lbs/ft, minimum, when tested in accordance with ANSI/SPRI ES-1 Test Method RE-1, current edition.
 - b. Fascia Pull-Off Resistance: At least the minimum required when tested in accordance with ANSI/SPRI ES-1 Test Method RE-2, current edition.
 - c. Provide product listed in current Factory Mutual Research Corporation Approval Guide meeting wind uplift requirements.
 2. Fascia Face Height: as indicated on drawings.
 3. Gravel stop on all edges excepted guttered sides.
 4. Edge Member Height Above Nailers: 1-1/4 inches.
 5. Fascia Material and Finish: 24 gage, 0.024 inch galvanized steel with Kynar 500 finish in manufacturer's standard color; (matching the existing color) matching concealed joint splice plates; factory-installed protective plastic film.
 6. Length: 144 inches, minimum.
 7. Functional Characteristics: Fascia retainer supports while allowing for free thermal cycling of fascia.
 8. Aluminum Bar: Continuous 6063-T6 alloy aluminum extrusion with pre-punched slotted holes; miters welded; injection molded EPDM splices to allow thermal expansion.
 9. Anchor Bar Cleat: 20 gage, 0.036 inch G90 coated commercial type galvanized steel with pre-punched holes.

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10. Curved Applications: Factory modified.
11. Fasteners: Factory-provided corrosion resistant fasteners, with drivers; no exposed fasteners permitted.
12. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, scuppers, and end caps; minimum 14 inch long legs on corner pieces.
13. Scuppers: Welded watertight.
14. Accessories: Provide matching brick wall cap, downspout, extenders, and other special fabrications as shown on the drawings, and as applicable.

2.8 ROOF DRAINS

- A. Wade Manufacturing company series W-3500; cast iron roof drain with flange, flashing ring, clamping units and mushroom type dome; or approved equal.

2.9 ACCESSORY MATERIALS

- A. Wood Nailers: PS 20 dimension lumber, Structural Grade No. 2 or better Southern Pine, Douglas Fir; or PS 1, APA Exterior Grade plywood; pressure preservative treated.
 1. Width: 3-1/2 inches, nominal minimum or as wide as the nailing flange of the roof accessory to be attached to it.
 2. Thickness: Same as thickness of roof insulation. Build up members as necessary.

PART 3 – INSTALLATION

3.1 GENERAL

- A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.
- D. Obtain all relevant instructions and maintain copies at project site for duration of installation period.
- E. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.
- D. Perform work using competent and properly equipped personnel.
- E. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.
- C. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the designated range.
- D. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
 1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.

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2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
 3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.
- E. Until ready for use, keep materials in their original containers as labeled by the manufacturer.
- F. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.2 EXAMINATION

- A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.
- B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.
- C. Examine roof substrate to verify that it is properly sloped to drains.
- D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptance of project conditions and requirements.
- E. Verify that wood nailers have been properly installed.

3.3 PREPARATION

- A. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.
- B. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.
- C. Wood Nailers: Provide wood nailers at all perimeters and other locations where indicated on the drawings, of total height matching the total thickness of insulation being used.
 1. Install with 1/8 inch gap between each length and at each change of direction.
 2. Mechanically fasten to deck to resist force of 200 lbf per linear foot.

3.4 INSULATION AND COVER BOARD INSTALLATION

- A. Install insulation in configuration and with attachment method(s) specified in PART 2.
- B. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.
- C. Lay roof insulation in courses parallel to roof edges.
- D. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch. Fill gaps greater than 1/4 inch with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch.
- E. Mechanical Fastening: Using specified fasteners and insulation plates engage fasteners through insulation into deck to depth and in pattern required by Factory Mutual for FM Class specified in PART 2 and membrane manufacturer, whichever is more stringent.
- F. Cold Adhesive Attachment: Apply in accordance with membrane manufacturer's instructions and recommendations; "walk-in" individual roof insulation boards to obtain maximum adhesive contact.

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- G. Adhesive for Insulation Attachment per manufactures by roof membrane manufacturer.
- H. Type as required by roof membrane manufacturer for roofing system and warranty to be provided; use only adhesives furnished by roof membrane manufacturer.

3.5 EPDM MEMBRANE INSTALLATION

- A. Place membrane without stretching over substrate and allow to relax at least 30 minutes before attachment or splicing; in colder weather allow for longer relax time.
- B. Lay out the membrane pieces so that field and flashing splices is installed to shed water.
- C. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.
- D. Install membrane adhered to the substrate, with edge securement as specified.
- E. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding adhesive, application rate, and procedures.
- F. Edge Securement: Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in 12 inches using mechanically fastened reinforced perimeter fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.
 - 1. Exceptions: Round pipe penetrations less than 18 inches in diameter and square penetrations less than 4 inches square.
 - 2. Metal edging is not merely decorative; ensure anchorage of membrane as intended by roofing manufacturer.

3.6 FLASHING AND ACCESSORIES INSTALLATION

- A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.
- B. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing membrane abuts to; extend flashing at least 8 inches high above membrane surface.
 - 1. Use the longest practical flashing pieces.
 - 2. Evaluate the substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.
 - 3. Complete the splice between flashing and the main roof sheet with specified splice adhesive before adhering flashing to the vertical surface.
 - 4. Provide termination directly to the vertical substrate as shown on roof drawings.
- C. Roof Drains:
 - 1. Taper insulation around drain to provide smooth transition from roof surface to drain. Use specified pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope; slope not to exceed manufacturer's recommendations.
 - 2. Position membrane, then cut a hole for roof drain to allow 1/2 to 3/4 inch of membrane to extend inside clamping ring past drain bolts.
 - 3. Make round holes in membrane to align with clamping bolts; do not cut membrane back to bolt holes.

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4. Apply sealant on top of drain bowl where clamping ring seats below the membrane
 5. Install roof drain clamping ring and clamping bolts; tighten clamping bolts to achieve constant compression.
- D. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.
1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.
 2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches deep, with at least 1 inch clearance from penetration, sloped to shed water.
 3. Structural Steel Tubing: If corner radii are greater than 1/4 inch and longest side of tube does not exceed 12 inches, flash as for pipes; otherwise, provide a standard curb with flashing.
 4. Flexible and Moving Penetrations: Provide weathertight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.
 5. High Temperature Surfaces: Where the in-service temperature is, or is expected to be, in excess of 180 degrees F, protect the elastomeric components from direct contact with the hot surfaces using an intermediate insulated sleeve as flashing substrate as recommended by membrane manufacturer.

3.7 FINISHING AND WALKWAY INSTALLATION

- A. Install walkways at access points to the roof, around (rooftop equipment, roof hatches, access doors, roof top ladders, etc.) that may require maintenance, and where indicated on the drawings.
- B. Walkway Pads: Adhere to the roofing membrane, spacing each pad at minimum of 1.0 inch and maximum of 3.0 inches from each other to allow for drainage.
1. If installation of walkway pads over field fabricated splices or within 6 inches of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6 inches on either side.
 2. Prime the membrane, remove the release paper on the pad, press in place, and walk on pad to ensure proper adhesion.

3.8 FIELD QUALITY CONTROL

- A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by Roofing System Manufacturer specifically to inspect installation for warranty purposes (not a sales person).
- B. Perform all corrections necessary for issuance of warranty.
- C. Correct any defective work including leaking, failure to stay in place, splitting, buckling, bulging, and tearing or standing water on the membrane.
- D. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.
- E. Use Pourable Sealer or other acceptable membrane seal in accordance with the manufacturer's requirements.

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3.9 CLEANING

- A. Clean all contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings daily.
- B. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.
- C. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.
- D. Prior to the Manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

3.10 PROTECTION

- A. Where construction traffic must continue over finished roof membrane, provide durable protection and replace or repair damaged roofing to original condition.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Precoated galvanized steel roofing and associated integral flashings.
- B. Counterflashing
- C. Gutters and downspouts
- D. Snow Guards
- E. Insulation

1.2 RELATED SECTIONS

- A. Section 05120– Structural Steel
- B. Section 06100 – Rough Carpentry
- C. Section 07620 - Sheet Metal Flashing and Trim.
- D. Section 07900 - Joint Sealers.
- E. Section 07210 – Insulation
- F. Section 09900 - Painting

1.3 REFERENCES

- A. ASTM A653- Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process
- B. ASTM B32 - Solder Metal.
- C. ASTM C665 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
- D. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free
- E. ASTM A792 – Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- F. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials
- G. FS-O-F-506 - Flux, Soldering, Paste, and Liquid.
- H. NRCA (National Roofing Contractors Association) - Roofing Manual.
- I. SMACNA - Architectural Sheet Metal Manual - latest edition.
- J. FM Global - *Loss Prevention Data Sheet 1-49* Johnston, RI: FM Global.
- K. SPRI ES-1, - *Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems*,
- L. Structural Engineering Institute/American Society of Civil Engineers. *SEI/ASCE 7: Minimum Design Loads for Buildings and Other Structures*. Reston, VA: ASCE.
- M. FM Global - *FMG Loss Prevention Data Sheet 1-28: Design Wind Loads*. Johnston, RI: FMG.

1.4 SUBMITTALS

- A. Submit under provisions of Section 1300.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Product Data: Provide data sheet for metal roofing.
- D. Samples: Submit two samples of sheet metal roofing from manufacturer's color selection.

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1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA and NRCA standard details and requirements.
- B. Provide roofing materials, components, and assemblies that meet the following criteria:
 - 1. Wind Resistance Classification: 1-90 (FM 4450 and FM 4470)
 - a. Hail Resistance: SH.
 - b. Install to withstand 90 mph peak gust.

1.6 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal roof installations with minimum 3 years experience.

1.7 WARRANTY

- A. Special warranty on finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory applied finishes within specified warranty period.
- B. Finish Warranty Period: 20 years from date of substantial completion.
- C. Special Installer's Warranty: Roof installer shall agree to repair or replace components of custom-fabricated sheet metal roofing that fail in materials or workmanship within specified warranty for 2 years from date of substantial completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 1.
- B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials which may cause discoloration or staining.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS

- A. Flexospan Siding www.flexospan.com
- B. Fabral Metal Wall & Roof System www.fabral.com
- C. Kingspan(Morin Corporation) www.kingspan.com
- D. Centria www.centria.com
- E. Substitutions: Under provisions of Division 1

2.4 SHEET MATERIALS

- A. Pre-coated Galvanized Steel: ASTM 653, Grade A, G90 Zinc coating, 22 gage minimum core steel shop Panel width 18 inches minimum with a minimum height of 2 inches.
- B. Galvanized Steel: Where noted on drawings as galvalume - Galvalume coated steel conforming to ASTM A792/A Grade 33 with an AZ55 coating when unpainted, 0.0299 (formally 22 gage) inches core steel.

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- C. Metal Thickness: minimum base (uncoated) metal thickness of 0.0320-inch core sheet steel.
- D. Plastic Cement: ASTM D4586, Type I.
- E. Color: As selected by Architect from the manufacturer's standard range of colors.
- F. Panel Width: Minimum 18 inches wide with a minimum height of 2 inches.

2.5 ACCESSORIES

- A. Fasteners: Self-tapping steel with neoprene washers. Exposed screws: Stainless steel, color finish to match panels. Concealed screws: Galvanized steel or stainless steel.
- B. Concealed Clips: Minimum 16 gage core sheet steel with G-90 Galvanized Steel, ASTM A653 concealed fastening clips. Clips to provide unlimited, unimpeded panel movement and designed to withstand negative-load requirements.
- C. Closures: Precut profile closures from closed-cell polyethylene composition foam.
- D. Sealants: Side lap sealants, non-skinning, non hardening butyl sealant. Exposed sealant - one component, skinning, polymeric joint sealant.
- E. Round Penetrations: Pre-molded EDPM boot with metal banding collar.
- F. Plastic Cement: ASTM D4586, Type I.
- G. Thermal Block: Non-treated wood per manufacturer's recommendation.

2.6 SHOP FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in single length sheets.
- C. Hem exposed edges on underside ½ inch, miter and seam corners.
- D. Form material with standing seams.
- E. Fabricate flashings to allow toe to extend 2 inches over roofing. Return and brake edges.
- F. Fabricate snow/ice guards in accordance with SMACNA Plate 159.
- G. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended by SMACNA.
 - 1. Coat back side of sheet metal roofing with bituminous coating where roofing will contact ferrous metal, or cementitious construction.

2.7 FINISH

- A. Exterior and interior face shall be factory painted.
- B. Painted products shall be packaged so they will be protected from normal abuse during shipment and job storage.
- C. Touch up any damaged surfaces with factory supplied paint. Field Touch-up Paint: As recommended by panel manufacturer.
- D. Color: As selected by Owner from the manufacturer's standard range of colors.
- E. Coatings:
 - 1. For Severe chemical exposure (minimum quantities may be required):
 - a. Flexospan: Flexshield

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- b. Fabral: System which includes 4 mils (minimum) of vinyl plastisol - submit for Owner approval prior to bid award.
 - c. Morin: Flurothane V
 - d. Centria: Versacor Elite PF
- 2. For moderate chemical exposure:
 - a. Flexospan: Kynar 500®/Hylar 5000®
 - b. Fabral: Kynar 500®/Hylar 5000®
 - c. Centria: Flourofinish®
 - d. Morin: Valshield

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify correct placement of wood nailers.
- B. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.
- C. Verify roofing termination and base flashing are in place, sealed, and secure.

3.2 INSTALLATION

- A. Install roofing system in accordance with approved shop drawings and per manufacturer's instructions.
- B. Install all attachments to allow for thermal expansion and contraction of the roofing panels,
- C. Install panels in one continuous length from ridge to eave.
- D. Seal top and bottom of metal closures with butyl tape or caulking.
- E. At eaves and gable ends, terminate roofing by hooking over edge strip.
- F. Space fasteners as required for FM 1-90 wind-uplift resistance.

3.3 PROTECTION OF FINISHED WORK

- A. Do not permit traffic over unprotected roof surface.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Parapet coping and cap flashings
- B. Fascia caps
- C. Roof edge flashings
- D. Roof base and counter flashings
- E. Opening and corner trims
- F. Roof joint cover flashings
- G. Copings
- H. Gutters and downspouts
- I. Snow guards

1.2 RELATED SECTIONS

- A. Section 4200 – Unit Masonry Assemblies for installing through-wall flashing, reglents and other sheet metal flashing and trim.
- B. Section 6100 – Rough carpentry for wood nailers, curbs and blocking
- C. Section 07465 – Metal and Insulated Composite Siding
- D. Section 07611 – Sheet Metal Roofing
- E. Section 07900 – Joint sealants

1.3 REFERENCES

- A. NAAMM - Metal Finishes Handbook
- B. SMACNA - Architectural Sheet Metal Manual - latest edition
- C. FM Global. - *Loss Prevention Data Sheet 1-49* FM Global.
- D. SPRI ES-1, - *Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems*,
- E. Structural Engineering Institute/American Society of Civil Engineers. *SEI/ASCE 7: Minimum Design Loads for Buildings and Other Structures*. Reston, VA: ASCE.
- F. FM Global. - *FMG Loss Prevention Data Sheet 1-28: Design Wind Loads*.FMG.
- G. FMG Loss Prevention - *Data Sheet 1-28*. FM Global.
- H. National Roofing Contractors Association. - *The NRCA Roofing and Waterproofing Manual, Fifth Edition*. Rosemont IL: NRCA.
- I. ASTM A 480 - *Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip*.
- J. ASTM F 2329-05: *Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners*

1.4 QUALITY ASSURANCE

- A. Applicator: Company specializing in sheet metal flashing work with 5 years minimum experience.

1.5 CONDITIONS/PROTECTION

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- A. Exercise care when working on or about roof surfaces to avoid damaging or puncturing membrane or flexible flashing.
- B. Place plywood panels on roof surfaces adjacent to work of this section and on access routes, keeping in place until work is finished.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS

- A. Galvanized Steel Sheet: ASTM A653, G 90, commercial quality.
- B. Pre-coated Galvanized Steel: ASTM A666, Grade A.
- C. Metal Thickness: minimum base (uncoated) metal thickness of 24 gage core sheet steel.
- D. Finish exterior face shall be factory painted; Kynar 500.
- E. Color: Medium Bronze, unless noted otherwise.

2.4 ACCESSORIES

- A. Fastener: Galvanized steel or stainless steel as applicable; concealed hook strip type; of same material as flashings; sized to suit application.
- B. Protective Backing Paint: Zinc chromate alkyd.
- C. Sealant: DC 790 Building sealant, matching adjacent surface color, manufactured by Dow Corning Corporation.
- D. Asphalt Roof Cement: ASTM D2822.
- E. Gutter and Downspout Anchorage Devices: Per SMACNA requirements.
- F. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating sheet metal roofing, and complete with predrilled holes, clamps, or hooks for anchoring.
 - 1. Seam-Mounted, Bar-Type Snow Guards: Rods or bars held in place by coated galvanized or stainless steel clamps attached to vertical ribs of standing seam sheet metal roofing.

2.5 FABRICATION

- A. Fabricate items such as flashings in accordance with applicable requirements of SMACNA "Architectural Sheet Metal Manual."
- B. Fabricate cleats and attachment devices from same material as accessory being anchored.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.
- C. Fabricate flashing and trim members to provide a complete neat-appearing finished weathertight installation, including for:
 - 1. External corners of siding.
 - 2. Top and bottom edges of siding.

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- 3. Jamb, head, and sill closure trim at all openings such as doors (exclude sill closure trim), louvers, and openings for cable trays, bus ducts, openings for multiple pipes, ducts, etc.
- 4. Trim at building wall expansion joints.
- D. Fasteners: Provide a minimum 1-1/2-inch fastener at 12-inch centers.
 - 1. Fasteners: Same metal as sheet metal flashing. Match finish of exposed heads with material being fastened.
- E. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- F. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- G. Form pieces in longest practical lengths in minimum 10-foot lengths.
- H. Fabricate continuous cleats and continuous starter strips of same material as sheet and interlockable with sheet.
- I. Hem exposed edges on the underside 1/2 inch; miter and seam corners.
- J. Form material with flat lock seam.
- K. Fabricate corners from one piece with minimum 18 inches long legs; seam for rigidity, seal with sealant.
- L. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- M. Seams are to be standing lock type except corners.
- N. Fabricate gutters and downspouts to profile and sized indicated on drawings.
- O. Fabricate snow guards in accordance with SMACNA.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Inspect project conditions and supporting substrates. Notify Owner's Representative in writing of conditions deleterious to proper installation.
- B. Do not proceed until steel substrates are aligned to tolerances established in the AISC Code of Standard Practice.
- C. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, nailing strips, membrane termination and base flashings are in place, sealed, and secure.
- D. Beginning of installation means acceptance of existing conditions.
- E. Torch cutting of sheet metal flashing and trim is not permitted.

3.2 INSTALLATION

- A. Field measure site conditions prior to fabricating work.
- B. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

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- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 - 1. Coat side of coated metal flashing and trim with bituminous coating where flashing and trim will contact ferrous metal or cementitious construction.
- D. Install starter and edge strips, and cleats before starting installation.
- E. Install surface mounted reglets true to lines and grades. Seal top of reglets with sealant.
- F. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations approved by Owner's Representative.
- G. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- H. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- I. Roof Edge Flashing and Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for applicable wind zone and as indicated.
 - 1. Interlock bottom edge of roof edge flashing and coping with continuous cleats anchored to substrate at 12-inch centers.
- J. Seam and seal all joints for watertight construction.
 - 1. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
- K. Slope gutters minimum 1/8 inch per foot.
- L. Install gutter with expansion joints at locations not exceeding 50 feet apart. Install expansion joint caps.
- M. The joints in the downspouts shall be lapped in the same direction as the flow of the water.

3.3 CLEANING

- A. Daily Cleaning: Remove metal shavings as a result of drilling, cutting, and related installation procedures from all surfaces. Discoloration of exterior wall will not be accepted as a result of improper cleaning.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Preparing sealant substrate surfaces
- B. Sealant and backing
- C. All sealants and caulking materials and their application, wherever required, for complete installation of building materials or systems.

1.2 RELATED SECTIONS

- A. Section 03300 – General Cast-in-Place Concrete.
- B. Section 04200 – Masonry Units.
- C. Section 07270 – Fire Stopping.
- D. Section 08800 – Glazing.
- E. Section 09260 – Gypsum Board System.

1.3 REFERENCES

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
- B. American Society for Testing and Materials (ASTM):
 - 1. C509 - Elastomeric Cellular Preformed Gasket and Sealing Material
 - 2. C612 - Mineral Fiber Block and Board Thermal Insulation
 - 3. C717 - Standard Terminology of Building Seals and Sealants
 - 4. C919 - Use of Sealants in Acoustical Applications
 - 5. C920 - Elastomeric Joint Sealants
 - 6. C1021 - Laboratories Engaged in Testing of Building Sealants
 - 7. C1193 - Standard Guide for Use of Joint Sealants
 - 8. C1330 - Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants
 - 9. D1056 – Specification for Flexible Cellular Materials – Sponge or Expanded Rubber
 - 10. E84-08 – Surface Burning Characteristics of Building Materials
- C. Sealant, Waterproofing and Restoration Institute (SWRI). The Professional's Guide.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience.
- B. Applicator: Company specializing in applying the work of this section with minimum five (5) years documented experience and approved by sealant manufacturer.
- C. Conform to Sealant and Waterproofers Institute requirements for materials and installation.
- D. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not proceed with installation of joint sealants under the following conditions.

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- a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F.
 - b. When joint substrates are wet.
- B. Joint-Width Conditions:
 - 1. Do not proceed with installation of joint sealants where joint widths are less or more than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions:
 - 1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the work of this section with all sections referencing this section.

1.7 WARRANTY

- A. Provide three (3) year warranty under provisions of Division 1.
- B. Warranty: Include coverage of installed sealants and accessories which fail to achieve airtight and watertight seal, exhibit loss of adhesion or cohesion failure, do not cure, and subject to terms of "Warranty of Construction".

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS- None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS -

- A. Acceptable Manufacturer: The Dow Corning Corporation

2.4 MATERIAL SELECTION

- A. Exterior joints shall be sealed with Dow Corning building sealants. Install in strict compliance with manufacturer recommendations. Use the following tables as guides for material selection:
 - 1. Joint Bonding to Surfaces – Use:
 - a. Masonry to Masonry – Dow Corning® 790
 - b. Masonry to Metal with High Displacement – Dow Corning® 790
 - c. Masonry to Metal with Low Displacement – Dow Corning® 795
 - d. Masonry to Concrete (i.e. Precast) – Dow Corning® 790
 - e. Concrete (i.e. Precast) to Metal with High Displacement – Dow Corning® 790
 - f. Concrete (i.e. Precast) to Metal with Low Displacement – Dow Corning® 795
 - g. Metal to Glazing – Dow Corning® 795
 - h. Metal to Metal – Dow Corning® 795
 - i. Non-Structural silicone glazing and Non-Porous surfaces - Dow Corning® 999

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2.5 DISPLACEMENT TABLE

- A. Dow Corning Sealant – Joint Displacement
 - 1. Dow Corning® 790 – 100 percent tension, 50 percent compression.
 - 2. Dow Corning® 795 – 50percent tension, 50 percent compression.
 - 3. Dow Corning® 999 – 25 percent tension, 25 percent (formerly Dow Corning® 732) compression.

2.6 CAULKING COMPOUND

- A. ASTM C834, acrylic latex.
- B. One component acoustical caulking, non-drying, non-hardening, synthetic rubber.

2.7 COLOR

- A. Sealants used with exposed masonry shall match color of mortar joints.
- B. Sealants used with painted or stained concrete shall meet color of adjacent painted concrete color.
- C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.

2.8 JOINT SEALING BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealers, primer, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 degrees F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.9 JOINT FILLER

- A. Mineral fiber board: ASTM C612.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.10 PRIMER

- A. Priming may be a requirement where sealant will contact either metal or painted surfaces. Priming should be done thoroughly with a degreasing solvent; e.g. MEK (methyl ethyl ketone), toluene, etc., prior to application of sealant. Surfaces must be dry of solvent before sealant is applied.
- B. Stain free type.

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2.11 CLEANERS-NON POROUS SURFACES

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials before proceeding with sealant installation.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS

- A. Prepare joints in accordance with manufacturer's written instructions and SWRI..
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

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- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
 - 1. Apply primer prior to installation of back-up rod or bond breaker tape.
 - 2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.
- G. Where plumbing fixtures such as water closets, independent lavatories, lavatories, urinals, and service sinks abut wall and floor, fill joint with mildew-resistant waterproof sealant. Apply sealant along joint at each counter and wall fill joint with mildew-resistant waterproof sealant.

3.3 BACKING INSTALLATION

- A. Install back-up material, to form joints enclosed on three sides as required for specific depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod without puncturing the material, to a uniform depth, within plus or minus 1/8 inch for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
 - 1. Take all necessary steps to prevent three sided adhesion of sealants.
 - 2. For exterior joints over 1 inch wide, use rectangular type backer rod and bond breaker.

3.4 BOND BREAKER

- A. Install an adhesive-backed polyethylene bond breaker tape to prevent three-sided adhesive. Use where joint depth will not permit, use the joint backing.

3.5 SEALANT DEPTHS AND GEOMETRY

- A. At widths up to ¼ inch, sealant depth equal to width.
- B. At widths over ¼ inch, sealant depth ½ of width up to ½ inch maximum depth at center of joint with sealant thickness at center of joint approximately ½ of depth at adhesion surface.

3.6 INSTALLATION

- A. General:
 - 1. Apply sealants and caulking only when ambient temperature is between 40 degrees and 100 degrees F.
 - 2. Do not use sealant type listed by manufacturer as not suitable for use in locations specified.
 - 3. Apply sealant compounds in accordance with manufacturer's printed instructions.
 - 4. Avoid dropping or smearing compound and finish compound smooth.
 - 5. Fill joints solidly with compound and finish compound smooth.
 - 6. Tool joints to concave surface unless shown, specified, or otherwise detailed.
 - 7. Finish paving or floor joints flush unless joint is otherwise detailed.
 - 8. Apply compounds with nozzle size to fit joint width.

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9. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
 1. Apply a ¼ thick minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
 2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
 3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
 4. Openings: Apply a ¼ inch bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
 5. Control joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.7 QUALITY CONTROL

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as recommended by sealant manufacturer:
 1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
- B. Inspect joint for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
- C. Repair sealant pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- D. Evaluation of field-test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.8 CLEANING

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Non-rated, fire rated and thermally insulated steel frames, doors and panels.
- B. Door louvers
- C. Sidelight frames
- D. See door and window schedules located on drawings for type, size and fire rating
- E. Steel windows
- F. Sub-frames, mullions, couplings, and accessories for a complete installation as indicated on drawings.
- G. Insect screens.

1.2 RELATED SECTIONS

- A. Section 04200 – Unit masonry assemblies
- B. Section 07900 – Joint Sealants
- C. Section 08712 - Door Hardware
- D. Section 08800 – Glazing
- E. Section 09900 - Painting
- F. Section 09260 – Gypsum Board Systems

1.3 REFERENCES

- A. ANSI A117.1 – Accessible and Usable Buildings and Facilities
- B. ANSI/SDI A250.8 (SDI-100) - Standard Steel Doors and Frames.
- C. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-dip Process.
- D. ASTM A 123/A 123M- Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- E. ASTM E 283- Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Difference Across the Specimen.
- F. ASTM E331- Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Door by Uniform Static Air Pressure Difference.
- G. Door Hardware Institute (DHI) - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames, and Builder's Hardware.
- H. NFPA 80 - Fire Doors and Windows.
- I. NFPA 252 - Fire Tests for Door Assemblies.
- J. UL 10B - Fire Tests of Door and Window Assemblies.
- K. ASHRA E 90.1- Energy Standard of Buildings
- L. NFRC 100 – Determining Fenestration Product U-Factors.
- M. NFRC 200- Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

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- N. AAMA 603/605 – Windows- Metal Standard: Part L, Powder Coating, Steel.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate door elevations, internal reinforcement, anchor types and spacing, closure method, and cut-outs for glazing, louvers, and finish.
- C. Product Data: For each product indicated, door and frame configurations, anchor types and spacing's and location of cut-outs for hardware reinforcement and model, material description, label compliance, fire-resistance ratings, and finishes.
- D. Manufacturer's Installation Instructions: Indicate special installation instructions.
- E. Manufacturer's Certificate: For fire-rated doors certify that products meet or exceed specified requirements.
- F. Door Schedule. Use same reference designations indicated on drawings.
- G. Certificate: Certify that an independent testing laboratory has found that the exterior door assemblies proposed for this work have been tested in accordance with ASTM E 283 and meet or exceed the following requirements.
1. Rate of leakage shall not exceed 0.5 cfm per foot of crack length at static air pressure of 1.567 psf (equivalent to 25 mph wind velocity) based on 3-foot by 7-foot operating door assembly.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of Steel Door Institute Standard SDI-100 and ANSI A117.1.
- B. Steel Door, Window and Frame Standard: Comply with ANSI A250.8, unless more stringent requirements are indicated.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
1. Fire door assemblies shall be labeled by an approved agency. The labels shall comply with NFPA 80, and shall be permanently affixed to the door and frame.
 2. Fire doors shall be labeled showing the name of the manufacturer, the name of the third-party inspection agency, and the fire protection rating. The label shall be applied at the factory or location where fabrication and assembly are performed.

1.6 QUALIFICATIONS

- A. Manufacturer Qualifications: A firm with not having less than 10 years experience in manufacture of similar type hot-rolled steel window and door and maintaining an ISO 9001 certified facility for manufacture of steel doors and windows.

1.7 REGULATORY REQUIREMENTS

- A. Fire Rated Frame Construction: Conform to NFPA 252, and UL 108.
- B. Fire Rated Door and Panel Construction: Conform to NFPA 252, and UL 108.
- C. Installed Door, Frame, and Panel Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products to site under provision of Division 1.

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- B. Accept doors onsite in manufacturer's packaging. Inspect for damage.
- C. Mark opening numbers established on floor plans and door schedule on doors and frames.
- D. Break seal onsite to permit ventilation.
- E. Provide temporary spreader across bottom of welded frames to maintain proper alignment.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and instructed by the manufacturer.

1.10 COORDINATION

- A. Coordinate work under provisions of Division 1.
- B. Coordinate work with door opening construction, door frame, and door hardware installation.

1.11 WARRANTY

- A. Provide three (3) year warranty under provisions of Division 1.
- B. Warranty: Include coverage of installed door, firm and accessories which fail to achieve airtight and subject to terms of "Warranty of Construction".

PART 2 – PRODUCTS

2.1 OWNER PROVIDED PRODUCTS – None

2.2 CONTRACTOR PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 DOOR AND FRAME MANUFACTURERS

- A. Amweld Building Products, Inc.- www.amweld.com
- B. Ceco Door Products, an Assa Abloy Group Company- www.cecodoor.com
- C. Pioneer Industries, Inc.- www.pioneerindustries.com
- D. Steelcraft, an Ingersoll-Rand Company- www.steelcraft.com
- E. Curries, an ASSA Abloy Group www.curries.com
- F. Substitutions: Under provision of Division 1.

2.4 FRAMES

- A. Exterior Frames: 0.0598-inch (formally 16 gage) thick material, base metal thickness at UL-labeled and nonlabeled openings.
- B. Interior Frames: 0.0598-inch (formally 16 gage) thick material, base metal thickness at UL-labeled and nonlabeled openings.
- C. Provide frames with mitered corners reinforced with corner clip for firm interlock of jamb to head. Draw up and secure mitered joints with concealed screws.
- D. Provide frames full weld and ground smooth.

2.5 FRAME ACCESSORIES

- A. Silencers: Resilient rubber fitted into pre-drilled holes.

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- B. Bituminous Coating: Fibered asphalt emulsion.
- C. Primer: Zinc chromate.
- D. Grout: Fine, premixed grout, per ASTM C-94.
- E. Weather stripping

2.6 FRAME FABRICATION

- A. Fabricate frames as welded unit. Comply with ANSI A 250.8, unless more stringent requirements are indicated.
 - 1. 0.0598-inch-thick (formally 16 gage) for level 3 steel doors.
- B. Mullions for Double Doors: Fixed type, of same profiles as jambs.
- C. Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
- D. Fabricate frames with hardware reinforcement plates welded in place. Attach fire rated label to each frame unit for rated assemblies. Refer to Door Schedule on drawings.
- E. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.
- F. Prepare frame for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.
- G. Plaster Guards: 0.1345-inch (formally 10 gage)-thick steel sheet plaster guards or mortar boxes welded in place for butts, strikes, closures, and other hardware. Provide plaster caps over cutouts and strike boxes.
- H. Fabricate frames to suit masonry wall coursing with 4 inch head member as needed.
- I. Fire-rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency.
- J. Include conduit for electronic hardware conduit and J box where indicated.
- K. Supports and Anchors: Not less than 0.0478-inch (formally 18 gage)-thick zinc-coated steel sheet.
 - 1. Masonry Wall Anchors: 0.177-inch diameter, steel wire complying with ASTM A510 may be used in place of steel sheet.
- L. Inserts, Bolts and Fasteners: Manufacturer's standard units. Zinc-coat items that are to be build into exterior walls according to ASTM A1531A, class cord as applicable.
 - 1. In metal siding and girt wall assemblies include with frame vertical struts with clips for anchoring extending upward from jambs or vertical mullions to structural framing above typical both sides of frame.

2.7 FRAME FINISH

- A. Steel Sheet: Free from defects and galvanized to ASTM A653 G40.
- B. Primer: Air dried.
- C. Coat inside of frame profile with bituminous coating to a thickness of 1/16 inch, metallic-coated steel channels with channel webs placed even with top and bottom edges.

2.8 DOORS AND PANELS

- A. Level 3 - Extra Heavy-duty 1 ¾ inches, Performance Level A, Model 3 - Hollow Steel construction.

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- B. Exterior Doors Non-thermally Broken: ANSI/SDI- A250.8 Level 3, thermally insulated.
- C. Interior Doors Non-rated: ANSI/SDI-A250.8 Level 3, sound rated.
- D. Interior Doors Fire Rated: ANSI/SDI-A250.8 Level 3, sound rated.

2.9 DOOR CONSTRUCTION

- A. Face: Steel sheet in accordance with ANSI/SDI-A250.8.
- B. Core: Vertical steel stiffeners.
- C. End Closure: Channel 0.04 inches thick, inverted.
- D. Sound-Rated Door: STC of 26, measured according to ASTM E413.
- E. Thermal Insulated Door: Total insulation "R" value of 2 measured in accordance with ASTM C1363.
- F. Vision Lite Systems: Manufacturer's standard kits consisting of glass lite moldings to accommodate glass thickness and size of vision lite indicated.
- G. Check floor finishes and door schedule for undercutting or other special requirements. Undercutting of doors, if required, shall be performed by door supplier during fabrication procedure.

2.10 DOOR ACCESSORIES

- A. Louvers: As manufactured by the door manufacturer. Provide fire rated louver at fire door location where indicated.
 - 1. Material and Finish: Roll formed steel wipe coat of zinc.
 - 2. Louver Blade: Inverted V blade, sight proof
- B. Removable Stops: Rolled steel channel butted corners; prepared for countersink style screws.
- C. Astragals for Double Doors: Steel "T" or "Z" shaped, specifically for double doors.
- D. Primer: Zinc chromate type.

2.11 DOOR FABRICATION

- A. Fabricate doors with hardware reinforcement welded in place.
- B. Attach fire rated label to each door unit for rated assemblies. Refer to Door Schedule on drawings.
- C. Close top and bottom edge of exterior doors with inverted steel channel closure. Seal joints watertight.
- D. Clearances for non-fire-rated door shall not be more than 1/8" at jambs and heads, except not more than 1/4-inch between pairs of doors, and not more than 3/4-inch at bottom.
- E. Clearances for fire-rated doors as required by NFPA 80.
- F. Tolerances comply with SDI 117.
- G. Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and A115.

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- H. All exterior locations and elsewhere as shown on schedule provide door fabricated as thermal-insulating door and frame assemblies and tested according to ASTM operable door assemblies.
- I. Coat inaccessible steel surfaces such as inside surfaces of doors and panels with coat of rust-inhibitive paint before fabrication.

2.12 DOOR FINISH

- A. Steel Sheet: Galvanized to ASTM A653.
- B. Primer: Air dried.
- C. Coat: Inside of exterior frame profile with bituminous coating to a thickness of 1/16".

PART 3 – EXECUTION

3.1. EXAMINATION

- A. Verify that opening sizes and tolerances are acceptable.

3.2. INSTALLATION

- A. Install frames and doors in accordance with ASNI A250.8.
- B. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Wall Anchors: Provide at least three per jamb. For openings 90-inches or more in height, install an additional anchor at hinge and strike jambs for every 32-inches additional height.
 - 2. Provide UL-approved or loose, tee-shaped, galvanized anchors of manufacturer's standard type. Jamb anchors at metal studs must be UL approved.
 - 3. Fire-rated Frames: Install according to NFPA 80.
- C. Comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
 - 1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
 - 2. Smoke Control Doors: Install to comply with NFPA 105.
- D. Coordinate installation of glass and glazing.
- E. Install door louvers plumb and level.
- F. Coordinate installation of doors with installation of frames and hardware specified in Division 1.
- G. Coordinate with masonry and wallboard wall construction for anchor placement, back coating and finishing.
- H. After installation, remove protective wrappings from doors and frames and touch up prime coat with compatible air-drying primer.

3.3. ERECTION TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4. ADJUSTING AND CLEANING

- A. Adjust work under provisions of Division 1.
- B. Adjust door for smooth and balanced movement.

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- C. Adjust hinge sets, locksets, and other hardware. Lubricate using a suitable lubricant compatible with door and frame coatings.
- D. Remove temporary covering and protection of adjacent work areas. Repair or replace damaged installations.
- E. Clean in accordance with manufacturer's instructions before Owner's acceptance.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDES

- A. Non-rated and fire-rated, interior, solid core, flush doors with wood veneer face, including transom panels and vision lights.
- B. See Door Schedule in Drawings for types, sizes, and fire ratings of wood doors.

1.2 RELATED SECTIONS

- A. Section 08111 – Steel Doors and Frames.
- B. Section 08712 – Door Hardware.
- C. Section 08800 – Glazing.
- D. Section 09900 – Painting.

1.3 REFERENCES

- A. American National Standards Institute (ANSI): ANSI A208.1 Particleboard, Mat-Formed Wood.
- B. American Society of Testing and Materials (ASTM):
 - 1. ASTM E90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 2. ASTM E413 Classification for Rating Sound Insulation.
- C. American Woodwork Institute (AWI): AWI Quality Standards.
- D. Code of Federal Regulations (CFR): CFR 16CFR 1201 Safety Standard for Architectural Glazing Materials.
- E. National Fire Protection Association (NFPA):
 - 1. NFPA 80-07 Standard for Fire Doors and Windows.
 - 2. NFPA 252 Fire Tests of Door Assemblies
- F. Underwriters Laboratories (UL): UL 10B Safety Fire Tests for Door Assemblies - Neutral Pressure.
- G. Window and Door Manufacturers Association (WDMA): 1.S-A-04 Architectural Wood Flush Doors

1.4 DEFINITIONS

- A. Warp: Any distortion in door plane independent of doorframe such as bow, cup, and twist.
- B. Bow: Curvature along length of door measured as deviation from straight line extended from top to bottom of door.
- C. Cup: Curvature along width of door measured as deviation from straight line extending from one door side to opposite side.
- D. Twist: Deviation of one or two door corners being out of plane from other corners.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01300:
 - 1. Product data for wood doors including:

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- a. Door core and edge construction.
 - b. Veneer species, cut, and matching.
 - c. Factory finish materials and application.
 - d. Vision lights
2. Shop drawings indicating door elevations, dimensions, swings, size and location of blocking for hardware, cutouts for vision lights, and details for fabrication and installation.
 3. Samples:
 - a. Factory finishes for selection by Architect.
 - b. 8 by 10 inches minimum door panel sample illustrating selected finished face, core, edges, and corner.
 4. Manufacturer's instructions for preparing, hanging, installing hardware, and adjusting wood doors. Include requirements for installing fire rated, positive pressure, and sound control doors.
 5. Copy of warranty.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer
- B. Conform to requirements of AWI Quality Standards, Section 1300, "Architectural Flush Doors".
- C. Fire-rated doors: Provide units complying with NFPA 80, identical to assemblies tested in accordance with ASTM E2074, and listed by Underwriters Laboratories (UL), or other Nationally Recognized testing agency acceptable to SNL Site Fire Marshall. Units shall bear testing agency labels.
 1. Oversize Door Assemblies: Provide certificate that assemblies exceeding fire tested assembly sizes conform to fabrication of tested and labeled assemblies except for size.
 2. Positive Pressure: Provide certificate that fire rated doors have been tested for positive pressure in accordance with IBC or NFPA.
- D. Sound Transmission Class: Provide certificate that door assemblies have been tested in accordance with ASTM E413 and ASTM E1408 to achieve minimum sound transmission class of STC 43.
- E. Door Glazing: Comply with CFR 16CFR 1201 and other applicable safety requirements. Each piece of safety glazing shall be permanently labeled with appropriate marking.
- F. Wood Louvers:
 1. Door manufacturer's standard product, fabricated of solid wood sections.
 2. Wood slats: not less than 3/16-inch thick.
 3. Stiles routed out to receive slats.
 4. Secure louvers in prepared cutouts with wood stops.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors by packaging and other means during delivery, storage, and handling to prevent damage and warpage.
- B. Site storage: Store flat on level surface in clean, dry, well ventilated area. Protect from sunlight. Cover to keep clean, but permit air circulation.
- C. Do not drag one door across another.
- D. Identify each door with opening number used on shop drawings, using temporary, removable or concealed markings.

1.8 PROJECT CONDITIONS

- A. Do not deliver and install wood doors until site conditions have been stabilized and will be maintained at:
 - 1. Temperature: 60 to 90 degrees F.
 - 2. Relative Humidity: 25 to 50 percent.

1.9 WARRANTY

- A. Submit in accordance with Division 1: General Requirements:
 - 1. Warranty to cover repair or replacement of defective interior wood doors for life of initial installation including:
 - a. Materials and workmanship.
 - b. Bowing, cupping, and twisting greater than 1/4 inch for 42 by 84 inches door panel.
 - c. Telegraphing of core through veneer exceeding 0.01 inch in 3 inches.
 - d. De-lamination.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED MATERIALS – None

2.2 CONTRACTOR-PROVIDED MATERIALS - All materials, equipment, services and labor required to perform the work of this section.

2.3 ACCEPTABLE MANUFACTURERS

- A. Algoma Hardwoods, Inc.; Algoma, Wisconsin; (www.algomahardwoods.com).
- B. Eggers Industries; Neenah, Wisconsin; (www.eggersindustries.com).
- C. Marshfield Door Systems Inc.; Marshfield, Wisconsin; (www.marshfielddoors.com).
- D. Mohawk Flush Doors, Inc.; Northumberland, Pennsylvania; (www.mohawkdoors.com).
- E. VT Industries, Inc.; Holstein, Iowa; (www.vtindustries.com).
- F. Manufacturers of equivalent products submitted and approved in accordance with Division 1: General Requirements

2.4 FLUSH DOORS WITH WOOD VENEER FACE

- A. Type: Flush interior doors, 1-3/4 inches thick, solid core, 5 ply construction with wood veneer suitable for transparent finish.

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- B. Construction: 5 plies with stiles and rails bonded to core and assembly sanded prior to gluing cross band and face veneer to each side of core. Comply with AWI Section 1300, PC-5, and Premium Grade.
- C. Core: Particleboard, ANSI A208.1 1-L-1 Grade.
 - 1. Minimum recycled content: 50 percent post-industrial wood waste such as sawdust, shavings, and lumber scraps.
 - 2. Core bonding adhesive: Resins complying with ANSI A208.1 formaldehyde limits. Adhesive shall not contain urea-formaldehyde resin.
 - 3. Blocking: Provide 5 inches wide minimum wood blocking for installation of locksets, closers, exit devices, kick plates, and other hardware items and eliminate need for through-bolting.
 - 4. Bonding: Glue stiles and rails to core and sand core assembly prior to applying faces.
- D. Stiles: 1-3/8 inches minimum hardwood, same species as face veneer with no visible joints.
- E. Top and bottom rails: 1-3/8 inches minimum solid wood.
- F. Wood veneer:
 - 1. Species: Plain sliced "White Maple/White Oak/White Birch/Red Oak", AWI Grade AA, suitable for transparent finish.
 - 2. Matching:
 - a. Center Balance Matching: Provide an even number of equal width veneer leaves from same flitch.
 - b. Book Matched: Veneers arranged in sequence with adjacent leaves forming mirror-like image.
 - c. Pair Patching: Provide for doors hung in same opening.
 - d. Set Matching: Provide for adjacent door pairs in close proximity.
 - e. Transom Match: Transom panel and adjacent door panel shall have continuous match.
- G. Finish: Factory finish wood doors in accordance with AWI Quality Standard Section 1500, System TR-6, Custom Quality.
 - 1. Type: Water-based stain followed by transparent ultraviolet cured, catalyzed polyurethane finish.
 - 2. Color: As selected by Architect from manufacturer's full range.
 - 3. Grain effect: Filled finish.
 - 4. Sheen: Satin semi-gloss.
 - 5. Seal top door edge with color sealer to match door facing.

2.5 FIRE-RATED WOOD DOORS

- A. Types: Provide fire-rated wood doors as indicated on Door Schedule in Drawings. Attach fire rating label to door edge.
 - 1. 20 minutes label: AWI FD 1/3.

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- a. Wood Veneer: 5 ply with particleboard core and wood veneer face, AWI PC-5, Premium Grade.
- b. Hardboard Face: 3 ply with particleboard core and hardboard face, AWI PC-3, Economy Grade.
- 2. Mineral Core Fire-Rated Doors: AWI FD-3/4, 45 minutes "C" label door with non-combustible mineral composition core.
 - a. Wood Veneer: 5 ply construction with stiles and rails bonded to mineral core and assembly sanded prior to gluing cross band and face veneer to each side of core. Comply with AWI Section 1300, FD-5, Premium Grade.
 - b. Hardboard Face: 3 plies with stiles and rails bonded to mineral core and assembly sanded prior to applying hardboard faces. Comply with AWI Section 1300, FD-3, Economy Grade.
 - c. Blocking: Provide 5 inches wide minimum composite blocking for installation of locksets, closers, exit devices, kick plates, and other hardware items and eliminate need for through-bolting. Composite blocking to have improved screw-holding capability and be approved for required fire rating.
- 2. Intumescent hot smoke seals: Conceal in door edges chemically inert, expandable, intumescent seal designed for multi-directional expansion at 400 degrees F, filling gap around perimeter of door. At Contractor's option, surface applied intumescent seals may be provided in lieu of concealed seals as part of Section 08710, "Door Hardware". Seals shall be tested and approved for fire rated door assemblies in accordance with UL Standard 10B.
- 3. Fire-Rated Door Pairs: Provide formed steel edges and astragals with intumescent seals as required for indicated fire ratings. Finish with baked enamel in color to match door.
- 4. Temperature-Rise Rated Doors: Provide temperature rise rated doors for stairwells and other exit enclosures to withstand 450 degrees F minimum temperature-rise in 30 minutes fire exposure.
- 5. Doors shall conform to the requirements of ASTM E2074, or NFPA 252, and carry an identifying label from a qualified testing and inspecting agency for class of door or opening shown designating fire performance rating. Provide metal labels with raised or incised markings.
- B. For glazed openings use steel frames approved for use in labeled doors.
- C. Provide a steel astragal on one leaf of pairs of doors, including double egress doors.

2.6 SOUND RETARDANT DOORS

- A. Fabricated as specified for flush wood doors with additional construction requirements to meet specified sound transmission class (STC).
- B. STC Rating of the door assembly in place when tested in accordance with ASTM E90 by and independent nationally recognized acoustical testing laboratory shall meet that required by the Architectural drawings.
- C. Accessories:
 - 1. Frame Gaskets: Continuous closed cell sponge neoprene metal.
 - 2. Automatic Door Bottom Seal:

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- a. Steel spring operated, closed cell sponge neoprene metal mounted removable in extruded aluminum housing with a medium matte 4.0 mil thick clear Anodized finish.
- b. Concealed or Surface Mounted.

2.7 VISION LIGHTS

- A. Provide vision lights of dimensions and configurations indicated on Drawings.
- B. Type: Metal frame with countersunk mounting holes.
- C. Provide fire-rated, labeled vision lights for doors indicated on Door Schedule to be fire-rated.
- D. Material: 20-gauge cold-rolled steel hot dipped galvanized.
- E. Finish: Factory primed.
- F. Glazing as specified in Section 08800, "Glazing":
- G. Glazing stops: Rectangular profile. Exterior stop to be non-removable. Interior stop to be removable snap-on type or attached with countersunk screws.
- H. Factory prepare door with cutout to receive vision light. Ship light separately as kit to be field installed in order to prevent damage to door finish.

2.8 FACTORY FINISHING

- A. Factory fit doors to coincide with designated frame opening sizes with these clearances and bevels:
 - 1. Non-Rated Door Clearances:
 - a. Head, jamb, and between double doors: 1/8 inch.
 - b. Bottom of door to floor finish: 1/8 inch.
 - c. Bottom of door to top of threshold: 1/4 inch.
 - 2. Fire-Rated Door Clearances: Comply with NFPA 80.
 - 3. Lock and hinge door edges shall be beveled 1/8 inch in 2 inches. Bevel of fire-rated doors shall not exceed that permitted by labeling agency.
- B. Finish doors at factory.
- C. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-6 catalyzed polyurethane.
- D. Staining: Clear finish, as approved by Architect.
- E. Factory machine doors to receive hardware in accordance with AWI requirements, Section 08710, "Door Hardware", and supplied hardware templates.
 - 1. Machine cut relief for hinges and coring for locksets, cylinders, and other items.
 - 2. Pilot drill screw and bolt holes.
- F. Seal cut surfaces after fitting and machining. Ensure that hardware recess edges are sealed with minimum two coats varnish.

2.9 IDENTIFICATION MARK:

- A. On top edge of door.

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- B. Either a stamp, brand or other indelible mark, giving manufacturer's name, door's trade name, construction of door, code date of manufacture and quality.
- C. Accompanied by either of the following additional requirements:
 - 1. An identification mark or a separate certification including name of inspection organization.
 - 2. Identification of standards for door, including glue type.
 - 3. Identification of veneer and quality certification.
 - 4. Identification of preservative treatment for stile and rail doors.

2.10 SEALING

- A. Give top and bottom edge of doors two coats of catalyzed polyurethane or water resistant sealer before sealing in shipping containers.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Inspect door and frames prior to hanging. Reject doors with defects. Verify frames are correct size and type, securely anchored, heads are level, and jambs are plumb.
- B. Do not proceed until deficiencies are addressed.

3.2 INSTALLATION

- A. Install wood doors in accordance with approved shop drawings, manufacturer's instructions, and AWI Custom Quality Standards.
- B. Install fire-rated doors in accordance with NFPA 80 for class indicated in Door Schedule on Drawings.
- C. Install sound retardant doors in sound control openings with appropriate hardware as indicated on Drawings.
- D. Hang doors and install hardware and vision lights.
- E. Fitting: Align and fit doors in frames with uniform clearances and bevels. Do not trim stiles and rails in excess of limits of manufacturer and permitted for fire-rated doors. Ensure that clearances are maintained.
- F. Restore factory applied door finish if site fitting and machining is required.
- G. Adjust hung doors for smooth and balanced movement. Re-hang or replace doors that do not operate freely.
- H. Field finish doors with hardboard face with opaque paint finish specified in Section 09900, "Painting". Do not paint over fire rating labels.
- I. Operation: Re-hang or replace doors that do not swing or operate freely.
- J. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Fire rated and non-rated Wall access doors and frames.
- B. Fire rated and non-rated Ceiling access doors and frames

1.2 RELATED SECTIONS

- A. Section 4200 – Unit Masonry for anchoring and grouting access door frames in masonry construction.
- B. Section 07553 - Roof Accessories for roof hatches.
- C. Section 08712 - Door Hardware for mortise or rim cylinder locks and keying.
- D. Section 09511 - Acoustical Tile Ceilings for suspended acoustical tile ceilings
- E. Section 09260 - Gypsum Board Systems.

1.3 REFERENCES

- A. ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- B. ASTM A1008 – Steel Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy
- C. AWS D1.3 – Structural Welding Code Steel Sheet
- D. NFPA 80 – Fire Doors and Windows
- E. NAAMM-AMP500 – Metal Finishes Manual
- F. UL – Fire Resistance Directory

1.4 DESIGN REQUIREMENTS

- A. Fabricate floor access assemblies to support live load of 100 lb/sq ft with deflection not to exceed 1/180 of span unless otherwise noted.

1.5 SUBMITTALS

- A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
- B. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.
- C. Manufacturer's Installation Instructions: Include rough-in dimensions.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.
- C. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

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1. NFPA 252 for vertical access doors and frames.
2. ASTM E 119 for horizontal access doors and frames.
3. NFPA 288 for floor hatches.
- D. Attach label from agency approved by authority having jurisdiction to identify each fire-rated access door.
- E. Installed Fire-Rated Access Door Assembly: Conform to NFPA 80 for fire-rated class as indicated.

1.7 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services and labor required to perform the work of this section. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Karp Associates, Inc. (www.karpinc.com)
 2. Larsen's Manufacturing Company (www.larsensmfg.com).
 3. Milcor Limited Partnership (www.milcorinc.com).
 4. Nystrom Building Products Co. (www.nystrom.com).

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568 for uncoated base metal.
- C. Drywall Beads: Edge trim formed from 0.0299-inch formally 22 gage) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.4 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for reglazing welds in steel, complying with SSPC-Paint 20.

2.5 ACCESS DOORS AND FRAMES

- A. Lock: Key-operated cylinder lock with interior release.

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- B. Flush, Uninsulated, Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
 - 1. Locations: Gypsum board and metal stud framing, with and without ceramic tile, wall surfaces.
 - 2. Door: Minimum 0.060-inch- (formally 16 gage) thick sheet metal, flush construction.
 - 3. Frame: Minimum 0.060-inch-(formally 16 gage) thick sheet metal with 1-1/4-inch- wide, surface-mounted trim.
 - 4. Hinges: Concealed pin type.
 - 5. Automatic Closer: Spring type.
 - 6. Lock: Prepared to receive mortise cylinder lock, specified in Division 8 Section "Door Hardware," with interior release.

2.6 FABRICATION

- A. General: Provide access door assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
- D. Provide mounting holes in frames to attach frames to metal drywall construction and to attach masonry anchors in masonry construction.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
- F. For doors with latches released by and locks operated by mortise cylinders, prepare access doors for cylinder specified in Division 8 Section "Door Hardware."

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.8 STEEL FINISHES

- A. Galvanizing of Steel Shapes and Plates: Hot-dip galvanize items indicated to comply with applicable standard listed below:
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

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- C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.
- D. Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pretreating.

2.9 ACCESS DOORS, FIRE RATED

- A. Shall meet requirements for "B" label 1-1/2 hours with maximum temperature rise of 120 degree C (250 degrees F) unless otherwise noted.
- B. Comply with NFPA 80 and have Underwriters Laboratories Inc., or other nationally recognized laboratory label for Class B opening.
- C. Door Panel: Form of 0.0359 inch thick steel or stainless steel, insulated sandwich type construction.
- D. Frame: Form of 0.0598 inch thick steel sheet depth and configuration to suit material and type of construction where installed.
 - 1. Weld exposed joints in flange and grind smooth.
 - 2. Provide frame flange at perimeter where installed in concrete masonry or gypsum board.
- E. Automatic Closing Device: Provide automatic closing device for door.
- F. Hinge: Continuous steel hinge with stainless steel pin.
- G. Lock:
 - 1. Self-latching, with provision for fitting flush a standard screw-in type lock cylinder. Lock cylinder specified in Division 8 Section – "Door Hardware".
 - 2. Provide latch release device operable from inside of door. Mortise case in door.
- H. Size: Minimum 24 inches square door unless otherwise shown on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install access doors in openings to have sides vertical in wall installations, and parallel to ceiling suspension grid or side walls when installed in ceiling.
- D. Set frames so that edge of frames without flanges will finish flush with surrounding finish surfaces.
- E. Set recessed panel access doors recessed so that face of surrounding materials will finish on the same plane, when finish in door is installed.

3.3 ADJUSTING AND CLEANING

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- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

3.4 LOCATION

- A. Provide access panels or doors wherever any valves, traps, dampers, cleanouts and other control items of mechanical, electrical and conveyor work are concealed in wall or partition, or are above ceiling of gypsum board or plaster.
- B. Use fire rated doors in fire rated partitions and ceilings.
- C. Use flush panels in partitions and gypsum board or plaster ceilings, except lay-in acoustical panel ceilings or upward access acoustical tile ceilings.

3.5 ANCHORAGE

- A. Secure frames to adjacent construction using anchors attached to frames or by use of bolts or screws through the frame members.
- B. Type, size and number of anchoring device suitable for the material surrounding the opening, maintain alignment, and resist displacement during normal use of access door.
- C. Anchors for fire rated access doors shall meet requirements of applicable fire test.

END OF SECTION

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OVERHEAD COILING DOORS

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Standard and fire-rated overhead coiling doors and shutters; operating hardware, electric and manually operated; field finish painted.
- B. Electric wiring from disconnect to door or shutter control station to door operator.

1.2 REFERENCES

- A. ASTM A526/A526M - Steel Sheet, Zinc-coated (Galvanized) by the Hot-dip Process, Commercial Quality.
- B. ASTM B221/A221M - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- D. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
- E. NEMA MG1 - Motors and Generators.
- F. UL - Fire Resistance Directory.
- G. UL 325 - Door, Drapery, Gate, Louver, and Window Operators and Systems

1.3 SYSTEM DESCRIPTION

- A. Electric motor operated unit with manual override in case of power failure.
- B. Fire rated door and or shutter fusible link activated with automatically governed closing speed.
- C. Interior locking device from the manufacturer.
- D. Manual chain operated.

1.4 DESIGN REQUIREMENTS

- A. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf, with maximum deflection of 1/120, and without damage to door or shutter and assembly components.
- B. Operation: Design door assembly including operator to operate for not less than 20,000 cycles and 10 cycles per day.

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300.
- B. Provide pertinent dimensioning, general construction, component connections and details, anchorage methods, hardware location, and installation details.
- C. Submit the manufacturer's installation instructions under provisions of Section 01300.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit the manufacturer's operation and maintenance data under provisions of Section 01700.
- B. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustment requirements.

1.7 QUALITY ASSURANCE

- A. Fire-Rated Door Construction: Conform to one of following:

1. NFPA 252.
2. UL 10B.
- B. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.
- C. Installed Fire-Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated.
- D. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.
- E. Surface Burning Characteristics:
 1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested according to ASTM E84.
- F. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.
- G. Manufacturer: Company specializing in manufacturing products specified in this Section with three years' experience.
- H. Installer: Company specializing in performing Work of this Section with five years' experience.
- I. Products Requiring Electrical Classification: Either UL/CSA Recognized or FM approved.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 ACCEPTABLE MANUFACTURERS

- A. Raynor Manufacturing Company
- B. OverHead Door Company
- C. Wayne Dalton Corporation
- D. C.H.I. Overhead Doors
- E. Substitutions: Under provisions of Section 01300.

2.4 COMPONENTS AND MATERIALS

- A. Door curtain: Conform to the following; fire-rated according to the door schedule requirements:
 1. Steel Slats: Fabricate coiling door curtain of interlocking slats, 2 inch. Slat material shall be structural quality, cold rolled steel sheets, flat-faced slat, minimum 20 gage thick. Span the entire width of the door opening without splices. Design to withstand 20 psf wind load.
 2. Bottom bar: Provide two (2) equal steel angles, minimum 1/8" thick, to stiffen curtain with neoprene loop astragal.
- B. Guides: 3/16 inch minimum rolled steel, continuous, vertical mounted with galvanized steel mounting brackets.

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OVERHEAD COILING DOORS

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- 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: Minimum 24 gage galvanized steel; internally reinforced to maintain rigidity and shape.
- E. Weather Seal: Water and rot proof, resilient type. Locate along jamb edges, bottom of curtain, and where curtain enters hood enclosure.
- F. Smoke Seals (Fire Rated Assemblies): Perimeter gaskets and closures to prevent spread of smoke through door assembly and to maintain required fire rating and fire label.
- G. Safety Edge: Locate on door bottom, full width, pneumatic sensitized type, wired to reverse door upon striking object, hollow rubber covered seal.

2.5 ELECTRICAL OPERATOR:

- A. Description: UL 325 side mounted.
 - 1. Motor Enclosure: NEMA MG1 Type 4 open drip proof.
 - 2. Motor Rating: HP rating as noted on drawings, continuous duty; 1/3 hp minimum.
 - 3. Motor Voltage 460 volt, three phase, 60 Hz.
 - 4. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 - 5. Controller Enclosure: NEMA 250 Type 4 Door Shutter Speed
 - 6. Adjustable friction clutch, double shoe brake system actuated by independent full line voltage solenoid controlled by motor starter; fully enclosed adjustable positive gear driven upper and lower CAM limit switches, fully enclosed magnetic cross line reversing starter
 - 7. See Electrical drawings for electrical classification description.

2.6 CONTROL STATION:

- A. Standard three button (OPEN-STOP-CLOSE) momentary control for each operator, 24 volt circuit, surface mounted.
- B. Refer to HSC 3226H V6.0 HSC Electrical/Instrumentation and Communications Master Construction Specification
 - 1. Materials of construction shall be as follows:
 - a. Allen-Bradley Bulletin 800R hermetically sealed contact units in NEMA 4X enclosures unless otherwise specified.
 - b. Stations shall be furnished with silicone rubber protective boots (standard Hypalon® boots are not acceptable).
 - c. Stop buttons shall be equipped with a Padlocking Attachment Unit.
 - d. Pushbuttons shall be Allen-Bradley Bulletin 800H and shall be provided with legend plate markings.

2.7 FINISH

- A. Shop-applied primer paint finish. Finish painting will be field-applied and under the provisions of Section 09900 of this specification.

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OVERHEAD COILING DOORS

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PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install overhead coiling doors, with electric operators and controls, in accordance with manufacturer's instructions. Coordinate installation with electric service.
- B. Fit, align, and adjust door assembly level and plumb; provide smooth operation.
- C. Mount doors and controls on side of wall as indicated on the drawings.
- D. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- E. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- F. Install fire-rated door assemblies according to NFPA 80 and requirements for fire listing.
- G. Install perimeter trim and closures.

3.2 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/16 inch
- B. Maximum Variation From Level: 1/16 inch
- C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

END OF SECTION

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ROLL-UP FABRIC DOORS

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PART 1 - GENERAL**1.1 SUMMARY**

- A. Fast acting roll-up fabric doors, operating hardware and electronic controls

1.2 RELATED SECTIONS

- A. Section 05500 - Metal Fabrications: Door framing members

1.3 REFERENCES

- A. ASTM A525/A525M - Steel Sheet, Zinc-coated by the Hot-dip Process
- B. ASTM B221/A221M - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- D. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies
- E. NEMA MG1 - Motors and Generators

1.4 SYSTEM DESCRIPTION

- A. Electric motor operated unit with an opening speed of 96 inches per second and a closing speed of 40 inches per second.

1.5 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide general construction component connections with detail and electrical equipment.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Each type of door showing details of construction, accessories and hardware, electrical and mechanical items, support brackets, locations and rating of motors and safety devices.
- E. Wiring diagrams for motors and controls, including wiring diagram for door, showing electrical interlock of motor with manually operated deadlock, electrical rough-in.
- F. Maintenance Data: Indicate lubrication requirements and periodic adjustments required.

1.6 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide high-speed rolling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components or excessive fluttering in the wind:
 - 1. Wind Load for Exterior Doors: Uniform pressure (velocity pressure) of 20 lbf/square foot, acting inward and outward.
- B. Operation-Cycle Requirements: Design high-speed rolling door components and operator to operate for not less than 1,000,000 cycles.

1.7 REGULATORY REQUIREMENTS

- A. Products requiring Electrical Classification: Either UL/CSA Recognized or FM approved.

1.8 WARRANTY

- A. Provide three (3) year warranty under provisions of Division 1.

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ROLL-UP FABRIC DOORS

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- B. Warranty: Include coverage of installed door, firmness and accessories which fail to achieve air tightness and are subject to terms of "Warranty of Construction".

PART 2 – PRODUCTS

2.1 OWNER PROVIDED PRODUCTS - None.

2.2 CONTRACTOR PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 ACCEPTABLE MANUFACTURERS

- A. Rite-Hite Corporation
8900 North Arbon Drive, Milwaukee, Wisconsin 53223
FasTrax
- B. Hormann FLEXON
Starpointe Business Park
117 Starpointe Boulevard
Burgettstown, PA 15021-09506
Speed-Master 1600 L, 2600L
- C. NERGECO USA,
6186 Centre Park Drive, West Chester, OH
Forum Star 2 "DuraRoll" High speed door
- D. Substitutions: Refer to Section 01600

2.4 MATERIALS

- A. Curtain Material: Flexible door panels shall be constructed of wear resistant PVC coated, UV protected multi-layer polyester fabric. Door panels shall be supported by evenly spaced horizontal composite rods, which are inserted and sealed within the curtain fabric. The composite rods shall extend into the side guides to provide air pressure/vacuum resistance without the need for counterweights, springs or tensioning devices of any kind. The door shall be specially designed to seal peripherally to minimize air leakage. Color shall be as selected from manufacturers standard color range.
- B. Side Frames: All structural members shall be non-corrosive multi-composite material capable of supporting the weight of the door assembly. All other components shall also be constructed of non-corrosive materials (plastic, SS, etc.). Open side guide/frame design shall be such as to allow for cleaning with the entire door assembly washable. Door to include multi-composite roll and motor/bearing covers.
- C. Automatic Reinsertion: the composite rods used to reinforce the curtain shall be flexible such that upon impact they allow the door panel to release from the side guides. Upon the completion of the next opening cycle the door panel will automatically reinsert back into the side guides thru the reinsertion tabs without any human assistance.
- D. Windlocks: Manufacturer's standard.
- E. Windbar: Integrated type, two minimum or free-traveling type with additional safety strap.
- F. Bottom Bar: Manufacturer's standard with a break-away safety feature.

- G. Curtain Jamb Guides: Fabricate curtain jamb guides with sufficient depth and strength to retain curtain loading with minimum air infiltration.
1. Quick Reset System: System designed to return door panel edge to guides after door sustains impact.
- H. Counterbalance System: Provide system to offset weight of curtain and bottom bar.
- I. Hood: Provide completely enclosed barrel and operator cover. Form to entirely enclose coiled curtain and operating mechanism at opening head and sides and act as weatherseal. Roll and reinforce top and edges for stiffness. Provide closed ends or sides for hoods and any portion of door projecting beyond wall face. Provide intermediate support brackets as required to prevent sag and warp.
1. Fabricate steel hoods for doors of not less than 0.0396-inch (20 gage) thick hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 525.
- J. Safety Controls
1. Photoelectric Eye Device: Provide each motorized door with photoelectric eye safety device at each side. Intersection of beam immediately stops and reverses downward door travel.
- a. Provide units with weatherproof housings and 30 degree universal adjustment.
- b. Provide units without moving parts.
- c. Locate send and receive units in a crossing pattern across the door opening. One unit located from 6 to 18 inches, and 24 to 36 inches.
- d. Locate so as not to be interfered with by curtain during operation.
2. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
- a. Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
- i. Provide electrically actuated automatic bottom bar of self-monitoring type, a 4-wire configured device.
- K. ACCESSORIES
1. Weatherseals: Provide replaceable, adjustable, continuous, compressible weatherstripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and at top of door.
- a. Provide motor-operated doors with combination bottom weatherseal and sensor edge. Refer to paragraph "Obstruction Detection Device" for sensor edge information.
- b. In addition, provide continuous flexible seals at door jambs for a weathertight installation.

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2. Miscellaneous Hardware: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.

L. Finish: Provide all components with factory finish that is smooth and easy to clean.

2.5 ELECTRIC OPERATOR

A. Electric Operator

1. 460 V.A.C., 3 phase (unless otherwise noted on the drawings) electronic motor controller and programmable PLC. Drive system to have closed loop electrical feed back for instantaneous response.
2. Drive System and Control Panel: Door roll and limit switch shall be driven directly from the motor through the gearbox without the use of chains or belts. The motor, control panel and through beam sensors shall be UL approved factory pre-wired and tested. The control panel shall be NEMA 4X, water tight and corrosion proof with "Manual" and "Automatic" operation selector, power "On/Off" indicator light, "Open" and "Close" push buttons and "mushroom" type "Emergency Stop" button. Drive system shall operate the door at a speed of 48in/sec. Verify electrical classification with the drawings.

B. See Electrical Drawings for electrical classification description.

1. Maximum Average Cycle Time
 - a. Opening Speed: 40 inches per second
 - b. Closing Speed: 30 inches per second

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes, tolerances, and conditions are acceptable.

3.2 INSTALLATION

- A. Install door unit assembly in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure.
- D. Fit and align assembly including hardware; level, and plumb, to provide smooth operation.

3.3 ADJUSTING

A. Adjust door, hardware, and operating assemblies for smooth and noiseless operation.

3.4 CLEANING

- A. Section 01700 - Contract Closeout: Cleaning installed work.
- B. Clean door and components.
- C. Remove labels and visible markings.

END OF SECTION

PART 1 – GENERAL**1.1 SUMMARY**

- A. Furnish labor, materials, tools and other equipment, and services necessary to provide commercial door hardware to the full extent of the Drawings and Specifications, including all accessory items required for a complete installation.
- B. Section includes hardware for wood and hollow steel doors, thresholds, weather stripping, seals and door gaskets and may include hardware for:
 - 1. Swinging doors.
 - 2. Electrified doors.
- C. Refer to Drawings and Schedules (e.g., Door Schedule) for type, location and extent of door hardware required, including all items necessary to complete work shown, scheduled or specified.

1.2 RELATED SECTIONS

- A. Section 06100 – Rough Carpentry
- B. Section 06200 – Finish Carpentry: Installation of Finish Hardware
- C. Section 08111 – Standard Steel Doors and Frames
- D. Section 08210 – Wood Doors

1.3 REFERENCE STANDARDS

- A. ANSI 156.18: Materials and Finishes
- B. ANSI A117.1: Accessible and Usable Buildings and Facilities
- C. ANSI A250.6: Hardware for Standard Steel Doors (Reinforcement - Application)
- D. ASTM E 283: Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
- E. U.S. Architectural & Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG). Adopted in 1991; continual revisions.
- F. NEMA ICS 6: Industrial Control and Systems: Enclosures
- G. NEMA LD 3: High Pressure Decorative Laminates
- H. NFPA 80: Fire Doors and Fire Windows
- I. NFPA 105: Recommended Practice for the Installation of Smoke-Control Door Assemblies
- J. NFPA 252: Methods of Fire Tests of Door Assemblies
- K. UL10C: Fire Tests of Door Assemblies (Positive Pressure)
- L. UL 305: Panic Hardware
- M. UL 437: Key Locks
- N. UL 1784: Air Leakage Tests for Door Assemblies

1.4 SYSTEM DESCRIPTION

- A. Fire Rated Openings: Provide door hardware listed by UL or other testing laboratory approved by applicable authorities.
 - 1. Hardware: Tested in accordance with NFPA 252.

1.5 SUBMITTALS

- A. Shop drawings: Indicate locations and mounting heights of each type of hardware, electrical characteristics and connection requirements including wiring diagrams.
- B. Door Hardware Sets: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - i. Identification number, location, hand, fire rating, and material of each door and frame.
 - ii. Type, style, function, size, quantity, and finish of each door hardware item.
 - iii. Complete designations of every item required for each door or opening including name and manufacturer.
 - iv. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
- C. Submit manufacturer's parts lists and templates.
- D. Manufacturer's Installation Instructions: Indication procedures and perimeter conditions requiring special attention.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- B. One complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the following requirements:
 - 1. ANSI A156 series.
 - 2. NFPA 80 – Fire Doors and Windows.
 - 3. NFPA 101 – Life Safety Code
- B. Supplier: Company specializing in supplying commercial door hardware with minimum three years experience, approved by manufacturer.
- C. Source Limitations:
 - 1. Obtain each type and variety of door hardware from a single manufacturer.
 - 2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to Authorities Having Jurisdiction are acceptable.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hardware to jobsite in manufacturer's original packaging, complete with basic installation instructions, templates, necessary fasteners and related pieces. Each item or package shall be clearly marked or tagged separately to indicate contents, locations in Hardware Sets Schedule and door numbers. Check hardware against reviewed hardware schedule.

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- B. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to manufacturer.
- C. Deliver keys to Owner's Representative upon completion of hardware installation.

1.9 COORDINATION

- A. Coordinate work of this section with other directly affected sections requiring integral reinforcement for door hardware.
- B. Electrical System Roughing-in: For electrified door hardware, coordinate hardware layout and installation of conduit and raceways as needed for such hardware. Coordinate electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and/or building control system.
- C. If recessed pivots and closers are specified, coordinate layout and installation with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- D. Coordinate floor-mounted hardware with finish floor materials.

1.10 WARRANTY

- A. Furnish manufacturer warranty for door hardware as follows:
 - 1. Closers: Ten-years mechanical, Two-years electrical.
 - 2. Exit Devices: Five-years.
 - 3. Electromagnetic Locks: Lifetime
 - 4. Mortise Locksets Grade One: Ten-years.

1.11 MAINTENANCE SERVICE

- A. Provide service and maintenance services of door closers for one year from Date of Substantial Completion.

PART 2- PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS

- A. Cylinders per section 2.9

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All other materials, equipment, services, and labor required to complete the work of this section.

2.3 GENERAL REQUIREMENTS

- A. Provide hardware items, articles, materials, operations, methods, and finish listed, scheduled, or mentioned herein or on drawings, and in adequate quantities required to complete Work in accordance with these specifications and manufacturers' written instructions.
 - 1. Include all items of hardware required for hardware systems to function properly that may be inadvertently omitted from the Contract Documents. Note these items in submittal for review.
- B. Where scheduled item is now obsolete and/or discontinued, bid and submit manufacturers updated item at no additional cost to the Owner. Note these items in submittal for review.

- C. All exit doors are to be operable for egress with single motion and without the use of a key or special knowledge or effort.
- D. Accessibility Requirements: Where door handles, pulls, latches, locks, control devices, and other operating devices are indicated to comply with accessibility requirements, comply with all applicable federal, state and local guidelines, codes and standards, including the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act" (ADA), "Accessibility Guidelines for Buildings and Facilities" (ADAAG)," ANSI A117.1,
- E. Means of Egress Requirements: Comply with NFPA 101.

2.4 HINGES, GENERAL

- A. Quantity: Two (2) hinges per leaf for openings up to 60-inches high. One (1) additional hinge per leaf for each additional 30-inches in height or fraction thereof.
- B. Hinge Weight: Interior doors to be standard weight minimum; entrance (exterior) doors to be heavy-weight minimum; doors over 3-ft. 5-inches in width shall have extra heavy weight ball bearing hinges. Hinges may be upgraded in weight pursuant to manufacturer's recommendations in consideration of door weight, frequency of use, frame and door hardware.
- C. Provide ball bearing hinges at all doors with closers. Quantity of ball bearings per hinge to be as recommended by the manufacturer for frequency of use and weight of door.
- D. Out-Swinging Exterior Doors: Provide non-removable (NRP) pins and safety / security studs.
- E. Hinge Base Metal: Unless otherwise indicated, provide stainless steel, with stainless-steel pin for hinges on exterior, out-swinging doors, and interior hinges for fire-rated assemblies. Provide steel, with steel pin for other interior hinges.

2.5 HINGES

- A. Butts and Hinges: BHMA A156.1. Hinge open widths minimum, but of sufficient throw to permit maximum door swing. Steel or stainless steel pins and concealed bearings.
 - 1. For Standard Frame: McKinney, Ives or equal Five Knuckle Full Mortise hinges
 - 2. For Channel Frames: McKinney, Ives or equal Five Knuckle Half Mortise Hinges
 - 3. For Double Acting Doors: McKinney Full Mortise Double Acting hinges or equal.
- B. Self-Closing Spring Hinges: BHMA A156.17.
- C. Pivots and Pivot Hinges:
 - 1. Pivots: BHMA A156.4. Complete with ball-bearing, oil-impregnated top pivot, floor plates, intermediate pivots and cement boxes unless indicated otherwise. High-strength forged bronze or stainless steel, tilt-on precision bearing and bearing pin. Bottom and intermediate pivots to be adjustable of minus 1/16-inch, plus 1/8-inch.
 - 2. For offset pivoted doors, provide one intermediate pivot for doors less than 91-inches high. Two intermediate pivots for doors between 91-inches and 121-inches high. Intermediate pivots spaced equally not less than 25-inches or not more than 35-inches on center, for doors over 121-inches high.

2.6 MECHANICAL LOCKS AND LATCHES:

- A. Extra Heavy-Duty Cylindrical Locks and Latches: As scheduled.
 - 1. Product: Yale 5400LN Series with "Augusta Trim"

- a. Latch (Pass) set at office and lab interior doors, production, shop and warehouse doors: Yale 5401LN
- b. Exit only: Yale 5428LN. Dead locking latch bolt. Use only where room has more than one entrance door.
- c. Lockset at office and lab interior doors, entrance doors: Yale 5407LN
- d. Lockset at Storeroom doors: Yale 5405LN
- e. Lockset at single occupancy toilet rooms: Yale 5402LN

2.7 ELECTROMAGNETIC LOCKS

- A. Reference Electrical Construction Performance Specification 3226H Section 16723 and EMTN 16.723.001 for installation details.

2.8 DOOR BOLTS

- A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors and other intended applications. Minimum 3/4-inch throw.
- B. Dustproof Strikes: BHMA A156.16.
- C. Surface Bolts: BHMA A156.16.
 - 1. Flush Bolt Heads: Minimum of 1/2-inch-diameter rods of brass, bronze, or stainless steel with minimum 12-inch-long rod for doors up to 84-inches in height. Provide longer rods as necessary for doors exceeding 84-inches.
- D. Manual Flush Bolts: BHMA A156.16; designed for mortising into door edge.
- E. Semi-Automatic Flush Bolts: BHMA A156.16; Low operating force design, consistent with application. To be installed in top edge of inactive leaf of pair of doors in conjunction with automatic flushbolt installed in bottom edge of inactive leaf. A door coordinator is required.
 - 1. Product: McKinney FB01M Series for metal doors, FB02W Series for wood doors. (Must be used in conjunction with McKinney FB06M or FB10W Series automatic flushbolt, and Trimco's CSM500 Series door coordinator) or equal.
- F. Automatic Self-Latching Flush Bolts: BHMA A156.16; low operating force design, consistent with application. To be installed in top and bottom edge of inactive leaf of pair of doors.
 - 1. Product: McKinney FB06M Series for metal doors and FB10W Series for wood doors. (Must be used in conjunction McKinney CSM500 Series door coordinator) or equal.

2.9 EXIT DEVICES / PANIC HARDWARE

- A. General:
 - 1. Exit Devices: BHMA A156.3 Grade 1.
 - 2. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Locks shall not require use of a key, tool, or special knowledge for operation.
 - 3. Panic Exit Devices: For panic protection, based on testing according to UL 305.
 - 4. Fire Exit Devices: Comply with NFPA 80 for fire and panic protection, based on testing according to UL 305 and NFPA 252.
 - 5. Removable Mullions: BHMA A156.3. Removable with single turn of building key. Securely reinstalled without need for key. Furnish storage brackets for securely stowing the mullion away from the door when removed.

6. Fire-Exit Removable Mullions: Removable mullions for use with fire exit devices complying with NFPA 80 for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.
7. Dummy Push Bar: Provide rigid, nonfunctioning push bar matching functional push bar.
8. Outside Trim: Match design, material and finish of locksets and latchsets, unless otherwise indicated.
9. Delayed Egress Devices: delayed egress exit devices to be specified in the hardware sets. Devices to conform to NFPA 101 - Special Locking Arrangements for delayed egress. Nuisance delay to be available as standard for either zero (0) or two (2) seconds. Internal latchbolt monitoring, and a standard 10-second delay for "Authorized Entry" to be standard features on every device.
10. Product: Von Duprin 99 Series Exit Devices

2.10 KEYING REQUIREMENTS

- A. Cylinders will be furnished by Owner.
 1. For Yale 5300 Series key in lever locksets, Yale 1802 cylinder with 6-pin tumbler will be provided for Contractor installation.

2.11 CLOSERS

- A. All door closers shall be ANSI 156.4, Grade 1 Certified.
- B. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- C. All closers shall have aluminum alloy bodies, forged steel arms, and separate valves for adjusting backcheck, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power.
- D. Surface Closers: Provide parallel arm type where possible and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Arm must be of type required for closer to always be located inside building, stairs and rooms (on non-public side of door), unless otherwise indicated.
- E. Provide hold open arm on non-fire rated doors.
- F. Hold-Open Closers / Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.
- G. Closer Holder Release Devices: On release of life-safety type hold open, door becomes self-closing. Automatic release is activated by smoke detection system and/or loss of power.
- H. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
- I. Product: Yale 4400 series, LCN 4111 Series or equal.

2.12 PROTECTIVE TRIM UNITS

- A. Size: 1 ½ -inches less than door width on push side and ½ -inch less than door width on pull side, by height specified in door hardware sets.
- B. Fasteners: Sheet-metal screws of same material and finish to match plates.

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- C. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; 10" high, fabricated from 0.050-inch minimum thickness stainless steel, unless otherwise indicated.

Product: McKinney KP50, Ives 8400 or equal.

2.13 STOPS AND HOLDERS

- A. Door Stops and Bumpers: BHMA A156.8. Provide stops to protect wall, casework or other hardware. Unless otherwise noted in Hardware Sets Schedule, provide wall type with appropriate fasteners. Where wall type cannot be used, provide overhead type. If neither can be used, provide floor type.

Product: McKinney Model No. WS02, Ives WS406 or equal for walls,

McKinney FS01/02, Ives FS436 or equal for floors as required.

- B. Electromagnetic Door Holders: BHMA A156.15. Coordinate and verify compatibility with fire detectors and interface with fire alarm system for labeled fire door assemblies.
- C. Mechanical Door Holders: BHMA A156.16. Kick down type unless otherwise noted.
- D. Silencers: Interior hollow metal and wood frames; fabricated for drilled-in application to frame; 3 for single doors, 4 for pairs of doors. Omit where adhesive mounted seal occurs. Leave no unfilled / uncovered pre-punched silencer holes.
 - 1. Metal Door Frames: BHMA A156.16, Grade 1; rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.
 - 2. Wood Door Frames: BHMA A156.16, Grade 1; rubber, minimum 5/8 by 3/4 inch; fabricated for drilled-in application to frame.

2.14 DOOR GASKETING

- A. Standard: BHMA A156.22
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
- C. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - 2. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- D. Resilient seal material: Solid high-grade neoprene. UL label applied to seals on rated doors. Products finished to match adjacent frame color.
 - 1. Solid Neoprene: MIL Spec. R6855-CL III, Grade 40.
 - 2. Silicone : For smoke and fire-rated gasketing.
 - 3. Non-corroding fasteners at in-swinging exterior doors.
 - 4. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283. Adhesive applied components are not acceptable.
 - 5. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 for smoke-control ratings indicated, based on testing according to UL 1784. Adhesive mounted components are not acceptable.

Provide smoke-labeled gasketing on 20-minute-fire-rated doors and on smoke-labeled doors.

6. Fire Rated Doors, Resilient Seals: Assemblies complying with NFPA 80 for fire ratings indicated, based on testing according to UL10C / UBC-7-2 compliant. Coordinate with selected door manufacturer and selected frame manufacturer's requirements. Where rigid housed resilient seals are scheduled in this Section and the selected door manufacturer only requires an adhesive mounted resilient seal, furnish rigid housed seal at minimum, or both the rigid housed seal and the adhesive applied seal if necessary to fulfill door manufacturer's requirement. Adhesive applied seal alone is not acceptable.
Provide fire-rated gasketing on doors with greater than 20-minute-fire-ratings.
7. Fire-Rated Doors, Intumescent Seals: Assemblies complying with NFPA 80 for fire ratings indicated, based on testing according to UL10C / UBC-7-2. Furnished by selected door manufacturer, these seals vary in requirement by door type and door manufacturer. Adhesive applied intumescent strips are not acceptable. Use concealed-in-door-edge type or kerfed-in-frame type. Careful coordination required.
8. Product: McKinney Products Company, or equal
McKinney MCK-303APK, National Guard Products 700NA or equal for weatherstripping.
McKinney MCK-303AS for smoke-labeled or fire-rated gasketing.
- E. Automatic Door Bottoms: Low operating force units. Doors and automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.
 1. Product: McKinney MCK- 412C or equal.

2.15 THRESHOLDS

- A. Standard aluminum, complying with BHMA A156.21, bevel raised thresholds, not to exceed 1/2-inch in overall height.
 1. Product: McKinney MCK-271A with MCK-315 door bottom or equal.
- B. Carpet Dividers: Provide firestops under all 'B' and 'C' rated doors where carpet occurs each side of door, and where carpet occurs one side under any fire rated door.
 1. Product: McKinney MCK236A firestop under all 'C' labeled doors; No. MCK-2364A firestop under all 'B' labeled doors; No. MCK-174C stop where carpet occurs one side under any labeled door or equal.
- C. Tile Dividers: Provide a 4-inch-wide aluminum plate under all 'B' and 'C' labeled doors where tile occurs each side of door. Butt tile into plate. Plate to match thickness of tile.

2.16 PUSH AND PULL PLATES

- A. Provide 8-inches x 16-inches x .050-inches minimum thickness push plates and pull plates measuring 4-inches x 16-inches x .050-inches minimum thickness, with 3/4-inch round pull x 6-inches on center.
- B. Push plate: McKinney, Model No. P055, Ives 8200, or equal
- C. Pull plate: McKinney DP 503, Ives 8302 or equal.

2.17 MISCELLANEOUS DOOR HARDWARE

- A. Monitor Strikes: Dustbox monitor for installation under standard strike.
- B. Electric Strikes: BHMA A156.31; use fail-secure electric strikes with fire-rated devices.
- C. Auxiliary Hardware: BHMA A156.16.

2.18 FINISHES

- A. Standard: BHMA A156.18, BHMA 626 Satin Chromium
 - 1. Areas using BHMA 626, all butt hinges for out-swinging exterior doors, exit devices, push plates, push / pull bars, kick / mop / stretcher / armor plates, edge guards, and latch protectors shall be of BHMA 630 - Satin Stainless Steel, unless otherwise noted.
- B. Door Closers: Provide satin-chrome plated or factory powder coated arms, tracks and covers to match adjacent hardware where scheduled.
- C. Thresholds: Mill-aluminum finish.
- D. Gaskets and Other Aluminum Items: Match predominant adjacent materials in color and finish.
 - 1. Color of seals to coordinate with frame color.

2.19 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, unless specified otherwise herein. Aluminum fasteners are not permitted. Provide Phillips flat-head steel machine or wood screws in exposed conditions with finished heads to match finish of door hardware.
 - 1. Steel Machine and Wood Screws: Provide thread-to-the-head type for fire-rated applications as well as all installations of mortise hinges to doors, strike plates to frames, and surface mounted closers to doors and frames.
 - 2. Steel Through Bolts: Through bolting is allowed for installation of door hardware only where bolt head or nut on opposite face is totally concealed, i.e. door pulls with bolt heads concealed on opposite side of door behind push plate, etc. OR in areas where extreme abuse to door may be a problem. Coordinate with "Exit Devices" and "Closers" Articles in Part 2 above. Provide spacers / sleeves or Sex Bolts for through bolting of hollow-metal doors.
 - 3. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping / gasketing.
 - 4. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
- D. Carefully coordinate with door manufacturer the installation of required blocking reinforcement during the fabrication of HM and wood doors for the installation of surface mounted hardware to doors and frames. Through bolting for anchoring of hardware to doors (fire rated and/or non-fire rated), due to lack of coordination and resulting in door lacking proper blocking reinforcement, IS NOT ACCEPTABLE.

PART 3 – EXECUTION**3.1 EXAMINATION**

- A. Verify doors and frames are ready to receive work and dimensions are as instructed by the manufacturer.
- B. Verify electric power is available to power operated devices and of the correct characteristics.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. For surface-applied door hardware, drill and tap doors and frames according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.
- C. Ensure that walls and frames are square and plumb before hardware installation.

3.3 INSTALLATION

- A. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.
- B. Mounting Heights: Mount door hardware units at heights specifically indicated herein or on Drawings:
 - 1. Required Heights:
 - Combination push/pull latch: Centered 45-inches above finish floor.
 - Panic bolt cross bars align in horizontal position with top and bottom bolts and rods aligned vertically. Install the centerline of strike 36-inches above finish floor.
 - Knob lock and knob latch strikes; center 40-inches above finish floor.
 - Push bars, push plates and pull handles: centered 42-inches above finish floor.
 - Mortise deadlock strike centered 48-inches above finish floor.
 - Extension level flush in the edge of door, center to bolt fronts, 12-inches from bottom and 12-inches from top edge of door.
 - 2. For all other door hardware units not listed above or dimensioned on Drawings, mount units at heights recommended by the following, unless otherwise indicated or required to comply with governing regulations.
 - Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been 100 percent completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- D. Anchor all components firmly into position for long life under hard use. Use only the anchoring devices furnished with the hardware item, unless otherwise specifically directed.
- E. Install hardware in accurate conformity with the manufacturer's templates, particularly with respect to the measurement of door control devices from the jamb.
- F. Gaskets: Install jamb-applied gaskets before closers, overhead stops, rim strikes, etc.
- G. Door Sweeps: Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
- H. Door Closing Devices: Install and adjust in strict accordance with the templates and printed instructions supplied by the manufacturer. Insofar as practicable, doors opening to or from halls or corridors shall have the closer mounted on the room side of the door.
- I. Kick Plates: on single-acting doors, install on push side. Kick plates on double-acting doors, install on both sides of door.
- J. Floor Stops: Locate stops not more than 4-inches from face of wall.
- K. Drill pilot holes for fasteners in wood doors and frames. Drill 5/32-inch hole and use No. 12, 1-1/4-inch steel threaded-to-the-head wood screws for hinges on wood doors.
- L. Thresholds: Set thresholds for exterior, and acoustical doors at sound control openings in full bed of sealant complying with requirements specified in Division 07 Section "07900 - JOINT SEALANTS", forming a tight seal between threshold and surface to which set. Securely and permanently anchor thresholds, using countersunk 1/4-inch stainless steel fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors (SS/FHSL) at aluminum thresholds.

3.4 INITIAL ADJUSTING

- A. Post Installation Inspection: Approximately two (2) weeks prior to scheduled date of Substantial Completion inspection visit Project to examine, re-adjust including adjusting operating forces; verify operating and control items of hardware are installed according to manufacturer's installation instructions and templates; check each door to ensure proper operation or function of every unit.
 1. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements as specified herein, unless required otherwise by Authorities Having Jurisdiction.
 2. Replace units that cannot be adjusted to operate freely and smoothly as intended for the application.
 3. Hardware damaged by improper installation or adjustment methods to be repaired or replaced to Owner's satisfaction.
 4. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 5. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 6. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3.5 PROTECTION AND CLEANING

- A. Protect finished work.

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- B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

END OF SECTION

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PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Provide and install glazing as shown on drawings and as specified.
- B. Fire-rated glazing materials installed in fire-rated window, door, transom, sidelite and borrowed lite assemblies.

1.2 RELATED SECTIONS

- A. Section 08111 - Standard Steel Doors and Frames

1.3 REFERENCES

- A. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
- B. ASTM C669 - Glazing Compounds for Back Bedding and Face Glazing of Metal Sash.
- C. ASTM C804 - Use of Solvent-Release Type Sealants.
- D. ASTM C864 - Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- E. ASTM C920 - Elastomeric Joint Sealants.
- F. ASTM C1036 - Flat Glass.
- G. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
- H. ASTM C1172 - Laminated Architectural Safety Glass.
- I. ASTM E84 - Surface Burning Characteristics of Building Materials.
- J. ASTM E283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
- K. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- L. ASTM E546 - Test Method for Frost Point of Sealed Insulating Glass Units.
- M. ASTM E576 - Test Method for Dew/Frost Point of Sealed Insulating Glass Units in Vertical Position.
- N. ASTM E773 - Test Method for Seal Durability of Sealed Insulating Glass Units.
- O. ASTM E774 - Sealed Insulating Glass Units.
- P. Glass Association of North America (GANA):
 - 1. GANA – Glazing Manual. FGMA – Sealant Manual.
 - 2. FGMA – Glazing Manual
 - 3. GANA Publications: Laminators Safety Glass Association - Standards Manual.
- Q. SIGMA - Sealed Insulated Glass Manufacturers Association.
- R. UL 10B and 10C National Fire Protection Association (NFPA):
 - 1. NFPA 80 - Fire Doors and Windows
 - 2. NFPA 252 - Fire Tests of Door Assemblies
 - 3. NFPA 257 - Fire Tests of Window Assemblies
- S. Underwriters Laboratories, Inc. (UL):
 - 1. UL 263: Fire tests of Building Construction and Materials
 - 2. UL 9: Fire Tests of Window Assemblies

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- 3. UL 10B: Fire Tests of Door Assemblies
- 4. UL10C: Positive Pressure Fire Tests of Door Assemblies
- T. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials

1.4 QUALITY ASSURANCE

- A. Comply with Flat Glass Marketing Association FGMA: "Glazing Manual", except as otherwise noted.
- B. Comply with the latest governing edition of the Michigan Building Code (MBC).
- C. Glass shall be produced by manufacturer's special process which eliminates tong marks.
- D. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.
- E. Fire Rated Wall Glazing:
 - 1. Tested Rating: Determined in accordance with ASTM E119.
- F. Fire Rated Window Glazing: Tested in accordance with NFPA 257 and complying with NFPA 80.
 - 1. NFPA 257; adjusted so two-thirds of test specimen is above neutral pressure plane at 10 minutes into test.
- G. Fire Rated Door Glazing: Tested in accordance with one of the following and complying with NFPA 80.
 - 1. NFPA 252; with neutral pressure level at 40 inches maximum above sill at 5 minutes into test.
 - 2. UL 10C.
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 DEFINITIONS

- A. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air.
- B. Fire-Rated Glass: Glass that has been placed in a specific fire-rated assembly and then tested as a barrier to smoke and flames for a specific time rating.
- C. Fire-Rated Safety Glass: Glass that has been placed in a specific fire-rated assembly and then tested as a barrier to smoke and flames for a specific time rating as well as meeting an impact rating per CPSC 16 CFR 1201.
- D. Sealed Insulating Glass Unit Surfaces & Coating Orientation:
 - 1. Surface 1 – Exterior surface of outer pane (surface facing outdoors of outboard lite).
 - 2. Surface 2 – Interior surface of outer pane (surface facing indoors of outboard lite).
 - 3. Surface 3 – Exterior surface of inner pane (surface facing outdoors of inboard lite).

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4. Surface 4 – Room side surface of inner pane (surface facing indoors of inboard lite).

1.6 SUBMITTALS

- A. Products Data: For each glass product and glazing material indicated.
- B. Samples: 12-inch square; for each type of glass product indicated.
- C. Glazing Schedule: Use same designations indicated on drawings.
- D. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period.
 1. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period.
 1. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 2. Warranty Period: 5 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period.
 1. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – NONE

2.2 CONTRACTOR PROVIDED PRODUCTS-

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 FLOAT GLASS MATERIALS

- A. Annealed Glass: ASTM C 1036, Type 1 transparent flat, Class 1, Quality Q3 float glass.
- B. Tempered Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT Fully Tempered Condition A uncoated, float glass with horizontal tempering

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1. Furnish tempered glass conforming to CPSC 16 CFR 1201 Category II at locations where safety glass is required.

2.4 FLOAT GLASS PRODUCTS

- A. Clear Glass: Annealed and Tempered float glass as specified; Class 1 clear.
 1. Minimum Thickness: ¼ inch unless otherwise indicated.
- B. Pyrolytic-Coated, Self-Cleaning, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading on exterior windows only.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AFG Industries, Inc.; Spotless Ti.
 - b. Cardinal Glass Industries; LoE2 Plus.
 - c. Pilkington North America; Activ.
 - d. PPG Industries, Inc.; SunClean.

2.5 LAMINATED GLASS PRODUCTS

- A. Clear Laminated Glass: ASTM C1172; with plastic interlayer.
 1. Clear laminated annealed glass: Kind LA, with two plies of annealed glass as specified.
 2. Clear laminated tempered glass: Kind LT with 2 plies of tempered glass as specified.
 3. Minimum Total Thickness: ¼ inch unless otherwise indicated.
 4. Plastic Interlayer: Polyvinyl butryal, minimum thickness 0.030 inch unless otherwise indicated.
 5. Safety Glass: Conform to CPSC 16 CFR 1201 Category II.

2.6 FIRE PROTECTIVE GLASS PRODUCTS

- A. Wired Glass: ASTM C1036, Type II wired flat, Class 1 clear, polished both sides, Quality Q6 glazing; Mesh of woven stainless steel wire, manufacturer's standard grid size; conforming to ANSI Z91.7.
 1. Clear Wired Glass: Polished both sides.
 2. Minimum Thickness: ¼ inch unless otherwise indicated.
 3. Wire glass is not allowed for use where safety glass is required.
- B. Fire Resistive Ceramic Glass: Transparent polished both surfaces
 1. Clear fire resistive ceramic glass.
 2. Thickness: Manufacturer's standard
 3. Fire Rating: Minute rating as shown on the drawings and as listed in UL Building Materials Directory and approved by authority having jurisdiction for applications indicated.
- C. Fire Resistive Film Faced Ceramic Safety Glass: Transparent polished both surfaces, faced one side with clear plastic glazing film.
 1. Thickness: Manufacturer's standard
 2. Fire Rating: Minute rating as shown on the drawings and as listed in UL Building Materials Directory and approved by authority having jurisdiction for applications indicated.

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3. Safety Glazing: Comply with CPSC 16 CFR 1201 Category II.
- D. Fire Resistive Gel Filled Safety Glass (FRG-GC): Transparent fire-resistive safety glazing fabricated from two lites of tempered glass as specified, gel filled and sealed.
 1. Thickness: Manufacturer's standard for applications indicated.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. InterEdge, Inc., a subsidiary of AFG Industries, Inc.; Pyrobel.
 - b. Pilkington Group Limited (distributed by Technical Glass Products); PyroStop.
 - c. Vetrotech Saint-Gobain; SGG Contraflam N2 or SGG Swissflam N2.
 3. Fire Rating: Minute rating as shown on the drawings and as listed in UL Building Materials Directory and approved by authority having jurisdiction for applications indicated.
 4. Safety Glazing: Comply with CPSC 16 CFR 1201 Category II.

2.7 GLAZING SCHEDULE TYPES

1. Door, Transom and Sidelight Glazing: Tempered, laminated or fire protective glass complying with testing requirements in 16 CFR 1201 for Category II materials. Fire rating to match door assembly refer to Door Schedule located on drawings.
 - a. Permanently label each piece of safety glazing with the appropriate marking.
2. Interior non-insulated uses unless otherwise noted: Clear laminated glass with two plies of tempered float glass
 - a. Thickness of Each Glass Ply: Provide in thickness to comply with requirements indicated but not less than 1/4" total thickness.
 - b. Interlayer Thickness: Provide interlayer, in thickness to comply with requirements indicated but not less than 0.030-inch.
 - c. Permanently label each piece of safety glazing with the appropriate marking.
3. Interior insulated windows unless otherwise noted: Clear insulating laminated glass.
 - a. Overall Unit Thickness: Minimum 1-inch
 - b. Thickness of Each Glass Lite: Provide glass lites in thickness to comply with requirements indicated but not less than 1/4-inch thick.
 - c. Outdoor Lite: Clear laminated tempered glass.
 - d. Interspace Content: Air.
 - e. Indoor Lite: Clear laminated tempered glass.
 - f. Permanently label each piece of safety glazing with the appropriate marking.
4. Interior non-insulated and insulated windows in rated wall assemblies unless otherwise noted: Ceramic or Laminated glass made from multiple plies of ultraclear float glass with intumescent interlayers. Provide two glass lites where insulated interior windows are indicated minimum 3/4-inch thick. Fire rating as required by building code, refer to drawings for ratings.

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- a. Permanently label each piece of safety glazing with the appropriate marking.
- 5. Exterior windows unless otherwise noted: Pyrolytic-coated, self-cleaning, low-maintenance, insulating laminated glass.
 - a. Overall Unit Thickness: Minimum 1-inch
 - b. Thickness of Each Glass Lite: Provide glass lites in thickness to comply with requirements indicated but not less than ¼-inch thick.
 - c. Outdoor Lite: Clear laminated tempered glass.
 - d. Coating: Pyrolytic-coated, self-cleaning, low-maintenance on surface 1
 - e. Interspace Content: Air.
 - f. Indoor Lite: Clear laminated tempered glass.
 - g. Low-E Coating: Pyrolytic on surface 2.
 - h. Permanently label each piece of safety glazing with the appropriate marking.

2.8 GLAZING ACCESSORIES

- A. Sealants: Dow Corning 795®
- B. Setting Blocks: Closed-cell neoprene complying with ASTM C542 and C509 in black color. Where glazing block is in contact with silicone sealant, provide black color silicone glazing block compatible with the silicone sealant.
- C. Spacer: Neoprene, 50 Shore A durometer hardness; size as required to set glass properly.
- D. Glazing Tape: Preformed butyl-polyisobutylene compound 10-15 Shore A durometer hardness, coiled on release paper, size as required to set glass properly, black color, Presstite, Hapco, or equal.
- E. Glazing Clips: Manufacturer's standard type.

2.9 FIRE RATED GLAZING ACCESSORIES:

- A. Sealants: Dow Corning 795®
- B. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air and vapor seal.
- C. Setting Blocks: Hardwood or calcium silicate; glass width by 4 inches by 3/16 inch thick.
- D. Spacer: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesive-backed on one face only, tested for compatibility with specified glazing compound.

2.10 GENERAL FABRICATION

- A. Glazing channel dimensions as shown are intended to provide for necessary minimum bite on the glass, minimum edge clearance, and adequate sealant thickness with reasonable tolerances. Correctly size glass for opening within the tolerances and necessary dimensions established.
- B. Factory label each pane of glass; do not remove labels until final acceptance is obtained.

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PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify surfaces of glazing channels or recesses are clean, free of obstructions, and ready for work of this section. Do not proceed with the glazing until unsatisfactory conditions have been corrected.
- B. Start of installation means the contractor has accepted the existing condition of the substrate.
- C. Clean the glazing channel or other framing members to receive glass immediately before glazing. Remove coatings which are not firmly bonded to the substrate.
- D. Inspect each piece of glass immediately before installation, and eliminate any which have observable edge damage or face imperfections.
- E. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer. Primer shall be applied to all aluminum surfaces to receive silicone sealants, unless sealant manufacturer certifies, in writing, that primer is not required.
- F. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.2 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified and except where manufacturers' technical representative's direct otherwise. Install products using the recommendations of manufacturers of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual".
- B. Install glass in prepared glazing channels and other framing members.
- C. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing Manual.
- D. Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by GANA Glazing Manual.
- E. Provide weep system as recommended by GANA Glazing Manual.
 - 1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
- F. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- G. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- H. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
- I. Remove and replace glass that is broken, chipped, cracked or damaged in any way.
- J. Install vision panels in doors and sidelites in accordance with NFPA 80.
- K. Trim protruding tape edge.

3.3 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure.

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Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.4 PLASTIC FILM INSTALLATION

- A. Install plastic film with adhesive.
- B. Place without air bubbles, creases or visible distortion.
- C. Fit tight to glass perimeter with razor cut edge.

3.5 CURE AND PROTECTION

- A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations to obtain high early-bond strength, internal cohesive strength, and surface durability.
 - 1. Protect glass and glazing sealants and compounds during construction period, so that they will be without deterioration or damage (other than normal weathering) at time of final acceptance by Owner.
- B. After installation, mark pane with an "x" by using removable plastic tape. Do not mark heat absorbing or reflective glass units.
- C. Remove and replace glass which is broken, chipped, cracked, abraded, or otherwise damaged during the construction period, including pieces damaged through natural causes, accidents, or vandalism.
- D. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- E. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- F. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- G. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- H. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.
- I. Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.
- J. Do not use scrapers or other metal tools to clean glass.

END OF SECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Safety and security window film
- B. Film attachment systems.

1.2 RELATED SECTIONS

- A. 08111 Standard Steel Doors and Frames
- B. 08800 Glazing

1.3 REFERENCES

- A. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
- B. ASTM D 2240 – Standard Test Method for Rubber Property – Durometer Hardness.
- C. ASTM D 624 - Standard Test Method of Test for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
- D. ASTM D 5895 - Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders.
- E. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
- F. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
- G. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- H. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure
- I. ASTM F 1642 Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings
- J. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
- K. ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
- L. ASTM D 1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).
- M. ASTM D 2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
- N. ASTM D 4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing.
- O. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
- P. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
- Q. ASTM G 26 - Standard Practice for Performing Accelerated Outdoor Weatherizing for Non-metallic Materials Using Concentrated Natural Sunlight.

- R. GSA-TS01-2003 -- Standard Test for Glazing and Glazing Systems Subject to Airblast Loadings.
- S. ISO 16933, International Standard for Glass in Building: Explosion-resistant security glazing - Test and classification for arena air-blast testing.
- T. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- U. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.
- V. Underwriters Laboratories Inc. (UL): UL 972 - Burglary Resisting Glazing Material.

1.4 PERFORMANCE REQUIREMENTS

- A. Flammability: Surface burning characteristics when tested in accordance with ASTM E 84:
 - 1. Flame Spread Index: 25 maximum
 - 2. Smoke Developed: Index 450 maximum

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations
 - 2. Installation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
- C. Performance Submittals: Provide 3rd party test reports or other documentation for relevant safety and security glazing performance testing

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
 - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
 - 2. Provide a commercial building reference list of 5 properties where the installer has applied Impact Protection Attachment systems. This list will include the following information:
 - a. Name of building.
 - b. The name and telephone number of a management contact.
 - c. Type of film and attachment system.
 - d. Amount of film installed.
 - e. Date of completion
 - 3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.

1.7 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.

1.8 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: 3M Window Film , which is located at: 3M Center Bldg. 0235-02-S-27 ; St. Paul, MN 55144-1000; Toll Free Tel: 800-480-1704; Tel: 651-733-2222; Fax: 651-737-3446; Web: www.3m.com/windowfilm
- B. Substitutions not permitted.

2.2 SECURITY FILM

- A. Clear Microlayered Safety and Security Window Film: 3M Ultra S600 Safety and Security Window Film. Optically clear micro-layered polyester film, with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film is clear and will not contain dyed polyester. Film contains at least forty-two micro-layers.
 - 1. Physical / Mechanical Performance Properties (nominal):
 - a. Film Color: Clear.
 - b. Thickness: Nominal 6.0 mils (0.15 mm), comprised of 42 micro-layers.
 - c. Tensile Strength (ASTM D 882): 30,000 psi.
 - d. Break Strength (ASTM D 882) (Per Inch Width): 180 lbs.
 - e. Tear Resistance (ASTM D 1004): Greater than 1,150 lbs.
 - f. Puncture Propagation Tear (ASTM D 2582): 19.2 lbs.
 - g. Young's Modulus (ASTM D 882): 500 kpsi.
 - 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
 - 3. Variation in Total Transmission Across the Width: Less than 2 percent over the average at any portion along the length.
 - 4. Identification: Labeled as to Manufacturer as listed in this Section.
 - 5. Solar Performance Properties: Film applied to 1/4 Inch (6.4 mm) thick clear glass.
 - a. Visible Light Transmission (ASTM E 903): 84 percent.
 - b. Visible Reflection (ASTM E 903): Not more than 10 percent.
 - c. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
 - d. Solar Heat Gain Coefficient (ASTM E 903): 0.78.
 - 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6.4 mm) annealed glass.
 - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
 - b. Safety Rating (ANSI Z97.1): Class A, Unlimited Size.
 - 7. Windstorm Protection: Film shall pass impact of Medium Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at 50

psf Design Pressure with use of 3M Impact Protection Adhesive or 3M Impact Protection Profile attachment system.

8. Bomb Blast Mitigation: Independent testing with results from high explosive arena blast testing.
 - a. GSA Rating with minimum blast pressure and impulse of 14 psi and 60 psi.msec, respectively: "2" (No Hazard / Very High Protection).
 - b. GSA Rating with minimum blast pressure and impulse of 10 psi and 89 psi.msec, respectively: "3B" (Low Hazard / High Protection).
 - c. ASTM F1642 Rating with minimum blast pressure and impulse of 10 psi and 89 psi.msec, respectively: "Minimal Hazard".

2.3 IMPACT PROTECTION ADHESIVE

- A. 3M Impact Protection Adhesive. Structural "wet glaze" film attachment system. Weatherable UV resistant polymer, moisture curable. Low VOC content and low odor.
 1. Properties, as supplied
 - a. Color - BLACK
 - b. Typical Cure Time: 3 – 7 days (25°C, 50% RH)
 - c. Full Adhesion: 7 – 14 days
 - d. Tack-Free Time (ASTM D 5895): 21 minutes (25°C, 50% RH)
 - e. Flow, Sag or Slump (ASTM D 2202): 0 inches
 - f. Specific Gravity: 1.4
 - g. Working Time: 10 – 20 minutes (25°C, 50% RH)
 - h. VOC Content: 16 g/L
 2. Properties, as cured (21 days at 25°C, 50% RH)
 - a. Ultimate Tensile Strength (ASTM D412): 380 psi (2.62 MPa)
 - b. Ultimate Elongation (ASTM D412): 640 psi
 - c. Durometer Hardness, Shore A (ASTM D2240): 38-39 points
 - d. Tear Strength, Die B (ASTM D624): 72 ppi
 3. Uniformity: Product shall have uniform consistency and appearance, with no clumping.
 4. Identification: Labeled as to Manufacturer as listed in this Section.
 5. Windstorm Protection:
 - a. As part of a filmed glass system, film attachment shall demonstrate ability to withstand Medium Large Missile C and Small Missile A impact, with subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 70 psf design pressure.
 - b. As part of a filmed glass system, film attachment shall demonstrate ability withstand structural load requirements of ASTM E330 when tested at +/- 120 psf design pressure.
 6. Bomb Blast Mitigation: Independent testing with results from high explosive arena blast testing.
 - a. GSA Rating with minimum blast pressure and impulse of 4 psi and 28 psi.msec, respectively: "2" (No Hazard / Very High Protection).

- b. GSA Rating with minimum blast pressure and impulse of 11 psi and 55 psi.msec, respectively: "2" (No Hazard / Very High Protection).
- c. GSA Rating with minimum blast pressure and impulse of 10 psi and 89 psi.msec, respectively: "3B" (Low Hazard / High Protection).
- d. ASTM F 1642 Rating with nominal blast pressure and impulse of 8 psi and 42 psi.msec, respectively: "Low Hazard"

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
- B. Commencement of installation constitutes acceptance of conditions.

3.2 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.
- C. Installer shall take necessary precautions to protect interior furnishings.

3.3 INSTALLATION

- A. Install film in accordance with manufacturer's instructions.
 - 1. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
 - 2. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
 - 3. Apply film to glass and lightly spray film with slip solution.
 - 4. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
 - 5. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
 - 6. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
- B. Install film attachment system in accordance with manufacturer's instructions.
 - 1. Prior to applying the film attachment system ensure proper drying of the film.
 - 2. Film attachment system shall be applied at the same time as the film. Dry film with heat per manufacturer's recommendations.
 - 3. Recommended minimum bead overlap for blast mitigation is 0.5 inch on both film and frame surfaces (excluding the glazing stops or compression gaskets); 0.375 inches on both surface for windstorm protection.
 - 4. To ensure a straight and consistent bead width is achieved, masking tape may be applied to film and frame surfaces before application of 3M Impact Protection Adhesive.

5. With prior approval of the building owner, property manager, or specifying authority, existing compression gaskets may be partially removed or trimmed to allow for a thinner bead. If removing the gaskets, trim sections approximately 3 inches in length and insert with appropriate spacing along all sides of the window to help secure the glazing during application and curing of the Impact Protection Adhesive.
6. Dispense Impact Protection Adhesive with a caulk gun and nozzle having an opening cut to approximate size of desired bead width.
7. Use a plastic putty knife to trowel and smooth out the adhesive. The trowel shall have a straight edge to create a triangular shaped bead with a smooth, flat surface.
8. Carefully remove any masking tape within 10 minutes of application before the Impact Protection Adhesive begins to form a hard skin.

3.4 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Film attachment system shall be allowed to cure for at least 3 to 7 days. Use necessary means to protect after installation.
- D. Remove any uncured excess material on film or frame using a disposable cloth or paper towel wet with isopropyl alcohol.
- E. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

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PART 1– GENERAL

1.1 WORK INCLUDED

- A. Non-load bearing metal studs for wall assemblies.
- B. Area separation and shaft wall framing products.
- C. Ceiling and soffit suspended or furred framing.
- D. Wall furring, fasteners and accessories for the screw attachment or gypsum board.
- E. 2x nested wood studs at swing door jambs.

1.2 RELATED SECTIONS

- A. Division 5 Section – Metal Fabrications
- B. Division 6 Section – Rough Carpentry.
- C. Division 9 Section – Gypsum Board System
- D. Division 9 Section – Suspended Acoustical Ceilings

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
- B. Design Loads: As indicated on drawings.
 - 1. AISI - Standard for Cold-Formed Steel Framing General Provisions.
 - 2. AISI - North American Specification (NASPEC) for the Design of Cold-Formed Steel Structural Members - 2012.
 - 3. AISI 2007 - Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Story Family Dwelling.
 - 4. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 6. ASTM A 1003 - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
 - 7. ASTM C 645 Standard Specification for Nonstructural Steel Framing Members.
 - 8. ASTM C 754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - 9. ASTM C 1513 – Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
 - 10. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 11. ASTM E 90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 12. ASTM E 119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 13. ASTM E 413 – Classification for Rating Sound Insulation.

14. ASTM A123 – Standard Specification for Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products.
15. ASTM A641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
16. ASTM C11 – Terminology Relating to Gypsum and Related Building Materials and Systems
17. ASTM C635 – Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings.
18. ASTM C636 – Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

1.4 DESIGN REQUIREMENTS

- A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.
- B. Design loads: As indicated on the Architectural Drawings. 5 PSF minimum design lateral load is required for interior walls by the building code. Shaft wall framing minimum design lateral load is typically 5 - 15 PSF.
- C. Design framing systems to withstand design loads without deflections greater than the following:
 1. Interior Non-Load Bearing Walls: Horizontal deflection of 1/360 of the wall height under a horizontal load of minimum 5 lbf/sq. ft or horizontal loading as indicated on drawings
 2. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
- D. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
- E. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 1. Upward and downward movement of 1 inch.
- F. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing laboratory. Products used in the assembly shall carry a classification label from the testing laboratory.
- G. Sound Transmission Characteristics STC: For gypsum assemblies wall/ceilings with STC rated requirements, provide materials and construction methods that are identical to the requirements of either ASTM E 90, for laboratory tests, or ASTM E 336, for field tests. Testing or inspection agencies must be qualified independent organizations.
- H. Design Framing system per International Building Code.

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1.5 SUBMITTALS

- A. Submit under provisions of Division 1, shop drawings, product data and samples.
- B. Submit manufacturer's product literature and data sheets for specified products.
- C. Manufacturer's Literature and Data:
 - 1. Studs, tracks, runners and accessories.
 - 2. Hanger inserts.
 - 3. Channels (Rolled Steel).
 - 4. Furring channels.
 - 5. Screws, clips and other fasteners
- D. Typical ceiling suspension system.
- E. Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- F. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.
- G. Test Results: Fire rating test designation, each fire rating required for each assembly.
- H. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer, registered in the state of the project, responsible for their preparation.
- I. Fire Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction. Products used in the assembly shall carry a classification label from a testing laboratory acceptable to authority having jurisdiction.

1.6 PROTECTIVE COATING

- A. Galvanize steel studs, runner (track), z-shaped furring channels, and resilient furring channels, with coating designation of G-90 minimum, per ASTM 123.

1.7 QUALITY ASSURANCE

- A. Contractor shall provide effective, full time quality control over all fabrication and erection complying with the pertinent codes and regulations of government agencies having jurisdiction.
- B. Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instructions.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installing.
Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials protected from exposure to rain, snow or other harmful weather conditions, at

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temperature and humidity conditions per the recommendations of ASTM C754 Section 8.

PART 2 – PRODUCTS

2.1 OWNER PROVIDED PRODUCTS- None

2.2 CONTRACTOR PROVIDED MATERIALS - All materials, equipment, services and labor requirement to perform the work of this section

2.3 MANUFACTURERS

A. Acceptable Manufacturer:

1. ClarkDietrich, West Chester OH 45069

B. Requests for substitutions will be considered in accordance with provisions of Division 1.

C. All products to be manufactured by current members of the Steel Stud Manufacturers Association (SSMA).

2.4 MATERIALS

A. Steel: Galvanized Steel meeting or exceeding the requirements of ASTM A 1003. -
Grade: 33 ksi

Coating: Galvanized G90 coating, complying with ASTM C 645.

B. Sheet for Vertical Deflection, Drift Clips: ASTM A 1003, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50 Class 1 or 2.
2. Coating: Galvanized G90 coating, complying with ASTM C 645.

2.5 COMPONENTS

A. Nonstructural Studs: Cold-Formed galvanized steel C-studs. Material: Galvanized steel meeting or

exceeding the requirements of ASTM A754 for conditions indicated below:

1. Basis-of-Design Product: Dietrich Metal Framing; CSJ.
2. Flange Width: 1-5/8"
3. Web Depth: As indicated on drawings.
4. Base Metal Thickness: Minimum 0.0396 inch, formerly 20 gage, unless approved design is more stringent.
5. Punch Outs: 12 inches from base and every 24 inches thereafter.

B. Nonstructural Track: Cold-Formed galvanized U-shaped steel track, unpunched, with straight flanges, and as follows:

1. Web Depth: Track web to match stud web size.
2. Base Metal Thickness: Track thickness to match wall stud thickness.

C. Deflection Track: Cold-Formed Slotted or Long Leg Track.

1. Leg Length: Provide minimum 1-inch deflection clearance unless approved design is more stringent
2. Base Metal Thickness: Minimum 0.0516 inch, formally 18 gage, unless approved design is more stringent.

- D. U-Channel (CRC Cold Rolled Channel):
 - 1. Size: 1-1/2 inch.
 - 2. Thickness: 0.0566 inch, formerly 16 gage.
 - 3. Spacing: 7'-0" c/c from floor to first channel, 6'-0" c/c thereafter or as indicated on drawings.
- E. Furring Channel: Furring walls and suspended ceiling applications.
 - 1. Size: As required by design.
- F. Drywall Corner Beads: Cold-Formed galvanized steel beads.
 - 1. 103 USG Durabead Deluxe Metal Corner Bead 1 1/4 inch x 1 1/4 inch.
 - 2. Bull Nose Drywall Corner Bead with 3/4 inch Radius.
- G. Drywall Trims: Cold-Formed galvanized steel trims.
 - 1. L-Trim (Mudable) Size: Same thickness as gypsum board.
 - 2. U-Trim (Mudable) Size: Same thickness as gypsum board.
 - 3. J-Trim (Reveal) Size: Same thickness as gypsum board.
- H. Framing Accessories: Accessories required.
 - 1. Flat Strapping for Backing Strip minimum 0.0396 inch, formerly 20 gage.
 - 2. L-Angles. SwiftClip Fixed Connection Angles.
 - 3. Fasteners: Self-drilling, self-tapping screws; complying with ASTM C 1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
 - 4. Touch-Up Paint: Complying with ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

2.6 MISCELLANEOUS MATERIALS

- B. ASTM C754, except as otherwise specified.
- C. For fire rated construction: Type and size same as used in fire rating test.
- D. Fasteners for steel studs thicker than 0.033-inch thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.
- E. Clips: ASTM C841, manufacturer's standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.
- F. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.
- G. Tie Wire and Hanger Wire:
 - 1. ASTM A641, soft temper, Class 1 zinc coating.
 - 2. Gauge (diameter) as specified (minimum 0.062 inches) in ASTM C754 or ASTM C841.
- H. Attachments for Wall Furring:
 - 1. Manufacturers' standard items fabricated from zinc-coated (galvanized) steel

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sheet.

2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 0.0396-inch thick galvanized steel with corrugated edges.
- I. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.
- J. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- K. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD (OPTION)

- L. Conform to ASTM C635, heavy duty, with not less than 1-3/8-inch wide knurled capped flange face designed for screw attachment of gypsum board.
- M. Wall track channel with 1-3/8-inch wide flange.
 1. Resilient furring channels:
 - a. Not less than 0.0217 thick bare metal.
 - b. Hat shaped, only one flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.
 2. "Z" Furring Channels:
 - a. Not less than 0.0217-inch thick bare metal, with 1-1/4-inch and flanges.
 - b. Web furring depth to suit thickness of insulation with slotted perforations.
 - c. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

PART 3 – EXECUTION

3.1 INSPECTION

- N. Inspect supporting substrates and structures for compliance of proper conditions for installation and performance of the cold-formed structural framing.

3.2 PREPARATION

- A. Prepare attachment surfaces so that they are plumb, level, and in proper alignment for accepting the cold-formed structural framing.

3.3 INSTALLATION CRITERIA

- A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.
- B. Construction requirements for fire rated assemblies and materials shall be as shown and specified.

3.4 INSTALLING STUDS

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.

- B. Space studs not more than 24-inches on center.
- C. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum ½ inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.
- E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound rated partitions and insulated exterior wall furring.
- F. Fastening Studs:
 - 1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.
 - 2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.
- G. Chase Wall Partitions:
 - 1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.
 - 2. Use studs or runners as cross bracing not less than 2-1/2 inches wide.
- H. Form building expansion joints with double studs back to back spaced three inches apart plus the width of the expansion joint.
 - 1. Form control joint, with double studs spaced 1/2-inch apart.
- I. Install 2x wood stud nested within metal jamb stud forming door opening on each side of swing type door. Length of wood stud to match height of metal jamb stud. Secure wood studs to metal jamb studs and door header.

3.5 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY

- O. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.
- P. Wall Furring-Stud System:

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1. Framed with 2-1/2 inch or narrower studs, 24-inches on center.
 2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.
 3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.
- Q. Direct attachment to masonry or concrete; rigid channels or "Z" channels:
1. Install rigid (hat section) furring channels at 24-inches on center, horizontally or vertically.
 2. Install "Z" furring channels vertically spaced not more that 24-inches on center.
 3. At corners where rigid furring channels are positioned horizontally, provide metered joints in furring channels.
 4. Ends of spliced furring channels shall be nested not less than 8-inches.
 5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners ion each flange.
 6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 4-inches of corner.
- R. Installing Wall Furring-Bracket System: Space furring channels not more than 16-inches on center.

3.6 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES

- S. Provide for attachment and support of electrical outlets, plumbing, laboratory or heating fixtures, recessed type plumbing fixture accessories, access panel frames, wall bumpers, wood seats, toilet stall partitions, dressing boot partitions, urinal screens, chalkboards, tackboards, wall-hung casework, handrail brackets, recessed fire extinguisher cabinets and other items like auto door buttons and auto door operators supported by stud construction.
- T. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

3.7 INSTALLING SHAFT WALL SYSTEM

- U. Conform to the UL Design corresponding to the required fire-resistance rating.
- V. Position J runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural supports with power driven fasteners at both ends and 24-inches on center.
- W. After liner panels have been erected, cut C-H studs and E studs, from 3/8-inch to not more than 1/2-inch less than floor-to-ceiling height. Install C-H studs between liner panels with liner panels inserted in the groove per manufacturers' recommendations.
- X. Install full-length steel E studs over shaft wall line at intersections, corners, hinged door jambs, columns and both sides of closure panels.
- Y. Suitably frame all openings to maintain structural support for wall:
1. Provide necessary liner fillers and shims to conform to label frame requirements.

2. Frame openings cut within a liner panel with E studs around perimeter.
3. Frame openings with vertical E studs at jambs, horizontal J runner at head and sill.

3.8 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS

- Z. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board to ceilings and for plaster ceilings or soffits.
1. Space framing at 16-inch centers for metal lath anchorage.
 2. Space framing at 24-inch centers for gypsum board anchorage.
- AA. New exposed concrete slabs:
1. Use metal inserts required for attachment and support of hangers or hanger wires with tied wire loops for embedding in concrete.
 2. Furnish for installation under Division 3, CONCRETE.
 3. Suspended ceilings under concrete rib construction shall have runner channels at right angles to ribs and be supported from ribs with hangers at ends and at 48-inch maximum intervals along channels. Stagger hangers at alternate channels.
- BB. Concrete slabs on steel decking composite construction:
1. Use pull down tabs when available.
 2. Use power activated fasteners when direct attachment to structural framing cannot be accomplished.
- CC. Where bar joist or beams are more than 48-inches apart provide intermediate hangers so that spacing between supports does not exceed 48-inches. Use clips, bolts or wire ties for direct attachment to steel framing.
- DD. Steel decking without concrete topping:
1. Do not fasten steel to decking 0.0299-inch or thinner.
 2. Toggle bolt to decking 0.0359-inch or thicker only where anchorage to steel framing is not possible.
- EE. Installing suspended ceiling system from gypsum board (ASTM C635 Option):
1. Install only for ceilings to receive screw attached gypsum board.
 2. Install in accordance with ASTM C636.
 - a. Install main runners spaced 48-inches on center.
 - b. Install four foot tees not over 24-inches on center; locate for edge support of gypsum board.
 - c. Install wall track channel at perimeter.
- FF. Installing Ceiling Bracing System:
1. Construct bracing of 1-1/2 inch channels for length up to 8 feet and 2-inch channels for lengths over 8 feet with ends bent to form surfaces for anchorage to carrying channels and over head construction. Lap channels not less than 2 feet at midpoint back to back. Screw or bolt lap together with two fasteners.
 2. Install bracing at an approximate 45 degree angle to carrying channels and

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structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.

3.9 TOLERANCES

GG. Fastening surface for application of subsequent materials shall not vary more than 1/8-inch from the layout line.

HH. Plumb and align vertical members within 1/8-inch.

3.10 PROTECTION

II. Protect installed products until completion of project.

JJ. Touch-up, repair or replace damaged products before substantial completion of final installation.

END OF SECTION

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GYPSUM BOARD SYSTEMS

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Metal wall framing
- B. Exterior gypsum board for ceilings and soffits
- C. Interior gypsum board
- D. Rigid board insulation
- E. Taped and sanded joint treatment
- F. Prefinished gypsum wall panels
- G. Tile backing boards

1.2 RELATED SECTIONS

- A. Section 05120 – Metal Framing
- B. Section 06100 – Rough Carpentry
- C. Section 07270 – Through-Penetration Firestop Systems
- D. Section 07900 – Joint Sealants
- E. Section 07210 – Building Insulation
- F. Section 09110 – Non-Load Bearing Steel Framing
- G. Section 09311 – Ceramic Tile
- H. Section 09900 – Painting

1.3 REFERENCES

- A. ASTM C1396 – Gypsum Board
- B. ASTM C1047 – Accessories for Gypsum Wallboard and Gypsum Veneer Panel
- C. ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction
- D. ASTM C645 – Nonstructural Steel Framing Members
- E. ASTM C754 - Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products
- F. ASTM C840 - Application and Finishing of Gypsum Board
- G. ASTM C1002 - Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products of Metal Plaster Bases to Wood Studs or Steel Studs
- H. ASTM D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- I. ASTM C1629 – Abuse-Resistant Gypsum Board
- J. “Gypsum Construction Handbook” - United States Gypsum Company - Latest Edition.
- K. GA-214 – Levels of Gypsum Board Finish.
- L. ASTM E 119 Fire-Resistance-Rated Assemblies
- M. For STC-Rated Assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements and classified according to ASTM E 413 Classification for Rating Sound Insulation.

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1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C840.
- B. Fire Rated Construction: Rating as indicated on Drawings:
 - 1. Tested Rating: Determined in accordance with ASTM E119
 - 2. UL listed assembly.
- C. Applicator: Company specializing in performing the work of this section with minimum 5 years experience.

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Provide product data on metal framing, gypsum board and joint tape and accessory items.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support on risers on a flat platform to prevent sagging.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS:

- A. National Gypsum Company. www.nationalgypsum.com
- B. United States Gypsum Company. www.usg.com
- C. Lafarge North America. www.lafargenorthamerica.com

2.4 FRAMING MATERIALS

- A. Wood studs, accessories and fasteners: refer to section 06100 - Rough Carpentry.
- B. Metal Framing:
 - 1. Studs and track: 22 gage minimum complying with ASTM C 645. Size as noted on the drawings.
 - 2. Metal furring channels: Rolled formed hat shaped sections, galvanized steel 25 gage minimum complying with ASTM C645.
 - 3. Cold rolled channels: Galvanized or black asphaltum painted 16 gage.
 - 4. Z - furring channels: 24 gage corrosion- resistant steel.
 - 5. Hanger and tie wire: Galvanized soft annealed wire. Hanger wire - 9 gage, Tie wire - 18 gage.
- C. Screws: ASTM C954 or ASTM C1002 or both with heads, threads, points and finish as recommended by the manufacturer.
- D. Nails: ASTM C514 with heads, lengths, configurations and finish as recommended by the manufacturer

2.5 GYPSUM BOARD MATERIALS

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- A. Standard Gypsum Board: ASTM C36; 5/8 inch thick by 48 inches wide or as noted on the drawings, maximum permissible length; ends square cut, tapered edges.
- B. Moisture Resistant Gypsum Backing Board: ASTM C630; 5/8 inch thick or as noted on the drawings. Provide water resistant gypsum board in toilet rooms behind all plumbing fixtures and ceiling in toilet rooms.
- C. Prefinished Gypsum Wall Panels: Durasan® Vinyl Covered Wall Panels as manufactured by National Gypsum; 1/2" thick panel; attached with adhesive to vertical wood or metal furring strips where anchored against masonry walls; attached to stud framing with adhesive and drywall screws where not visible; all required accessories; color - as selected from manufacturer's standard color range.
- D. Fire rated Gypsum Board: ASTM C36; fire resistive type, UL rated gypsum board thickness noted on the drawings. Maximum permissible lengths, ends square cut, tapered edges.
- E. Cementitious Backer Units: ANSI A108.1: Custom building products; wonderboard or approved equal; 5/8" thick panel, or as noted on the drawings. Provide at toilet and as indicated on the drawings, as backer board.

2.6 TILE BACKING PANELS

- A. Water-Resistant Gypsum Backing Board: ASTM C 1396, with manufacturer's standard edges.
 - 1. Core: Regular type 5/8 inch thick unless indicated otherwise.
 - a. Provide Type X where indicated and where fire-resistance rating gypsum board assemblies are indicated.
 - 2. Provide water resistant gypsum board in toilet rooms behind all plumbing fixtures and ceiling in toilet rooms where tile is indicated. Extend water-resistant gypsum board a minimum of thirty inches each way from fixture centerline. Where there is more than one fixture on the same wall, install water-resistant gypsum board over the entire wall.

2.7 ACCESSORIES

- A. Corner Beads: Formed galvanized steel angle 0.014 inch thick, ASTM C1047.
- B. Casing Bead: Formed galvanized steel trim 0.014 inch thick, ASTM C1047 LC- Bead, L- Bead, J-Bead and U-Bead.
- C. Control Expansion Joint: Rolled formed zinc with ¼ inch. open slot.
- D. Sheet Steel Reinforcing: 25 gage sheet steel.
- E. Joint Materials: ASTM C 475
 - 1. Joint Tape.
 - a. Interior Gypsum Wallboard: Paper.
 - b. Glass-Mat Gypsum Sheathing Board: Quick Tape. Inc. 2-inch minimum 10-by-10 glass mesh joint tape or equivalent.
 - c. Tile Backing Panels: As recommended by panel manufacturer.
 - 2. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

- a. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners and trim flanges, use setting-type taping compound.
- 3. Use setting-type compound for installing paper-faced metal trim accessories.
 - a. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - b. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - c. Skim Coat: For final cat of level 5 finish, use drying-type, all-purpose compound.
- 4. Joint Compound for Tile Backing Panels:
 - a. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - b. Cementitious Backer Units: As recommended by backer unit manufacturer.
- F. Bullnose Beads: $\frac{3}{4}$ " R., plastic where indicated, ASTM C1047.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesives: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Acoustical Sealant:
 - 1. Glass-Mat Gypsum Sheathing Board: As recommended per manufacturer's written installation instructions. Refer to Part 3 for description about installation methods 1 and 2
 - a. Installation Material:
 - i. Dow Corning Corporation; 795.
 - b. Use Backer Rod at openings larger than 1/8-inch.
 - ii. ASTM C 1330, Type C (closed-cell material with a surface skin), polyurethane foam rod, oversized 20 to 50 percent larger than joint width, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - c. All other Panel Products: To comply as specified in Division 7 Section "Joint Sealants" and with manufacturer's recommendations.

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- E. Thermal and Sound Attenuation Insulation: As specified in Division 7 Section "Building Insulation".
- F. Isolation Strip at Exterior Walls:
 - 1. Asphalt-Saturated Organic felt: ASTM D 226, Type 1 (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick, in width to suit stud size.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that existing conditions are ready to receive work.
- B. Beginning of installation means acceptance of existing conditions.
- C. Coordinate framing and gypsum installation with other trades.

3.2 METAL STUD INSTALLATION

- A. Install metal in accordance with ASTM C754.
- B. Metal Stud Spacing: 16 inches on center or as noted on the drawings.
- C. Refer to drawings for locations of partitions extending to finished ceiling only and for partitions extending through the ceiling and extending to the structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners. Brace top runners as needed for stiffness and alignment.
- D. Door Opening Framing: Install double studs at door frame jambs.
- E. Blocking: Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, and hardware. (Use of full wall plywood is recommended.)
- F. Gypsum board at wall base must be separated from carpet by 1-inch minimum or use waterproof file to prevent transfer from floor.
- G. Install sound attenuation blankets before installing gypsum board unless blankets are readily installed after panels have been installed on one side.
- H. Attach panel to steel framing so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 WALL FURRING INSTALLATION

- A. Install wall furring in accordance with ASTM C754.
- B. Erect wall furring for direct attachment to concrete block and brick walls.
- C. Where indicated on the drawings at exterior concrete masonry walls directly attach in accordance with manufacturer's instructions.
- D. Where indicated on the drawings, erect furring channels vertically; space maximum 16 inches on center, not more than 4 inches from floor and ceiling lines. Secure in place on alternate channel flanges at maximum 24 inches on center.

3.4 CEILING FRAMING INSTALLATION

- A. Install metal ceiling framing in accordance with ASTM C754

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- B. Coordinate location of hanger with other work.
- C. Install framing independent of walls, columns, and above ceiling work.
- D. Reinforce opening in ceiling suspension system which interrupt main carrying channels or furring channels.
- E. Install ceiling panel across framing to minimize the number of abutting end joints and to avoid abutting end joints in center area of each ceiling.
- F. Install panels with face side out. Butt panels together for a tight contact at edges and ends with not more than 1/16-inch of open space between panels. Do not force into place.

3.5 GYPSUM BOARD INSTALLATION

- A. Install gypsum board in accordance with ASTM C840.
- B. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Use screws when fastening gypsum board to metal furring or framing.
- D. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
- E. Treat cut edges and holes in water resistant gypsum board with sealant.

3.6 JOINT TREATMENT

- A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
- B. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.

3.7 PREFINISHED VINYL-COVERED PANEL INSTALLATION

- A. Install panels in accordance with manufacturer's recommendations.
- B. Erect panels in vertical direction, with joints centered on architectural features of walls.
- C. Use screws to anchor panels to wood furring or stud walls above ceiling level and below wall base. Use adhesive to anchor panels where exposed fasteners would be visible.
- D. For panels attached directly to stud wall framing, install sound attenuation insulation between studs to provide noise abatement between rooms.
- E. Do not allow adhesive to contact face of panel. Clean over runs after adhesive dries.
- F. Pre-stress Durasan panels when gluing to metal studs.
- G. Use Durasan clips and wall joints.
- H. Butt wall joints tight. Mullion strips are not permitted.
- I. Wrap interior corners at cut sheets for a straight and accurate interior corner joint.

3.8 APPLYING TILE BACKING PANELS

- A. Water-Resistant Gypsum Backing Board: Install at ceilings of toilets, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.1, at toilet rooms and where indicated locations indicated to receive tile.
- C. Where tile backing panels abut other type of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

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3.9 TOLERANCES

- A. Maximum Variation of Finished Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.10 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: L-Shaped; exposed long flange receives joint compound.
 - 4. U-Bead: J-Shaped; exposed short flange does not receive joint compound, use at exposed panel edges.
 - 5. Curved-Edge Cornerbead: Use at curved openings.

3.11 FINISHING GYPSUM BOARD

- A. General: treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.'
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
 - 1. Level 1: Ceiling plenum areas and concealed areas.
 - 2. Level 2: Where panels from substrates for ceramic/porcelain and acoustical tile.
 - 3. Level 4: For gypsum board surface where wall coverings and flat paints are specified.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.
 - 4. Level 5: At panel surfaces that will be exposed to view.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.
- E. For level 5 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories; and apply a thin, uniform skin coat of joint compound over entire surface. For skim coat, use joint compound specified for third coat, or a product specially formulated for this purpose and acceptable to gypsum board manufacturer. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.
- F. For level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coat of joint compound over joints, angles, fastener heads,

and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.

- G. For level 2 gypsum board finish, embed tape in joint compound and apply first coat of joint compound.
- H. For level 1 gypsum board finish, embed tape in joint compound.
- I. Contractor's Option: Instead of using the Gypsum Board Finish Level Process the following product is acceptable:
 - 1. Manufacturer: USG Corporation; Product: Sheetrock Brand Primer-Surfacer.
 - a. Architect approved equal.
 - 2. General: One-step spray application in lieu of Level 5 process and primer specified in Division 9 Section "Interior Painting".
 - 3. Installation: As recommended per manufacturer written installation instructions.
- J. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions.
- K. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.12 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 - 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings.
 - a. Installation of 80 percent light fixtures, powered for operation.
 - b. Installation, insulation, leak and pressure testing of water piping system.
 - c. Installation of air duct systems.
 - d. Installation of mechanical system control-air tubing.
 - e. Installation of air devices.
 - f. Installation of ceiling support framing.

3.13 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damages include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Ceramic tile floor, wall and base and finish using the thinset application method.
- B. Edge protection installed as part of tile installations.

1.2 RELATED SECTIONS

- A. Section 03470 - Concrete Floor Finishing: Troweling of floor slab for tile application.
- B. Section 07900- Joint Sealers: Mildew resistant sealant.
- C. Section 09260- Gypsum Board Systems: Water resistant gypsum board.

1.3 REFERENCES

- A. ANSI - A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.
- B. ANSI A108.10 - Installation of Grout in Tilework.
- C. ANSI A118.1 - Dry-Set Portland Cement Mortar.
- D. ANSI A118.5 – Chemical Resistant Furan Mortars and Grouts for Tile Installation
- E. ANSI A118.6 – Standard Cement Grouts for Tile Installation
- F. ANSI A137.1 - Standard Specifications for Ceramic Tile.
- G. TCA (Tile Council of America) - Handbook for Ceramic Tile Installation (latest edition).

1.4 SUBMITTALS

- A. Shop Drawings: Indicate patterned applications and thresholds.
- B. Product Data: Provide instructions for using adhesives and grouts.
- C. Samples:
 - 1. Mount tile and apply grout on one plywood panel, 12 x 12 inches in size illustrating pattern, color variations, grout joint size variations and locations of expansion, control and isolation joints.
 - 2. Assembled samples with grouted joints for each type, composition, color and finish of tile.
- D. Manufacturer's Certificate: Certify that products meet or exceed ANSI A137.1.

1.5 MAINTENANCE DATA

- A. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods and polishes and waxes.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with TCA Handbook, ANSI A108.5 and A137.1.
- B. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.
- C. Installer: Company specializing in performing the work of this section with minimum five (5) years experience and approved by manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.

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- B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

1.9 WARRANTY

- A. Special project warranty: Submit flooring installer's warranty, signed by installer, covering work of the section, for the following warranty period.
 - 1. Warranty period: 2 years from date of substantial completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-sized units equal to 3 percent of amount installed, for each type, composition, color, pattern and size indicated.

PART 2 – PRODUCTS

2.1 OWNER PROVIDED PRODUCTS - None.

2.2 CONTRACTOR PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 TILE MANUFACTURERS

- A. Florida Tile Industries, Inc. (www.floridatile.com)
- B. Summitville Tiles, Inc. (www.summitville.com)
- C. American Olean (www.americanolean.com)
- D. Substitutions: Under provisions of Division 1.

2.4 CERAMIC TILE MATERIALS

- A. Ceramic Mosaic Wall/Floor Tile: ANSI A137.1
- B. Ceramic Mosaic Wall/Floor Tile: ANSI A118.10

2.5 BASE MATERIALS

- A. Base: Match floor tile for moisture absorption, surface finish and color:
 - 1. As described on the drawings.

2.6 ADHESIVE MATERIALS

- A. Manufacturers:
 - 1. Bostick (www.bostik.com)
 - 2. Laticrete International Inc. (www.laticrete.com)
 - 3. Mapei Corporation (www.mapei.com)
- B. Epoxy Adhesive: ANSI A118.3, thinset bond type

2.7 GROUT MATERIALS

- A. Grout: ANSI A118.6 and ANSI A118.7, tile grout, color as selected.

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1. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.
 - a. Sanded grout mixture for joints 1/8 inch and wider.
 - b. Un-sanded grout mixture for joints 1/8 inch and narrower.
 - B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 1. Prepackaged dry-mortar mix combined with liquid-latex additive.
 2. For wall applications, provide non-sagging mortar.
- 2.8 ACCESSORIES
- A. Thresholds: Marble color, smooth finish, 3/4 inch by full width of wall or frame opening, beveled both sides to vertical face.
 - B. Tile Floor Edge Strips: Stainless steel.
- 2.9 GROUT MIX
- A. Mix and proportion pre-mix grout materials in accordance with manufacturer's instructions.
 - B. Chemical-resistant water-cleanable, tile-setting and grouting epoxy: ANSI A118.3.
 1. Available product: Laticrete International, Inc.; Spectralock Pro Grout.
- 2.10 MISCELLANEOUS MATERIALS
- A. Elastomeric Sealants: Elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants".
 1. One-Part, Mildew-Resistant Silicone: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for in-service exposures of high humidity and extreme temperatures.
 - a. Available Products:
 - i. Dow Corning Corporation; Dow Corning 786.
 - B. Cementitious Backer Units: ANSI A118.9 in maximum lengths available to minimize end-to-end butt joints.
 1. Thickness: 1/2 inch
 2. Available Products:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products: Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
 - C. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials.
 - D. Edge Protection:
 1. Floor Profiles: Provide Schluter; "SCHIENE" edge protection profile in satin anodized aluminum or Architect approved equal.
 2. Wall Profiles: Provide Schluter; "RONDEC" edge protection in satin anodized aluminum or Architect approved equal.
 - E. Transition Strips: Manufactured from a homogeneous composition of polyvinyl chloride (PVC), high quality additives, and colorants. The transition strips shall meet or exceed the

recommendations of the Americans with Disabilities Act (ADA). Transitional strips shall provide a gradual transition between flooring of varying heights and in maximum lengths to minimize running joints.

1. Type: to be selected by Architect for various flooring materials.
 2. Color: To be selected by Architect from manufacturer's full color range.
- F. Grout Sealer: manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.

3.2 PREPARATION

- A. Protect surrounding work from damage or disfiguration.
- B. Remove protrusions, bumps and ridges by sanding or grinding.
- C. Vacuum and damp clean surfaces. Remove coatings including curing compounds and other substances that contain soap, wax, oil or silicone, that are incompatible with tile-setting materials.
- D. Seal substrate surface cracks, holes, and depressions with filler. Level existing substrate surfaces to acceptable flatness tolerances and manufacturer's written instructions.
- E. Apply sealer or conditioner to substrate surfaces in accordance with adhesive manufacturer's instructions.
- F. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at project site before installing.
- G. Install adhesive tile, thresholds and grout in accordance with TCA Handbook, Thinset Method. Method number per drawing schedule.
- H. Place thresholds and edge strips at locations indicated.
- I. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- J. Cut and fit tile tight to penetrations through tile. Form corners and bases neatly. Align floor, base and wall joints.
- K. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar or excess grout.
- L. Form internal angles coved and external angles bull nosed.
- M. Install ceramic accessories rigidly in prepared openings.
- N. Sound tile after setting. Replace hollow sounding units.
- O. Keep expansion and control joints free of adhesive or grout. Apply sealant to joints, per manufacturer's written instructions.
- P. Allow tile to set for a minimum of 48 hours prior to grouting.
- Q. Grout tile joints.
- R. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
- S. Field-applied temporary protective coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat them with

continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION – GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series “Specifications for Installation of Ceramic Tile” that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA’s “Handbook for Ceramic Tile Installation”. Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars or covers overlap tile.
- E. Jointing Pattern: Lay tile in pattern indicated on drawings. Align joints when adjoining tiles on floor, base, walls and trim are same size. Lay out tile work and center fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Expansion Joints: Locate expansion joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section “Joint Sealants”.
- H. Grout tile to comply with requirements of ANSI A108.10, unless otherwise indicated.
 - 1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.
- I. At showers, tubs, and where indicated, install cementitious backer units and treat joints to comply with ANSI A108.11.
- J. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer’s written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
 - 1. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
- K. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for back butting of tile with 95 percent mortar coverage.
 - 1. Tile floors in wet areas, including showers and toilet rooms.
 - 2. Tile floors composed of tiles 8 by 8 inches or larger.
 - 3. Tile floors composed of rib-backed tiles.
- L. Install tile on floors with the following joint widths:
 - 1. Ceramic tile: 1/8 inch.
 - 2. Quarry Tile: 3/8 inch.

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- M. Stone thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
 - 1. Set thresholds in latex-Portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent floor finish.
- N. Transition Strips and Edge Protection: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- O. Install metal lath and scratch coat for walls to comply with ANSI A108.1A, Section 4.1.
- P. Install tile on walls with the following joint widths:
 - 1. Glass Mosaic Tile: 1/16 inch.
 - 2. Ceramic Wall Tile: 1/8 inch.
 - 3. Quarry Tile: 3/8 inch.
- Q. Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that may have gotten on tile faces by wiping with soft cloth.

3.4 WALL TILE INSTALLATION SCHEDULE

- A. Ceramic Tile Wall Installation: Where interior wall installations of this designation are indicated, comply with the following:
 - 1. Tile Type: Porcelain Wall Tile, Ceramic Wall Tile and Glass Mosaic Wall Tile.
 - 2. Installation Method: TCA W244-03 (thin-set mortar bonded to cementitious backer units on metal studs).
 - 3. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:
 - a. Latex-Portland cement mortar.
 - b. Un-sanded Polymer-Modified tile grout.

END OF SECTION

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SUSPENDED ACOUSTICAL CEILINGS

09511-1

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PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Suspended metal grid ceiling system and perimeter trim.
- B. Acoustical panels.
- C. Supplementary acoustical insulation over system units.

1.2 RELATED SECTIONS

- A. Section 05500 – Metal Fabrications
- B. Section 06100– Rough Carpentry.
- C. Section 09260– Gypsum Board System
- D. Section 09110 – Non-Load Bearing Steel Framing

1.3 REFERENCES

- A. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- B. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- C. ASTM C665 - Standard Practice for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- D. ASTM D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- E. ASTM A641– Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

1.4 SYSTEM DESCRIPTION

- A. Suspended grid acoustical ceiling system including, but not limited to, exposed tee metal ceiling suspension grid, including hardware for hanging from building structure, lay in ceiling panels and perimeter trim. Attachment of partition wall to suspended ceiling assembly is not permitted.

1.5 PERFORMANCE

- A. Minimum intersection strength limits at MT/CT shall be 60-pounds.

1.6 SUBMITTALS

- A. Submit product data under provisions of Division 1.
- B. Provide product data literature on metal grid system components and acoustical units.
- C. Samples: For each acoustical panel, for each exposed suspension system member, for each exposed molding and trim and for each color and texture required.
 - 1. Acoustical Panel: Set of 6-inch square samples of each type, color, pattern and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long sample of each type, finish and color.
- D. Product test reports.
- E. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items. Show the following:
 - 1. Ceiling layout

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2. Ceiling suspension assembly members.
3. Method of attaching hangers to building structure.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels and special moldings.
5. Minimum Drawing Scale: 1/8-inch = 1 foot

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- B. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP accredited laboratory.
- C. Fire Rated Construction: Rating as indicated on Drawings:
 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify materials with appropriate markings of applicable testing and inspecting agency.
- D. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
 - a. Flame Spread : 25 or less
 - b. Smoke-Developed Index: 450 or less.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of between 60°F and 85 °F, and humidity not more than 75 percent prior to, during and after installation.

1.9 SEQUENCING/ SCHEDULING

- A. Do not install acoustical ceilings until building is enclosed, sufficient heat is provided, dust generating activities have terminated and overhead work is completed, tested and approved.

1.10 EXTRA STOCK

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Acoustical Ceiling Panels: Full-size panels equal to 3.0 percent of quantity installed but not less than one carton.

PART 2- PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 SUSPENSION SYSTEMS MANUFACTURER'S

- A. Armstrong World Industries, Inc
- B. USG Interiors, Inc.
- C. Chicago Metallic

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- D. Ecophon CertainTeed, Inc
- E. Substitutions: Under provisions of Division 1.

2.4 ACOUSTICAL UNITS MANUFACTURERS

- A. Armstrong
- B. USG Interiors, Inc.
- C. Ecophon CertainTeed, Inc.
- D. Substitutions: Under provisions of Division 1.

2.5 ACOUSTICAL UNITS MATERIALS

- A. Acoustical Panels: ASTM E1264, conforming to the following unless otherwise described on the drawings.

1. CL-1 Open Office Areas, Offices, Break Room, Kitchen, and Satellite Control Room, use the following:
 - a. Basis of Design: USG Radar Firecode 2315
 - b. Edge: Square
 - c. Panel Size: 2' by 4' x 5/8-inch
 - d. Construction: Wet-formed mineral fiber substrate.
 - e. NRC Rating: 0.55
 - f. Color: White
 - g. Grid: ASTM C635; 15/16" width, exposed tee system, double-web hot-dipped galvanized steel body; steel cap finished with four-step protective coating. Main tee heavy duty, height 1.64-inches, cross tee height 1-1/2 inches
2. CL-2 Locker Rooms, Shower Rooms, Toilet Rooms use the following:
 - a. Basis of Design: USG Radar ClimaPlus Firecode 2415
 - b. Edge: Square
 - c. Panel Size: 2' by 4' x 5/8-inch
 - d. Construction: Wet-formed mineral fiber substrate.
 - e. Sag Warranty: 30-year
 - f. NRC Rating: 0.55
 - g. Color: White
 - h. Grid: ASTM C635; 15/16" width, exposed tee system, double-web hot-dipped galvanized steel body; aluminum cap finished with four-step protective coating. Main tee heavy duty, height 1-1/2 inches, cross tee height 1-1/2 inches

Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment:
Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

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2.6 PERFORMANCE / DESIGN CRITERIA

- A. Provide system capable of supporting imposed loads with deflection limited to 1/360 of span.

2.7 ACCESSORIES

- A. Acoustical Ceiling Batt Insulation: ASTM C665, Johns Manville, Poly-encapsulated ComfortTherm
 1. Thickness: 4 inches, sized to fit above 2x4 ceilings
 2. ASTM E84: Flame spread 25 or less, smoke developed 40 or less
 3. Installation: Lay insulation flat over top of ceiling tiles. Keep insulation away from recessed light fixtures.
- B. Expansion Joints: Elastomeric, multi-cell with aluminum edge retainers. White.
- C. Touch-up Paint: Type and color to match acoustical and grid units.
- D. Wire Hangers, Braces and Ties: Zinc-coated carbon-steel wire, ASTM A 641, class 1 zinc coating, soft temper minimum 0.1046 (formally 12-gage) wire.
- E. Wall Molding: Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width, material, finish and configuration of exposed runners, unless otherwise indicated.
- F. Hold-down clips.
- G. Splices.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that existing conditions are ready to receive work.
- B. Verify that layout of hangers will not interfere with other work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Beginning of installation means acceptance of existing conditions.
- D. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Install system in accordance with manufacturer's instructions, ASTM C636, ASTM C635 as supplemented in this section.
- B. General: Install acoustical panel ceilings to comply with ASTM C 636
- C. Install after major above ceiling work is complete. Coordinate hanger location with others for interferences.

- D. Hang system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members. Use of laser level is recommended.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance. Do not suspend hangers from conduit and piping.
- F. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors
- G. Locate system on room axis according to reflected ceiling plant.
- H. Lay directional patterned units one way with pattern parallel to longest room axis. Align pattern arrows to point north.
- I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
- J. Do not eccentrically load system or produce rotation of runners.
- K. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions. If panel has factory beveled edges, field bevel any cut edges to match.
- L. Where bullnose concrete block corners round obstructions occur, provide preformed closers to match edge molding or use flexible wall angle.
- M. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
- N. Cut tile to fit irregular grid and perimeter edge trim. Field rabbet tile edge. Double cut and field paint exposed edges of regular units.
- O. Maintain minimum 3/8-inch on all sides for sprinkler heads and other items penetrating ceiling panels. Maintain minimum 3/8-inch grid end clear clearance at wall angle molding.
- P. Install acoustic units level, in uniform plane and free from twist, warp and dents.
- Q. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
- R. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet Miter corners accurately and connect securely.
- S. Form expansion joints to accommodate plus minus 1-inch movement. Maintain visual closure.
- T. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions as indicated on the drawings.
- U. Install hold-down clips to retain panels tight to grid system within 8 feet of an exterior door.
- V. Install vertical hanger wire maximum variation from plumb 1 horizontal unit in 6 vertical units (plus/minus 10-percent from plumb) spaced at 4-feet maximum centers each way.

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3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 SCHEDULE

- A. Refer to Drawings for Reflected Ceiling Plans.
- B. Refer to Drawings for Room Finish Schedule.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Resilient tile flooring.
- B. Resilient base and accessories.

1.2 REFERENCES

- A. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM F1066 – Standard Specification for Vinyl Composition Floor Tile.
- C. FS L-F-1641 - Floor Covering Translucent or Transparent Vinyl Surface with Backing.
- D. FS L-F-475 - Floor Covering, Vinyl Surface (Tile and Roll), with Backing.
- E. FS SS-W-40 - Wall Base: Rubber and Vinyl Plastic.

1.3 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- B. Samples: Submit two samples, 12 x 12 inch in size illustrating color and pattern for each floor material for each color specified.
- C. Submit two 12 x 12 inch long samples of base material and accessory material for each color specified.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Protect roll materials from damage by storing on end.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Store materials for three days prior to installation in area of installation to achieve temperature stability.
- B. Maintain ambient temperature required by adhesive manufacturer three days prior to, during and 24 hours after installation of materials.

1.6 MAINTENANCE DATA

- A. Maintenance Data: Include maintenance procedures, recommend maintenance materials, and suggested schedule for cleaning, stripping and re-waxing

PART 2 – PRODUCTS

2.1 OWNER PROVIDED PRODUCTS - None.

2.2 CONTRACTOR PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS - TILE FLOORING MANUFACTURERS:

- A. Azrock Commercial Flooring (www.azrock.com)
- B. Armstrong Flooring Systems (www.armstrong.com)
- C. Congoleum Corporation (www.congoleum.com)

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- D. Tarkett (www.tarkett.com)
- E. Substitutions: Under provisions of Division 1.

2.4 MATERIALS - BASE MANUFACTURERS:

- A. Johnsonite
- B. Armstrong Flooring Systems
- C. Roppe Corporation
- D. Tarkett
- E. Substitutions: Under provisions of Division 1.

2.5 RESILIENT BASE

- A. Resilient Base Standard – ASTM F 1861.
 - 1. See “Resilient Base” article in the Evaluation for a discussion of material requirements, manufacturing method, and style.
- B. Material Requirement:
 - 1. Type TV (vinyl, thermoplastic) or Type TS (rubber, vulcanized thermoset) as indicated.
- C. Manufacturing Method:
 - 1. Group I (solid, homogeneous) or Group II (layered).
- D. Style:
 - 1. Cove (base with toe).
 - a. For non-carpeted areas as indicated and in restrooms and locker rooms.
 - 2. Straight (flat or toeless).
 - a. For carpeted areas.
 - 3. Both types of rubber base are generally 0.125-inch thick; however some manufacturers offer various thicknesses. Vinyl base is available in both thickness options in first paragraph below but not from every manufacturer.
- E. Minimum Thickness - 0.125-inch.
- F. Height - 4-inches, 6-inches in restrooms and locker rooms and as indicated.
 - 1. Some manufacturers do not offer coils for every height.
- G. Lengths - Coils in manufacturer’s standard length.
- H. Outside Corners - Preformed.
- I. Inside Corners - Job formed.
- J. Finish – Matte or Low luster.
- K. Color – As selected by Architect from full range of industry colors.

2.6 ACCESSORIES

- A. Subfloor Filler: Type recommended by adhesive material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- C. Edge Strips: Flooring material as described on the drawings.
- D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 – EXECUTION**3.1 EXAMINATION**

- A. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization or dusting and comply with ASTM F710.
- B. Examine areas where installation of tiles will occur, with installer present, to verify that substrates and conditions are satisfactory to tile installation and comply with tile manufacturer's requirements.
 - 1. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 before beginning installation.

3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes or other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.
- D. Apply primer to surfaces, in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - TILE FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Mix tile from container to ensure shade variations are consistent when tile is placed.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Set flooring in place, press with heavy roller to attain full adhesion.
- E. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
- F. Install tile to ashlar pattern. Allow minimum 1/2 full size tile width at room or area perimeter.
 - 1. Lay out tiles from center marks established with principal walls.
- G. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- H. Install edge strips at unprotected or exposed edges, and where flooring terminates.
- I. Scribe flooring to walls, columns, cabinets, floor outlets and other appurtenances to produce tight joints.
- J. Adhesives (Cements): Water-Resistant type recommended by tile manufacturer to suit resilient floor tile products and substrate conditions indicated.

3.4 INSTALLATION - BASE

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints.
- E. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

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- F. Install base on solid backing. Bond tight to wall and floor surfaces.
- G. Scribe and fit to door frames and other interruptions.
- H. Do not stretch resilient base during installation.

3.5 CLEANING

- A. Remove excess adhesive from floor, base and wall surfaces without damage.
- B. Clean, seal and wax floor and base surfaces in accordance with manufacturer's instructions four (4) days prior to date scheduled for inspections intended to establish date of substantial completion. Apply protective polish according to floor tile manufacturer's directions.

3.6 PROTECTION OF FINISHED WORK

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Cover resilient products until Substantial Completion.

3.7 FINISH: COLOR SCHEDULE

- A. Refer to drawings for descriptions.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Surface preparation of concrete.
- B. Epoxy fortified concrete floor coatings.

1.2 RELATED SECTIONS

- A. Section 03300 - Concrete Surface coordination and curing provisions.
- B. Section 07900 – Joint sealants
- C. Section 09900 – Painting

1.3 REFERENCES

- A. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- B. ASTM D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader.
- C. ASTM D 2794 – Standard Test Method of Organic. Coatings to the Effects of Rapid Impact Resistance.
- D. ASTM D 522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
- E. ASTM D 4585 - Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- F. ASTM D 3363 - Standard Test Method for Film Hardness by Pencil Test.
- G. ASTM D 2486 - Standard Test Method for Scrub Resistance of Wall Paints.
- H. ASTM C 1028 - Standard Test Method for Determining the Static Coefficient of Friction.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each fluid-applied flooring component required.
- B. Samples for Initial Selection: For each type of exposed finish required.
- C. Samples for Verification: For each fluid-applied flooring system required; 6 inches square, applied to a rigid backing by Installer for this Project.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. Material Certificates: For each fluid-applied flooring component, signed by manufacturer.
- F. Maintenance Data: For fluid-applied flooring to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying fluid-applied flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to fluid-applied flooring manufacturer.
- B. Engage an installer who employs only persons trained and approved by fluid-applied flooring manufacturer for applying fluid-applied flooring systems indicated.

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- C. Source Limitations: Obtain primary fluid-applied flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with fluid-applied flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting fluid-applied flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during fluid-applied flooring application.
- C. Close spaces to traffic during fluid-applied flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver materials to the Owner.
- B. Quantity: Furnish Owner with an additional three percent, but not less than 1 gallon or one case, as appropriate, of each material and color applied.

PART 2 – PRODUCTS

2.1 FLUID-APPLIED FLOORING

- A. Manufacturers:
 - 1. Stonhard Inc:
 - 2. Chemproof Polymers Inc.

2.2 COMPONENTS

- A. Products: Subject to compliance with requirements, provide one of the following as noted on the drawings.
 - 1. Stonhard Inc.: Stonchem 602 system.
 - 2. Stonhard Inc.: Stonclad GS/Stonkote GS4 system.
 - 3. Stonhard Inc.: Stonflex LTE
 - 4. Stonhard Inc.: Stontec ERF
 - 5. Stonhard Inc.: Stonkote GS4 / Standard Primer
 - 6. Stonhard Inc.: Stonclad GS / ATK/ AT5
 - 7. Stonhard Inc.: Stonclad HT system.
 - 8. ChemProof Polymers, Inc.: PERMACOAT 4000

- B. System Characteristics:
1. Color and Pattern: See architectural drawings for floor color and pattern.
 2. Wearing Surface: See architectural drawings for floor finish texture. Textured finish for slip resistance where noted on the drawings.
 3. Integral Cove Base: 4-inch high unless noted otherwise.
 4. System Components: Manufacturer's standard components that are compatible with each other
- C. Stonchem 602 System: nominal 40 mil thick system comprised of a penetrating two-component epoxy primer, a three-component mortarcoat consisting of novolac epoxy resin, curing agent and finely divided mineral composite aggregate and a highly impermeable, mineral composite, novolac epoxy topcoat.
- D. Stonclad GS / Stonkote GS4: nominal 1/4"/6mm thick system comprised of a penetrating, moisture tolerant, two-component epoxy primer, a high performance, three component mortar consisting of epoxy resin, curing agent and selected, graded aggregates blended with inorganic pigments and a two-component, 100% solids, general service, epoxy coating.
- E. Stonflex LTE: nominal 40 mil/1 mm thick system comprised of penetrating two-component epoxy primer, free flowing, two-component, liquid applied, urethane membrane, and a high performance, 100% solids, two-component coating consisting of epoxy resin and curing agent.
- F. Stontec ERF : nominal 2mm thick system comprised of a penetrating two-component epoxy primer, quartz silica aggregate, a three component free flowing epoxy undercoat including resin, hardener and filler, brightly colored vinyl flake broadcast, and two two-component, high performance, clear epoxy sealers.
- G. Stonkote GS4 / Standard Primer: nominal 8-10 mil thick system comprised of a penetrating, moisture tolerant, two-component epoxy primer, and a two-component, 100% solids, general service, epoxy coating.
- H. Stonclad GS / ATK Primer / AT5 : nominal 1/4"/6mm thick system comprised of a penetrating, moisture tolerant, two-component epoxy primer, a high performance, three-component mortar consisting of epoxy resin, curing agent and selected, graded aggregates blended with inorganic pigments and a two-component conductive epoxy primer and a two-component, 100% solids, chemical resistant, static dissipative bisphenol F epoxy coating.
- I. Stonclad HT / Stonkote HT4 / GS 7: nominal 1/4"/6mm thick system comprised of a four component, troweled, epoxy mortar system with epoxy resin, amine curing agent, pigment and selected, graded aggregates for superior chemical resistance.
- J. PERMACOAT(PC) 4000 System: 100% solids modified epoxy double broadcast coating
1. Horizontal areas:
 - a. Base Coat: PC 4000 applied at a rate of 80-90 square feet per gallon. Broadcast to excess a 20/0 mesh silica into the wet resin.
 - b. Second Coat: PC 4000 applied at a rate of 80-90 square feet per gallon. Broadcast silica to excess.
 - c. Final Coat: PC 4000 applied at a rate of 90-100 square feet per gallon.
 - d. Total thickness of 90-110 mils
 2. Vertical Areas
 - a. Base coat: PC 4000V at a rate of 100-120 square feet per gallon.

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- b. Top coat: PC 4000V at a rate of 100-120 square feet per gallon.
 - c. Total thickness of 25-35 mils
- K. Patching and Fill Material:
 - 1. Fluid-applied flooring product of or approved by fluid-applied flooring manufacturer and recommended by manufacturer for application indicated.
- L. Joint Sealant:
 - 1. Type recommended or produced by fluid-applied flooring manufacturer for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to fluid-applied flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral pH substrate for fluid-applied flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with fluid-applied flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to fluid-applied flooring manufacturer's written recommendations.
 - 3. Verify that concrete substrates are dry.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab in 24 hours.
 - b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 - 4. Verify that concrete substrates have neutral pH and that fluid-applied flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Fluid-applied flooring Materials:
 - 1. Mix components and prepare materials according to fluid-applied flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through fluid-applied flooring according to manufacturer's written recommendations.
- F. Provide 4-inch high concrete column wash at column locations.

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3.2 APPLICATION

- A. General: Apply components of fluid-applied flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
- B. Coordinate application of components to provide optimum adhesion of fluid-applied flooring system to substrate, and optimum inter-coat adhesion.
- C. Cure fluid-applied flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- D. At substrate expansion and isolation joints, provide joint in fluid-applied flooring to comply with fluid-applied flooring manufacturer's written recommendations.
- E. Apply joint sealant to comply with manufacturer's written recommendations.
- F. Apply primer, if required by manufacturer, over prepared substrate at manufacturer's recommended spreading rate.
- G. Integral Cove Base: Apply cove base to concrete masonry, metal wall panel wall surfaces and concrete column washes before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners.
- H. Apply troweled or screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- I. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.
- J. At adjacent floor finish edges, provide 3-inch wide saw cut across line of transition varying in depth from 1/2-inch – 1/4-inch across the width of the saw cut forming a keyway. Remove concrete on surfacing side of saw cut by grinding or scarifying to provide a smooth transition to adjacent floor elevation.
- K. No. 36 grit aluminum oxide slip resistant material is to be intermixed with the topcoat material at a rate of 12 oz. of aluminum to every 3 gallons of topcoat material or provide sufficient slip resistant material to meet minimum slip resistance standards as outlined above.

3.3 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during fluid-applied flooring application, require material samples for testing for compliance with requirements.
- B. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
- C. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
- D. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 CLEANING AND PROTECTING

- A. Protect fluid-applied flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by fluid-applied flooring manufacturer.

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- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged surfaces before Substantial Completion

END OF SECTION

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CARPET

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- A. Tile carpet, fully adhered or self-stick adhesive backed placed with glue down method
- B. Roll carpet for direct-glued installation on base.
- C. Accessories
- D. Edge strips and other items required for complete installation

1.2 RELATED SECTIONS

- A. Section 03300 – Cast-in-Place Concrete: Floor substrate surface
- B. Section 09650 – Resilient Flooring: Base materials and installation

1.3 REFERENCES

- A. American National Standards Institute (ANSI): ANSI/NSF 140– Sustainable Carpet Assessment Standard
- B. American Association of Textile Chemist and Colorists (AATCC):
 - 1. AATCC 16– Colorfastness to Light
 - 2. AATCC 129– Colorfastness to Ozone in the Atmosphere under High Humidity's
 - 3. AATCC 134– Electric Static Propensity of Carpets
 - 4. AATCC 165– Colorfastness to Crocking: Textile Floor Coverings – AATCC Crockmeter Method
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM E84 – Surface Burning Characteristics of Building Materials
 - 2. ASTM E648 – Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
 - 3. ASTM D3278- Flash Point of Liquids by Small Scale Closed-Cup Apparatus
 - 4. ASTM D5116– Determination of Organic Emissions from Indoor Materials/Products
 - 5. ASTM D5252– Operations of the Hexapod Tumble Drum Tester
 - 6. ASTM D5417– Operation of the Vettermann drum tester
 - 7. ASTM E648– Critical Radiant Flux of Floor –Coverings Systems Using a Radiant Heat Energy Source
- D. National Fire Protection Association (NFPA) – NFPA 253 – Test for Critical Radiant Flux of Floor Covering Systems

1.4 QUALITY ASSURANCE

- A. Conform to ASTM E648 for flooring radiant panel test
- B. Conform to ASTM D2859 for surface flammability ignition test

1.5 SUBMITTALS

- A. Submit in accordance with Division 1, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- B. Product Data:

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1. Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading and flame resistance characteristics for each type of carpet material and installation accessory
 2. Manufacturer's printed installation instructions for the carpet, including preparation of installation substrate, seaming techniques and recommended adhesives and tapes
 3. Manufacturer's certificate verifying carpet containing recycled materials include percentage of recycled materials as specified
- C. Samples:
1. Carpet: "Productive Quality" samples 12 x 12 inches of carpets, showing quality, pattern and color specified in, SCHEDULE FOR FINISHES.
 2. Floor Edge Strip (Molding): 6 inches long of each color and type specified
 3. Base Edge Strip (Molding): 6 inches long of each color specified
- D. Shop Drawings: Installers layout plan showing seams and cuts for sheet carpet and carpet module
- E. Maintenance Data: Carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods and cleaning cycles

1.6 DELIVERY, STORAGE AND PROTECTION

- A. Store materials for 3 days prior to installation in area of of installation to achieve temperature stability
- B. Maintain minimum 70 degrees F ambient temperature 1 day prior to, during and 24 hours after installation

1.7 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations
- B. Environmental Limitations: Do not deliver or install carpet until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period
- C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer

PART 2 - PRODUCTS

2.1 OWNER PROVIDED PRODUCTS – None

2.2 CONTRACTOR PROVIDED PRODUCTS – All materials, equipment, services, and labor required to perform the work of this section

2.3 MATERIALS – ROLL CARPET

- A. Carpet: Refer to drawings for description
- B. Physical Characteristics:
 1. Carpet free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains and other physical and manufacturing defects

2. Manufacturers standard construction commercial carpet:
 - a. Broadloom; maximum width to minimum use
3. Provide static control to permanently control static build up to less than 2.0 kV when tested at 20 percent relative humidity and (70 degrees F) in accordance with AATCC 134
4. Pile Height: Maximum (0.10 inch)
5. Pile Fiber: Nylon with recycled content 25 percent minimum branded (federally registered trademark)
6. Pile Type: Level Loop
7. Backing materials: Manufacturer's unitary backing designed for glue-down installation using recovered materials
8. Appearance Retention Rating (ARR): Carpet shall be testing and have the minimum 3.5 – 4.0 Severe ARR when tested in accordance with either the ASTM D 5252 (Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified
9. Tuft Bind: Minimum force of (10 lb) required to pull a tuft or loop free from carpet backing. Test per ASTM D1335
10. Colorfastness to Crocking: Dry and wet crocking and water bleed, comply with AATCC color transfer chart
11. Colorfastness to Ozone: Comply with AATCC 129, minimum rating of 4 on the AATCC color transfer chart
12. Delamination Strength: Minimum of (2.5 lb/inch) between secondary backing
13. Flammability and critical Radiant Flux Requirements
 - a. Test carpet in accordance with ASTM E 648
 - b. Class I: Not less than 0.45 watts per square centimeter
 - c. Class II: Not less than 0.22 watts per square centimeter
 - d. Carpet in corridors, exits and Medical Facilities: Class I
14. Density: Average Pile Yarn Density (APYD)
 - a. Corridors, lobbies, entrances, common areas or multipurpose rooms, open offices waiting areas and dining areas: Minimum APYD 6000
 - b. Other areas: Minimum APYD 4000
15. VOC Limits: Use carpet and carpet adhesive that comply with the following limits for VOC content when tested according to ASTM D 5116:
 - a. Carpet, Total VOCs: 0.5 mg/sq.m x hr
 - b. Carpet, 4-PC (4-Phenlcyclohexene): 0.05 mg/sq.m x hr
 - c. Carpet, Formaldehyde: 0.05 mg/sq.m x hr
 - d. Carpet, Styrene: 0.4 mg/sq.m x hr
 - e. Adhesive: Total VOCs: 10.0 mg/sq.m x hr
 - f. Adhesive: Formaldehyde: 0.05 mg/sq.m hr

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g. Adhesive, 2-Ethyl-1-Hexanol: 3.00 mg/sq.m x hr

C. Shall meet platinum level of ANSI/NSF 140

D. Color, Texture and Pattern: As specified in, SCHEDULE FOR FINISHES

2.4 CARPET TILE

A. Products: Subject to compliance with requirements:

1. Interface: Entropy/Basalt

B. Basis-of-Design Product:

1. Interface: Carpet Tile

C. Color: Entropy/Basalt 7238

D. Pattern: Entropy/Basalt 14648

E. Fiber Content: 100 percent nylon 6, 6:

F. Fiber Type: Post consumer content type 6, 6 Nylon

G. Yarn Count: 20 oz/yd²H. Density: 5035 oz/yd²

I. Pile Thickness: 0.143 in for finished carpet tile

J. Stitches : 9.661 per in

K. Gage: 1/12 in

L. Size: 19.69 in x 19.69 in

M. Applied Soil-Resistance Treatment: ProTekt

N. Antimicrobial Treatment: Intersept (AATCC 138 Washed)(AATCC 174 Parts 2 & 3)

O. Performance Characteristics: As follows:

1. Appearance Retention Rating: [Moderate traffic, 2.5] minimum according to ASTM D7330
2. Dry Breaking Strength : Not less than 100 ibf (445 N) according to ASTM D 2646
3. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement
4. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test)
5. Resistance to Insects: Comply with AATCC 234
6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165
7. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading unites) according to AATCC 16, Option E
8. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, and no fungal growth, according to AATCC 174
9. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program
10. Emissions: Provide carpet tile that complies with the product requirements of the California Departmental of Health Services "Standard Practice for the Testing of

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Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 ACCESSORIES

- A. Sub-Floor Filler: White latex or type recommended by adhesive material manufacturer
- B. Moldings and Edge Strips:
- C. Adhesive: Compatible with carpet material; as recommended by carpet manufacturer

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710
- C. Verify that surfaces are smooth and flat with maximum variation of ¼ inch in 10 ft, and are ready to receive work
- D. Verify concrete floors are dry to a maximum content of 7 percent; and exhibit negative alkalinity, carbonizations, or dusting
- E. Waterproof, resistant to cleaning solutions, steam and water, nonflammable, complies with air-quality standards as specified. Adhesives flashpoint, complies with ASTM D 3278
- F. Seam Adhesives: Waterproof, nonflammable and non-staining

3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes and other defects with sub-floor filler
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured
- C. Vacuum clean substrate

3.3 STEAMING TAPE

- A. Permanently resistant to carpet cleaning solutions, steam and water
- B. Recommended by Manufacturer

3.4 EDGE STRIPS (MOLDING)

- A. Metal:
 - 1. Hammered surface aluminum, pinless, clamp down type designed for the carpet being installed
 - 2. Floor flange not less than (1/2 inch) wide, face not less than (5/8 inch) wide
 - 3. Finish: Clean anodic coating unless specified otherwise in the Architectural Drawings
- B. Vinyl Edge Strip:
 - 1. Beveled floor flange minimum (2 inches) wide
 - 2. Beveled surface to finish flush with carpet for tight joint and other side to floor finish

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- 3. Color as specified in SCHEDULE FOR FINISHES
- C. Carpet Base Top Edge Strip:
 - 1. Vinyl "J" strip wall flange minimum of (1 ½ inches) wide with cap beveled from wall to finish flush with carpet being installed
 - 2. Color as specified in SCHEDULE FOR FINISHES
- 3.5 LEVELING COMPOUND (FOR CONCRETE FLOORS)
 - A. Provide Portland cement bases polymer modifier with latex or polyvinyl acetate resin manufactured specifically for resurfacing and leveling
 - B. Determine the type of underlayment selected for use by condition to be corrected
- 3.6 INSTALLATION – ROLL CARPET
 - A. Apply carpet and adhesive in accordance with manufacturer's instructions
 - B. Verify carpet match before cutting to ensure minimal variation between dye lots
 - C. Double cut carpet, to allow intended seam and pattern match. Make cuts straight, true, and unfrayed.
 - D. Locate seams in areas of least traffic
 - E. Join seam by hot adhesive tape method. Form seams straight, not overlapped or peaked, and free of gaps.
 - F. Lay carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance. Provide monolithic color, pattern, and texture match within any other area
 - G. Do not change run of pile in any room where carpet is continuous through a wall opening into another room. Locate change of color or pattern between rooms under door centerline.
 - H. Cut and fit carpet around interruptions
 - I. Fit carpet tight to intersection with vertical surfaces without gaps
 - J. Where wall bases are scheduled, cut carpet tight to walls. Fit carpet tight to vertical interruptions, leaving not gaps
 - K. Install edge strips over exposed carpet edges adjacent to uncarpeted finish flooring
 - L. Anchor metal strips to floor with suitable fasteners, per manufacturers' requirements. Apply adhesive to edge strips, insert carpet into lip and press it down over carpet
- 3.7 INSTALLATION – CARPET TILE
 - A. Proceed with installation only after unsatisfactory conditions have been corrected
 - B. Preparations: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparation substrates indicated to receive carpet tile installation
 - C. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions
 - D. Installation Method: As recommended in writing by carpet tile manufacturer
 - E. Maintain dye lot integrity. Do not mix dye lots in same area
 - F. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edging, thresholds, and nosings. Bind or seal cut

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edges as recommended by carpet tile manufacturer

- G. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings
- H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device
- I. Install pattern parallel to walls and borders
- J. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer
 - 2. Remove yarns that protrude from carpet tile surface
 - 3. Vacuum carpet tile using commercial machine with face-beater element
- K. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

3.8 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces
- B. Clean and vacuum carpet surfaces
- C. Do not permit traffic on carpeted surfaces for at least 48 hours after installation. Protect the carpet in accordance with CRI 104

3.9 SCHEDULE

- A. Refer to drawings for schedules
- B. Just before final acceptance of work, remove protection and vacuum carpet clean

END OF SECTION

PART 1 – GENERAL**1.1 WORK INCLUDED**

- A. This is a coating repair system for walls, floors and joints and cracks in the floors. This coating system is for an application for chemical resistance standard to spill ponds in the HSC Plant previously coated and designed for submersed conditions and appropriate for large spans of concrete.
- B. This work will consist of removing and replacing the coating on the pond floor and repairing spots in the walls and around the wall pipe penetrations.

1.2 RELATED SECTIONS

- A. Section 03300 – Cast in Place Concrete

1.3 REFERENCES

- A. ACI 308 – Recommended Practice for Curing Concrete.
- B. ASTM D-4258 – Surface Cleaning Concrete for Coating
- C. ASTM D-4259 – Abrading Concrete
- D. ASTM D-4260 – Liquid and Gelled Acid Etching of Concrete
- E. ASTM D-4261 – Surface Cleaning Concrete Masonry Units for Coating

PART 2 – PRODUCTS**2.1 OWNER-PROVIDED PRODUCTS – None.****2.2 CONTRACTOR-PROVIDED PRODUCTS**

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS

- A. Approved coating products supplied by Chemproof Polymers, 2750 Charles Page Blvd. Tulsa, OK 74127-8315
- B. Contact Jeff Glass at chemproof@sbcglobal.net or 918-584-0364 Fax 584-0366

2.4 COATING PRODUCTS

- A. PermaCoat 4000 PP
- B. PermaCoat 4000 V
- C. PermaFlex 1100
- D. PermaCast 4000

2.5 REINFORCEMENT PRODUCTS

- A. Fiberglass Mesh: 5-12 oz fiberglass cloth / 1.5 oz chopped matte (walls only)
- B. Silica: 20-40 mesh silica sand (typical Wedron 480)

2.6 ACCESSORIES

- A. ICO GEL Fill
- B. Joint Material: MasterSeal NP 1

PART 3 – EXECUTION**3.1 PREPARATION**

- A. Spill Containment will be cleaned by Owner prior to the start of work.

- B. HSC Loss Prevention will ready the pond for safe access by plugging inlets when there is not a forecast for rain.
- C. Coating and joint work can begin application when there is a visibly dry surface for 4-5 hours. Ensure moisture does not wick to the surface by applying an absorbent material with light pressure. If this remains dry, coating application can proceed.
- D. Concrete Surface Temperature minimum of 60 degrees or higher.
- E. Refer to all the manufacturer's installation recommendations for the Coating Products.
- F. Recommend the concrete be falling in temperature during the application and curing verses increasing in temperature.

3.2 SPILL POND WALLS

- A. Remove any loose coating identified by missing spots of coating.
- B. Brush blast per SSPC SP-7 the concrete and coating to 6" beyond the exposed concrete.
- C. Roll two 16 mill (wet) coats of PermaCoat 4000 V, letting it cure between coats. No fiberglass mat is to be used.

3.3 PIPE PENETRATIONS

- A. Remove any loose concrete surrounding the pipe penetrations of the walls and dust blast exposed surfaces per SSPC SP-7.
- B. Fill with PermaCast 4000 to the face of the wall.

3.4 POND BOTTOM COATING

- A. Use an electric scarifier to remove the existing coating exposing a solid concrete surface. Clean up removed material from pond bottom.
- B. Shave scarified concrete surface to a smooth broomable surface meeting the abrasive requirements of PermaCoat 4000.
- C. V grind any new cracks in slab that are clearly visible.
- D. Apply PermaCoat 4000PP with a roller in a thin coat at 150 Sq. Feet per gallon. (Thin coats are better than heavy coats, no build up on the surface with the material is desired) Apply 3 coats. Apply re-coats when the coating has visibly penetrated the concrete completely and within 2 hours of the last coat. (recoats must be done when applied material is still wet) If concrete will accept more material, the re-coats after the 3rd coat will be done T&M.
- E. This material should be applied over V ground cracks and joints but the material should not be puddle in the cracks and joints, it must not build up these openings. Once the slab has been completed with the PermaCoat 4000PP proceed to the "Joint and Crack Repair" Procedure.

3.5 JOINT AND CRACK REPAIR

- A. After PermaCoat 4000PP is applied on the slab clean out joints and cracks and ensure they are dry. Within 24 hours of PermaCoat 4000PP application, fill cracks with PermaFlex 1100.
- B. Caulk joint with NP-1 when PermaFlex is dry and will not cause a problem with tooling of the caulk. Caulking shall be done no longer than 24 hours after the PermaFlex is installed.
- C. Joint between wall and slab shall be caulked with a heavy bead of NP-1 caulk and tooled.

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SPILL POND COATING REPAIR SYSTEM

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3.6 BOTTOM JOINTS

- A. As soon as an area is covered with the base coat and before it begins to set up, embed a layer of 5-12 oz Fiberglass cloth using a short nap or ribbed (serrated) roller to press the glass into the wet basecoat. Overlap edges of glass a minimum of two inches.
- B. Next mix and apply PermaCoat 4000 as needed as a saturate to make sure that all of the Fiberglass is wetted out using a medium nap roller. Glass reinforcement is saturated when the white appearance of the glass disappears. Allow to cure until tack free approximately 8 hours depending on the temperature.

END OF SECTION

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SPILL POND COATING SYSTEM

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. This coating system is for an application for chemical resistance standard to spill ponds in the HSC Plant. This is a fiberglass lined system designed for submersed conditions and appropriate for large spans of concrete.
- B. This work includes the surface preparation and application of protective floor and wall coatings.

1.2 RELATED SECTIONS

- A. Section 03300 – Cast in Place Concrete

1.3 REFERENCES

- A. ACI 308 – Recommended Practice for Curing Concrete.
- B. ASTM D-4258 – Surface Cleaning Concrete for Coating
- C. ASTM D-4259 – Abrading Concrete
- D. ASTM D-4260 – Liquid and Gelled Acid Etching of Concrete
- E. ASTM D-4261 – Surface Cleaning Concrete Masonry Units for Coating

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS

- A. Approved coating products supplied by Chemproof Polymers, 2750 Charles Page Blvd. Tulsa, OK 74127-8315
- B. Contact Jeff Glass at chemproof@sbcglobal.net or 918-584-0364 Fax 584-0366

2.4 COATING PRODUCTS

- A. PermaCoat 4000
- B. PermaCoat 4000 V

2.5 REINFORCEMENT PRODUCTS

- A. 5-12 oz. fiberglass cloth
- B. 20-40 mesh silica sand

PART 3 – EXECUTION

3.1 SUBSTRATE

- A. New concrete shall be cured per ACI 308, Recommended Practice for curing Concrete.
- B. New concrete should have a minimum of twenty eight (28) days cure at an average temperature of 73 degrees F prior to the application of the floor coating.
- C. The optimum finish for concrete surface to receive this floor coating is wood floating with one pass of a steel trowel. This procedure provides a surface that is relatively free of defects with the least amount of surface laitance. Excessive troweling or power troweling can result in greater amounts of laitance brought to the surface, resulting in difficulty during preparation.

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3.2 PREPARATION

- A. Prior to the application of coating, concrete surface shall be prepared by chemical and/or mechanical means, as dictated by jobsite conditions or as specified on the plans.
- B. When grease and oil deposits are present, a cleaner/degreaser should be utilized prior to the main preparation operation. Follow the decreasing operation with a thorough flushing of fresh water.
- C. Chemical surface preparation shall be in accordance with ASTM D-4260.
 - 1. Dilute the acid, one gallon acid to one gallon water and apply at a maximum spreading rate of 2 gallons of mixture per 100 square feet to obtain a total wetting of the surface. The solution shall be worked into the surface of the concrete by stiff bristle brushes until the bubbling action has subsided.
 - 2. A texture similar to that of 60-80 grit sandpaper should be present after the chemical preparation is complete and thoroughly washed from the surface. If it is not, the chemical etching process must be repeated.
 - 3. Test for neutral pH after the surface has been thoroughly washed and neutralized
- D. Mechanical surface preparation shall be in accordance with ASTM D-4259, Section 6 Mechanical Abrading Procedure, Section 7 Water Blast Cleaning or Section 8 Abrasive Blast Cleaning Procedure
 - 1. Abrasive Blast Cleaning procedure is the preferred method of preparing floor surfaces prior to coating, whenever practical. The use of a portable shotblasting machine is recommended.
- E. Verify substrates are dry prior to application.

3.3 PERMACOAT 4000 125-150 MIL GLASS REINFORCED LINING SYSTEM (HORIZONTAL AREAS)

- A. 1st Coat (Base Coat) - PermaCoat 4000 @ 60 S.F./Gal.
 - 1. Apply the PermaCoat 4000 to prepared concrete using notched or straight squeegees using a nap roller to evenly spread out the coating.
 - 2. As soon as an area is covered with the base coat and before it begins to set up, imbed a layer of 5-12 oz. Fiberglass cloth using a short nap or ribbed (serrated) roller to press the glass into the wet basecoat. Overlap edges of glass a min. of two inches.
 - 3. Mix and apply PermaCoat 4000 as needed as a saturate to make sure that all of the Fiberglass is wetted out using a medium nap roller. Glass reinforcement is saturated when the white appearance of the glass disappears.
 - 4. Allow to cure until tack free approximately 8 hours depending on the temperature.
- B. 2nd Coat – PermaCoat 4000 @ 75 S.F./Gal.
 - 1. After the 1st coat has cured and within 24 hours apply the 2nd coat.
 - 2. Apply the second coat @ 75 S.F./gal using a squeegee and back roll with a medium nap roller to evenly distribute the coating. As soon as the 2nd coat had been backrolled and before it begins to set up or gel, broadcast a clean and dry 20-40 mesh silica (typical Wedron 480) into the coating. Broadcast in a method such that the silica falls straight down into the PermaCoat 4000 so that ridges will be avoided. Continue to broadcast to excess, meaning that the area is “Whited Out” with silica and no wet resin is visible. This will take approximately .6 lbs silica per square foot.

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3. Allow the 2nd coat to cure until tack free, approximately 8-12 hours depending on the temperature, after the 2nd coat has cured, sweep up any loose or unanchored silica sand and remove.
 - C. 3rd Coat – PermaCoat 4000 @ 75 S.F./Gal.
 1. Repeat steps of 2nd coat.
 - D. 4th Coat (Topcoat) – PermaCoat 4000 @ 100 S.F./Gal.
 1. After sweeping and removing any loose silica from the 3rd coat the topcoat can be applied.
 2. Apply the 4th coat (topcoat) using a straight edge squeegee to spread the PermaCoat 4000 over the surface at approximately 100 S.F./Gal. Then backroll using a medium nap roller to evenly distribute the PermaCoat 4000 and remove any ridges or puddles.
 3. No silica broadcast is needed on the topcoat.
 - E. This system will yield a 125-150 mil finished coating system.
- 3.4 PERMACOAT 4000 V REINFORCED LINING SYSTEM (VERTICAL AREAS)
- A. 1st Coat (Base Coat) PermaCoat 4000 V @ 90 S.F./Gal.
 1. Apply the PermaCoat 4000 V to prepared concrete using a medium nap roller at approximately 90 S.F./Gal using a medium nap roller
 2. As soon as the area is covered with a base coat and before it begins to set up or gel, imbed a layer of 5-12 oz fiberglass cloth using a short nap or ribbed (Serrated) roller to press the glass into the wet basecoat. Overlap the edges of fiberglass a minimum of two inches.
 3. Mix and apply PermaCoat 4000 as needed as a saturate to make sure that all of the Fiberglass is wetted out using a medium nap roller. Glass reinforcement is saturated when the white appearance of the glass disappears.
 4. Allow to cure until tack free approximately 8 hours depending on the temperature.
 - B. 2nd Coat – PermaCoat 4000 V @ 100 S.F./Gal.
 1. After the 1st coat has cured and within 24 hours apply the 2nd coat.
 2. Apply the 2nd coat of PermaCoat 4000 V at 100 S.F./Gal. using a medium nap roller to evenly distribute the PermaCoat 4000 V.
 3. Allow the 2nd coat to cure tack free, approximately 8 hours depending on the temperature.
 - C. 3rd Coat – PermaCoat 4000 V @ 100 S.F./Gal.
 1. After the 2nd coat has cured tack free and within 24 hours apply the 3rd coat.
 2. Apply the 3rd coat of PermaCoat 4000 V at 100 S.F./Gal. using a medium nap roller to evenly distribute the PermaCoat 4000 V.
 3. Allow the 3rd coat to cure tack free, approximately 8 hours depending on the temperature.
 - D. 4th Coat – (Topcoat) – PermaCoat 4000 V @ 100 S.F./Gal.
 1. After the 3rd coat has cured tack free and within 24 hours apply the 4th coat.
 2. Apply the 4th coat of PermaCoat 4000 V at 100 S.F./Gal. using a medium nap roller to evenly distribute the PermaCoat 4000 V.

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- E. This will yield a final film thickness of 100-125 mils.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged surfaces before Substantial Completion

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, materials, tools, equipment and service for all concrete diamond polishing and sealer/densifier/hardener application as indicated, in accordance with provisions of Contract Documents.
- B. Furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to, or necessary for sound, secure and complete installation.

1.2 RELATED SECTIONS

- A. Section 03470 – Cast-In-Place Concrete: Concrete floor finishes.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics.
- C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- D. Maintenance Data: Include manufacturer's instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum conditions under anticipated use. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.
- E. Project information: Provide test reports, certificate of rate of application, and signed warranty.

1.4 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum 1 year documented experience approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.

1.6 DISPOSAL

- A. Owner will provide for disposal of debris and slurry generated. Utilize containers as provided.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperature required by manufacturer three days prior to, during, and 24 hours after installation of materials. Do not apply materials under adverse weather and temperature conditions.
- B. Comply with all VOC and EPA requirements.

1.8 WARRANTY

- A. Provide written warranty signed jointly by applicator, manufacturer and contractor.
- B. Warrant installation for a period of 10 years from date of substantial completion against dusting from abrasion.

PART 2 – PRODUCTS

2.1 OWNER PROVIDED PRODUCTS - None.

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2.2 CONTRACTOR PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.

2.3 MATERIALS

- A. LION HARD: Lithium Silicate concrete sealer, densifier and hardener manufactured by L&M Construction Chemicals Omaha, Nebraska.

2.4 POLISHING EQUIPMENT

- A. Field Grinding and Polishing Equipment:
 - 1. Variable speed, multiple head, counter-rotating, walk-behind machine with not less than 600 pounds of down pressure on grinding or diamond polishing pads.
- B. Edge Grinding and Polishing Equipment: Hand-held or walk-behind machines which produces same results, without noticeable differences, as field grinding and polishing equipment.
- C. Burnishing Equipment: High speed walk-behind or ride-on machines capable of generating 1000 to 2000 revolutions per minute and with sufficient head pressure of not less than 20 pounds to raise floor temperature by 20 degrees F.
- D. Metal Bonded Pads: Grinding pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.
- E. Resin Bonded Pads: Polishing pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.
- F. Burnishing Pads: Maintenance pads for use with high speed burnishing equipment.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify that surfaces are flat and surface finish meets manufacturer's requirements.
- C. Verify that concrete surface is properly cured (a minimum of 3 days) to meet manufacturer's requirements per ASTM D-4263 test method.
- D. Verify concrete is sound, clean, and visibly dry. Irregularities in the concrete should be filled.
- E. Beginning of installation means Contractor accepts existing conditions.

3.2 PREPARATION

- A. Check existing slab for oil, grease, and sealers that will inhibit bondability.
- B. The existing concrete surface shall be sandblasted, shotblasted, or shotblasted with vacuum clean up, removing any existing sealers and or membrane forming curing compounds.
- C. If degreasing is necessary, the concrete must be scrubbed with a cleaner/degreaser solution and thoroughly flushed with clean water. The concrete surface shall be tested by applying a 1 to 1 ratio of muriatic acid and water. Lack of bubbling indicates remaining grease or oil, and the concrete should be rescrubbed. Continue until the concrete passed the acid bubbling test.
- D. Protect surfaces, equipment, and embedded items that are not to receive floor finish.
- E. Follow manufacturer's instruction for floor preparation and product application.

3.3 POLISHING CONCRETE FLOORS

- A. Perform all polishing steps utilizing the wet method to minimize dust unless otherwise approved by the engineer.
- B. Initial Grinding:
 - 1. Use grinding equipment with metal bonded grinding pads.
 - 2. Begin grinding in one direction using sufficient size grit pad.
 - 3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass, up to 150 grit.
 - 4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
 - 5. Vacuum floor using squeegee vacuum attachment after each pass.
 - 6. Continue grinding until desired aggregate exposure is achieved.
- C. Treating Surface Imperfections:
 - 1. Mix patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface.
 - 2. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids.
 - 3. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not reasonably noticeable when viewed from 10 feet away under lighting conditions that will be present after construction.
- D. Apply Lion Hard concrete densifier, hardener and sealer in two phases according to manufacturer's instructions for use on diamond polished concrete.
 - 1. The air, concrete, and material temperatures should be 40 deg F and rising for application.
- E. Grout Grinding:
 - 1. Use grinding equipment and appropriate grit grinding pads.
 - 2. While applying fresh grout material prior to, grind concrete in direction perpendicular to initial grinding to remove scratches.
 - 3. Vacuum floor using squeegee vacuum attachment after each pass.
- F. Honing:
 - 1. Use grinding equipment with resin bonded grinding pads.
 - 2. Grind concrete in one direction starting with 50 grit pad and make as many sequential passes required to remove scratches, each pass perpendicular to previous pass, up to 400 grit pad reaching maximum refinement with each pass before proceeding to finer grit pads.
 - 3. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.
- G. Polishing:
 - 1. Use polishing equipment with resin bonded polishing and burnishing pads.
 - 2. Begin polishing in one direction starting with 800 grit pad.
 - 3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass, up to 3000 grit.

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4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
 5. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.
 6. Continue polishing until gloss appearance, as measured according to ASTM E 430 is achieved.
- H. Final Polish: Using burnishing equipment and finest grit burnishing pads, burnish to uniform sheen.
- I. Final Polished Concrete Floor Finish if not otherwise specified shall be Class A, Level 3.
1. Class A – Cream Finish: Polish portland cement paste resulting in little or no aggregate exposure.
 2. Level 3 – High Gloss Appearance:
 - a. Procedure: Not less than 6 steps with full refinement of each diamond pad up to 1500 grit resin bonded pad with one application of densifier.
 - b. Gloss Reading: Not less than 60 according to ASTM E 430 before polish guard application.

3.4 PROTECTION

- A. Prohibit traffic on floor finish per manufacturer's recommendations.
- B. Barricade area to protect flooring until cured.

END OF SECTION

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PART 1 - GENERAL**1.1 WORK INCLUDED**

- A. All supervision, labor, materials and equipment necessary to complete all surface preparation, prime, intermediate, finish and touchup painting of structural steel, metal fabrications, carpentry, doors, steel frames, masonry, gypsum board as specified herein.
- B. In addition to this section, all protective coating applications must comply with the following attached documents. These documents are also referenced below where applicable:
 - 1. 0000-SPC-09900013 Global Protective Coatings Specification. Europe and Asia painting standards are not included.
 - 2. 0000-STD-09900014 Protective Coatings Quality Assurance Standard
 - 3. 0000-STD-09900015 Global Protective Coatings Standard
- C. Protection of adjacent structures and facilities from overspray.
- D. Fire Wall Labeling
 - 1. All fire walls or barriers identified in the plans shall have stenciling to identify it.
 - a. Stenciling should be located between 48" and 72" from floor level. The stenciling (red) must include two items, the words "FIRE WALL" in six inches letters, and the rating such as "1 HOUR" in three inch letters below it.
 - b. Spacing of stenciling should be visible from anywhere in the room, assuring walls are labeled on both sides as well.
- E. Fire Extinguisher
 - 1. Interior walls or supports which will have fire extinguishers mounted to them shall be painted red to identify fire extinguisher location with a 2' wide x 7' high band as directed by the Owner's Representative.
- F. SS/EW target
 - 1. Paint black and yellow bullseye on the floor underneath Safety Shower Eyewash stations DC-80.
- G. Field touch-up work.
- H. All bolts and studs including hot dipped galvanized structural steel bolts but excluding Teflon-coated bolts/studs are painted after installation as long as the adjacent surface is painted.

1.2 RELATED SECTIONS

- A. Section 03415 Precast Concrete Planks
- B. Section 04200 Unit Masonry System
- C. Section 05120 Structural Steel
- D. Section 05210 Steel Joists
- E. Section 05311 Steel Floor and Roof Deck
- F. Section 05500 Metal Fabrications
- G. Section 06200 Finish Carpentry

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H. Section 08111 Standard Steel Doors and Frames

I. Section 09260 Gypsum Board Systems

1.3 REFERENCES

- A. ANSI/ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.
- C. Refer to Mechanical, Process, and Electrical Divisions for scope of painting and identification of mechanical, process, and electrical items.

1.4 DEFINITIONS

- A. Refer to the Drawings for areas that are to be painted.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to 0000-SPD-09900015 Global Protective Coatings Standard for coating material storage and protection requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Refer to 0000-STD-09900014 Protective Coatings Quality Assurance for coating atmospheric condition requirements.

1.2 QUALITY CONTROL

- A. Refer to 0000-STD-09900014 Protective Coatings Quality Assurance for coating quality control requirements.

PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None.

2.2 CONTRACTOR-PROVIDED PRODUCTS

- A. All materials, equipment, services, and labor required to perform the work of this section.
- B. When ordering materials and paint supplies make sure to get the corporate discount and volume purchase credit from the Owner's approved suppliers, if available.

2.3 MATERIALS

- A. Refer to 0000-SPC-09900013 Global Protective Coatings Specification for coating material requirements.
- B. Line striping on Roadways and Paved Areas:
 - 1. Traffic Marking Paint manufactured by Sherwin Williams, Rustoleum or Seal Master as follows:

Manufacturer/Supplier	Yellow	White	Red	Blue
Sherwin Williams	TM-2205	TM-2204	TM-2132	TM-2133
Rustoleum	2348402	2391402	2366402	2326402
Seal Master	M210	M200	M220	M230

PART 3 - EXECUTION**3.1 INSPECTION**

- A. Refer to the following:
 - 1. 0000-STD-09900014 Protective Coatings Quality Assurance Standard
 - 2. 0000-STD-09900015 Global Protective Coatings Standard
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless the moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent
 - 3. Concrete Floors: 12 percent
- E. Beginning of installation means acceptance of existing surfaces.

3.2 PREPARATION

- A. Correct minimum defects and clean surfaces which affect work of this Section.
- B. Provide temporary protection at mechanical, electrical, and process equipment not scheduled to be painted. Remove upon completion of painting work or as directed by Owner's Representative.

3.3 SURFACE PREPARATION

- A. Refer to the following:
 - 1. 0000-SPC-09900013 Global Protective Coatings Specification
 - 2. 0000-STD-09900014 Protective Coatings Quality Assurance Standard
 - 3. 0000-STD-09900015 Global Protective Coatings Standard
- B. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- C. Uncoated Steel and Iron Surfaces: Cleaning, degreasing, and removal of all mill scale, rust, oxides, and foreign matter
- D. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- E. If flash rusting occurs or if cleaned surfaces become wet or otherwise contaminated prior to painting, reclean to the degree specified.
- F. Masonry surfaces shall be brushed free of dust, dirt and other foreign matter and be completely dry prior to coating. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry. Verify cleaning materials with paint manufacturer for compatibility. All cleaned surfaces shall be primed immediately after cleaning is completed.

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- G. Galvanized surfaces shall have oil and grease removed by solvent cleaning or brush off blasting. Nonferrous metals specified to be coated shall be cleaned to remove all dirt, oil, and foreign particles from the surface prior to priming.
- H. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
- I. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.4 APPLICATION

- A. Refer to the following:
 - 1. 0000-SPC-09900013 Global Protective Coatings Specification
 - 2. 0000-STD-09900014 Protective Coatings Quality Assurance Standard
 - 3. 0000-STD-09900015 Global Protective Coatings Standard
- B. General
 - 1. Touch-up shop-applied prime coats which have been damaged, and touch-up bare areas prior to start of finish coats application.
 - 2. Apply finish coat prior to field installation.
 - 3. New paints are to be compatible with existing paints.
 - 4. Repair primer, if necessary. Cure primer fully per primer manufacturer's time-temperature curing curves prior to the application of fireproofing materials.
 - 5. Do not paint over fire rating labels
- C. Drying
 - 1. Allow sufficient drying time between coats, modifying the period as recommended by the material manufacturer to suit adverse weather conditions. Follow paint manufacturer's surface temperature and curing directions. When measuring skin temperature of hot or cold surfaces to determine compliance with manufacturer requirements, a contact-type thermometer must be used instead of an infrared gun.
- D. Brush Applications
 - 1. Brush out and work the brush coats onto the surfaces in an even film.
 - 2. Cloudiness, spotting, laps, brush marks, runs, sags, ropiness, and other surface imperfections are not acceptable.
- E. Spray Applications
 - 1. Confine spray applications to metal framework and similar surfaces where hand brush work would be inferior, except as otherwise approved by the Owner.
 - 2. Do not double back with spray equipment to build-up film thickness of two coats in one pass.

3.5 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

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- D. Remove empty paint containers from site.
- E. Upon completion of steel erection, provide necessary touch up painting of steel members.

3.6 COLOR SCHEDULE

- A. Refer to 0000-SPC-09900013 Global Protective Coatings Specification for color schedule including safety accent painting

3.7 ROADWAY LINE STRIPING SCHEDULE

- A. Unless noted otherwise on the drawings line striping shall be in accordance with the following schedule within the plant fenceline:

1.	Stop Line	White
2.	Centerline	White
3.	No Parking	Yellow
4.	Pedestrian Walkway	Yellow
5.	Parking Stalls	White
6.	Pavement Symbols	White

3.8 INSPECTION

- A. Refer to the following:
 - 1. 0000-STD-09900014 Protective Coatings Quality Assurance Standard

END OF SECTION

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TOILET AND BATH ACCESSORIES

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PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Toilet and bath, shower, washroom accessories
- B. Attachment hardware

1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Wood blocking for internal wall reinforcement.
- B. Section 09260 - Gypsum Board Systems: Sheet steel reinforcing for internal wall reinforcement.
- C. Section 10160 - Toilet Compartments: Toilet compartments and screens

1.3 REFERENCES

- A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible To and Usable by Physically Handicapped People
- B. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- D. ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- E. ASTM B456 - Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.4 PERFORMANCE REQUIREMENTS

- A. Coordinate installation locations to maintain required clear floor space (ADAAG 4.27.2), 48 inches by 30 inches.
- B. Coordinate installation height to maintain highest operable parts to be within reach ranges (ADAAG 4.27.3).
 - 1. Forward without Obstruction: 48 inches maximum
 - 2. Side without Obstruction: 54 inches maximum
- C. Operation of Controls and Operating Mechanisms: Operable with one hand without tight grasping, pinching, or twisting of wrist (ADAAG 4.27.4)
- D. Toilet Paper Dispensers: Do not control delivery (ADAAG 4.16.6).

1.5 SUBMITTALS

- A. Submit under provision of Section 01300.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

1.6 COORDINATION

- A. Coordinate the work of this section with the placement of internal wall reinforcement.

1.7 WARRANTY

- A. Furnish 10 year manufacturer's warranty for electric hand dryers.
- B. Furnish 15 year manufacturer's warranty for mirror glass and stainless steel mirror frames.

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TOILET AND BATH ACCESSORIES

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PART 2 - PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS

- A. The following items are furnished by Owner - Installed by General Contractor unless otherwise indicated.
 - 1. Paper Towel Dispensers
 - 2. Toilet Paper Dispensers
 - 3. Soap Dispensers

2.2 CONTRACTOR-PROVIDED PRODUCTS - All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS/SUPPLIERS

- A. Bobrick Washroom Equipment, Inc.
- B. McKinney/Parker
- C. Bradley Corporation
- D. Submit alternates to Owner for approval per submittal guidelines in Division 1.

2.4 ACCEPTABLE PRODUCTS

- A. Grab Bar: Bobrick B-6806
- B. Robe Hook: Bobrick B-6727
- C. Feminine Napkin Dispenser: Bobrick B-2706 25
- D. Feminine Napkin Disposal: Bobrick B-270 (Unless otherwise indicated, install one sanitary napkin receptacle in each water closet compartment in women's toilet rooms)
- E. Stainless-steel Shelf: Bobrick B-298x24
- F. Mirror: Bobrick B-165 2460
- G. Mirror with Shelf: Bobrick B-292 24"x36"
- H. Mop Rack: Bobrick B-223-36
- I. Utility Shelf: Bobrick B-298x24
- J. Soap Dish: Gamco MSA-5 (Install one in each shower)
- K. Hand Dryer: Xlerator XL-C 120v with 1:1 nozzle
- L. Seat Covers: Kimberly-Clark 09526
- M. SHOWER CURTAIN
 - 1. Shower curtains shall be opaque, matte white vinyl, 0.008-inch thick, containing antibacterial and flame-retardant agents, and shall have nickel-plated brass grommets along top. Bottom and sides shall be hemmed.
- N. SHOWER CURTAIN HOOKS
 - 1. Shower curtain hooks shall be 0.09-inch diameter, Type 304 stainless steel. Hooks shall be usable with 1-inch and 1-1/4-inch diameter shower curtain rods.

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TOILET AND BATH ACCESSORIES

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O. SHOWER CURTAIN ROD

1. Shower curtain rod shall be Type 304, 20-gage stainless steel tubing with satin finish and 1-inch outside diameter. Flanges shall be Type 304, 20-gage stainless steel with satin finish and drawn, one-piece, seamless construction.

2.5 Performance and Design Criteria: Design grab and attachments to resist minimum 250 lb concentrated load applied at any point in any direction.

2.6 ACCESSORIES

- A. Fasteners, Screws, and Bolts: Hot dip galvanized, tamperproof.
- B. Expansion Shields: Fiber, lead, or rubber as recommended by the accessory manufacturer for component and substrate.

2.7 FACTORY FINISHES

- A. Galvanizing: ANSI/ASTM A123 to 1.25 oz/sq yd
- B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- C. Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- D. Chrome/Nickel Plating: ANSI/ASTM B456, Type SC 2 satin finish.
- E. Stainless Steel: No. 4 satin luster finish.

2.7 KEYING

- A. Master key all accessories. Supply three (3) master keys to the Owner's Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive work and dimensions are as indicated.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site at appropriate time for building-in.
- B. Provide templates and rough-in measurements as required.
- C. Verify exact location of accessories for installation.

3.3 INSTALLATION

- A. Install fixtures, accessories, and items in accordance with the manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.

3.4 CLEANING

- A. Refinish abraded surfaces to match finish. Use materials and methods recommended by manufacturer.
 1. Repaired Surface: Uniform and free of color variation and surface texture variation from that of adjacent, like surfaces.
- B. Damaged Units: Replace components of the work that have been damaged or that have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Foundation work coordination including conduit embedded into leveler pit concrete and field preparation.
- B. Prefabricated steel framed leveler.
- C. Prefabricated steel truck restraint.
- D. Prefabricated dock sheltering device.
- E. Prefabricated dock bumpers.
- F. Operating controls, equipment and hardware.
- G. Field installation including coordination with electrical.

1.2 RELATED WORK

- A. Section 03300 - Cast-In-Place Concrete: Concrete Pit
- B. Section 05500 - Metal Fabrications: Pit Frame Edge Angles.

1.3 SEQUENCE OF OPERATION

- A. The normal sequence of operation shall be as follows:
 - 1. Driver shall back up to the dock when green light is flashing outside (red light is flashing inside).
 - 2. As the trailer backs into position, the rear impact guard contacts the spring-loaded structural steel housing. The housing rides down in its track, allowing the rear impact guard to move over the top of the housing.
 - 3. The vehicle restraining device shall be activated to engage the ICC bumper upon pressing the "raise" button on the push-button control stations. As the vehicle restraining device engages the bumper, the outside light shall change to flashing red and the inside light shall change to green.
 - 4. Overhead door is opened.
 - 5. When door is in raised position and push button is depressed, dock leveler shall automatically raise to full height and the lip extend and lock in place. When push button is released, dock leveler shall move downward and automatically stop upon contact with truck.
 - 6. Once the trailer is no longer required at the dock, an operator shall return the dock leveler to the storage position.
 - 7. The overhead door is closed.
 - 8. To disengage the vehicle restraining device, the "release" button in the push-button control station shall be pushed. When the vehicle restraining device disengages, the outside light shall change to green and the inside light shall change to red.
 - 9. Under no circumstances shall it be possible for the leveler lip to be in such position, when it is not serving a truck, that it could damage a vehicle (or be damaged by a vehicle) that is backing into position at the dock.
- B. In the event of an override situation where the vehicle restraining device could not find an ICC bar to restrain, the sequence of operation would be as follows:
 - 1. Visual flashing red light, both inside and outside, and audible alarm shall sound

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when abnormal hooking position exists or when no rear impact guard is present.

2. Coded alarm override shall allow communication, via the lighting system and an audible alarm, when abnormal hooking position exists or no rear impact guard is present. Override will turn off audible alarm and leave outside light red, with inside lights simultaneously red and green, indicating abnormal condition. Touch pad shall not function until code is re-entered to turn override off.
3. Secure the truck with wheel chocks in an override situation.

1.4 SUBMITTALS

- A. Submit information under the provisions of Section 01300.
- B. Shop Drawings: Indicate framed wall opening, dimensions and tolerances, adjacent construction and fittings required for anchorages, and anchor points. Indicate special embedment requirements and relation to adjacent work to accept work of this section. Indicate required opening dimensions, tolerances of opening dimensions, placement dimensions of safety lock device and perimeter conditions of construction.
- C. Product Data: Submit materials and finish, installation details, roughing-in measurements, operation of unit and safety lock device.

PART 2 PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS - None

2.2 CONTRACTOR-PROVIDED PRODUCTS

All materials, equipment, services, and labor required to perform the work of this section.

2.3 ACCEPTABLE DOCK LEVELER AND RESTRAINT MANUFACTURERS

- A. Rite-Hite Corporation: Model RHH5000 SAFE-T-LIP with DOK-LOK SHR-5000, rated for NEC Class 1, Division 2 where indicated on drawings.
- B. Kelley Company, Inc.: HHC Series with Barrier Lip - Heavy Capacity with The APS 2000™ rated for NEC Class 1, Division 2 where indicated on drawings.
- C. Blue Giant: Heavy Capacity Hydraulic Dock Leveler with Dock Lip Barrier, Strong Arm HVR303 vehicle restraint rated for NEC Class 1, Division 2 where indicated on drawings.

2.4 ACCEPTABLE DOCK SHELTER MANUFACTURERS

- A. Frommelt by Rite-Hite Corporation: Frommelt Eliminator™ - Gapmaster™ II Soft-Sided Dock Shelter - Model 610G.with Durathon™ Fabric.
- B. Kelley Company, Inc.: Flexframe™ Sealing Edge Dock Shelter with TS-55™ Wear Pleat Fabric.
- C. Blue Giant: Hingemaster dock shelter with Hi-Tear base fabric.

2.5 ACCEPTABLE DOCK BUMPER MANUFACTURERS

- A. Rite-Hite Corp.
- B. Kelley Company, Inc.
- C. Blue Giant

2.6 REQUIREMENTS OF OPERATION

- A. DOCK LEVELER EQUIPMENT
 1. Dock leveler to meet the following requirements:
 - a. Operation: Hydraulic with biodegradable hydraulic fluid.

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- b. Deck Size: 84 x 96 inches, unless noted otherwise furnished with 20" lip.
- c. Furnished with brush and rubber weather seals at leveler perimeter
- d. Operating Range: 12 inches above dock level, and 12 inches below dock level, unless noted otherwise
- e. Capacity: 50,000 lbs., unless noted otherwise.
- f. Combined leveler, vehicle restraint and overhead door push button controller.
- g. Deck/lip maintenance support bar with LO/TO provisions.

B. TRUCK RESTRAINT EQUIPMENT

- 1. Electrically operated truck restraint to following requirements:
 - a. Electrically operated hook to secure a truck ICC bar as low as 12 inches and as high as 31 inches from grade.
 - b. Operator control box with inside and outside communication system.
- 2. Safety equipment (communication system): Outside system with full-time flashing lights with signs to warn the truck driver when safe to back in or pull out; inside system with full-time flashing lights with signs that tell the dock attendant when it is safe to perform loading/unloading operations; warning to alert dock attendant when ICC bar is not properly engaged.

C. DOCK SHELTER MATERIALS

- 1. Stationary Dock Shelter
 - a. Base cover fabric for head and side panels shall be minimum 40 ounce vinyl and shall incorporate manufacturer's maximum available improved wear material.
 - b. Color: Black with Manufacturer's Standard Yellow Striping.
 - c. Front face of base cover fabric on side pads shall have 24-inch wide, 35-ounce armor pleats running full length of each shelter. Armor pleats shall have 6-1/2-inch exposure.
 - d. Head curtain shall include four overlapping armor pleats at each end.
- 2. Provide truck dock shelter at all loading docks.
- 3. Provide truck dock shelters with "NO WOOD". Shelter shall have a galvanized tubular-steel welded frame and flush steel mounting plates. Unit shall include tapered foam bottom pads and one pair of steel bumpers.
- 4. Provide anchors and accessories required for installation as standard with manufacturer.

D. DOCK BUMPERS

- 1. Steel-faced bumper shall be manufactured under pressure exceeding 1,500 pounds to absorb over 80 percent of the impact. Bumpers to be a minimum 4-inch by 11-inch by 24-inch.
- 2. Bumper shall have 3/8-inch angles or flat plates which shall be closed on each end with 3/4-inch tie rod.
- 3. Bumpers shall have a 3/8-inch steel plate equal to the rubber surface dimensions. Plate to be welded to two (2) steel support brackets which are extended back to the

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3/4-inch supporting rods. Brackets are punched with elongated holes to allow steel face to "float" upon impact.

4. Anchor leg of angle extends a minimum of 3 inches beyond the rubber surface at either end and contains 2-inch or 3-3/4-inch anchor bolt holes as required (anchor bolts are not supplied); finish for exposed metal parts is black shop primer.

PART 3 EXECUTION**3.1 PREPARATION**

- A. Verify that recess and wall openings are sized and aligned to tolerances.
- B. Verify that required anchors will fit and are compatible with sized openings.

3.2 DOCK LEVELER AND TRUCK RESTRAINT INSTALLATION

- A. Install dock leveler and mechanical safety vehicle lock unit in prepared pit in accordance with the manufacturer's instructions.
- B. Set square and level
- C. Anchor unit securely, flush with dock. Weld back of leveling dock to pit frame. Touch-up weld with primer.
- D. Anchor safety vehicle lock securely.
- E. Adjust unit for smooth and balanced operation.

3.3 CONTROLS

- A. Control Panel: Provide NEMA ICS 6, Type 12, oil-resistant enclosure with flange-mounted hinged door. Provide one of these panels for each dock position. Include the following:
 1. General: Mount electrical components inside enclosure to allow physical clearances sufficient for mounting, wiring adjustment, testing, and replacement. Arrange and orient each component so identification can be determined without moving component or its wiring. Use separately mounted terminal strips for power circuits and control circuits.
 2. Incoming Power Supply: 480 volt, 3 phase, 60 Hertz unless noted otherwise.
 3. Combination control panel shall be provided by the same manufacturer as the dock leveler and vehicle restraint. Combination control panel to have the following features:
 - a. Control panel shall provide for a single connection for the entire system. If the voltage requirements of the restraint or door are different than the dock leveler, manufacturer shall provide an internal step-down transformer.
 - b. Control panel shall provide the following operations: Control panel shall incorporate overhead door push buttons with Open, Close, and Stop to activate the locally supplied powered overhead door.
 - c. Control panel shall incorporate the additional components required to provide the desired interconnect and interlock package.
 - d. Control panel shall provide an integral rotary fused disconnect that allows compliance with OSHA lock-out/tag-out requirements and a protective guard to protect workers from accidental contact with incoming power. Disconnect to be located on load side of panel to provide power

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to combination control panel and the sectional overhead door motor (this will allow the disconnect to kill power to both control panels and dock door).

- e. Control panel to incorporate a selector switch allowing activation of the locally supplied dock light.
 - f. Control panel to incorporate an integral 15-amp duplex outlet.
 - g. The control panel shall be UL approved.
- B. Loading dock levelers, restraining devices, dock doors, control panels, and related electrical work to comply with NEC Class 1, Division 2.

3.4 DOCK SHELTER ERECTION

- A. Erect door shelter in accordance with the manufacturer's instructions and shop drawings.
- B. Attach anchors and fittings to prepared wall construction and opening frame.
- C. Use galvanized fasteners permitting site adjustment and alignment.

3.5 DOCK BUMPER INSTALLATION

- A. Install dock bumpers in accordance with the manufacturer's instructions.
- B. Bolt angle end frames to concrete or weld angle end frames to steel dock frame as required. Touch up weld with primer.

3.6 FINAL ADJUSTING

- A. After dock levelers are installed, a representative of the manufacturer shall test-demonstrate that the levelers operate properly under all conditions, in the proper sequence, and to full extent of the minimum range specified. Adjust leveler assembly, controls, and travel range, causing the return of the released leveler to be flush with the dock or pavement and level at all sides. Correct malfunctioning leveler, leveler component, or accessories to provide a fully operational dock leveler.
- B. Replace components or parts that are damaged during transport, storage, or installation.
- C. Paint exposed non-factory painted metal furnished as part of the leveler assembly, except as otherwise specified, with one rust-inhibitive prime coat and one finish coat of enamel.
- D. Adjust and lubricate dock leveler and dock lock operating components to work freely without binding.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment. Demonstrate operation of dock leveler and lock by use of a semitrailer.

3.8 CLEANING

- A. Refinish abraded surfaces to match finish. Use materials and methods recommended by manufacturer.
 - 1. Repaired Surface: Uniform and free of color variation and surface texture variation from that of adjacent, like surfaces.
- B. Damaged Units: Replace components of the work that have been damaged or that have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.
- C. Daily Cleaning: Do not permit rubbish or debris resulting from this work to accumulate at

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any time during installation.

- D. Final Cleaning: Upon completion of installation, clean finished surfaces as recommended by manufacturer. Discoloration of components will not be accepted as a result of improper cleaning.

END OF SECTION

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PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: Pre-engineered, shop fabricated structural steel building frame; insulated metal wall and sloped roof system including soffits, gutters and downspouts, and roof mounted equipment curbs. Drawings and general provisions of the Contract apply to this Section.

1.2 RELATED SECTIONS

- A. Section 03300 – Cast-In-Place Concrete
- B. Section 05120 – Structural Steel Framing
- C. Section 08111 – Standard Steel Doors and Frames
- D. Section 08712 – Door Hardware
- E. Section 08800 – Glazing

1.3 REFERENCES

- A. AISC 360- Specification for Structural Steel Buildings
- B. AWS D1.1 – AWS Structural Welding Code – Steel
- C. International Building Code (Governing Edition)
- D. ASCE 7 – Minimum Design Loads for Buildings and other Structures.
- E. American Society for Testing and Materials (ASTM)
 - 1. A36 – Carbon Structural Steel
 - 2. A242 – High-Strength Low-Alloy Structural Steel
 - 3. A653 – Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - 4. A1008 – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy
 - 5. B117 – Standard Practice for Operating Salt Spray (Fog).
 - 6. C553 – Specifications for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 7. C1036 – Flat Glass
 - 8. D522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
 - 9. D2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 - 10. D2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation.
 - 11. D3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
 - 12. D4214 – Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
 - 13. G153 – Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
- F. Metal Building Manufacturers Association (MBMA).
 - 1. Recommended Guide Specifications for Pre-Engineered Metal Buildings.
 - 2. Recommended Design Practices Manual.

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- G. National Fire Protection Association (NFPA), No. 220: Standard Types of Building Construction (2006).
- H. American Iron and Steel Institute (AISI):
 - 1. Light Gage Cold Formed Design Manual.

1.4 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.
- B. Bay Spacing: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured perpendicular to end or side wall (outside face of end-wall girt).
- C. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).
- D. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).
- E. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame, or knee).
- F. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).
- G. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.
- H. Professional Engineer: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who has a minimum of five years of experience in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal building systems that are similar to those indicated for this Project in material, design, and extent.
- I. Surveyor: A land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide a complete, integrated set of mutually dependent components and assemblies that form a steel building system of adequate stiffness and strength which is capable of withstanding specified structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, roof panels, and accessories complying with requirements indicated, including those in this Article.
- B. Building to be designed to the following codes and insurance requirements:
 - 1. Building Code: Governing building code of the authority having jurisdiction.
 - 2. ASCE 7 – Minimum Design Loads for Buildings and Other Structures
 - 3. Insurance: FM Global Data Sheets
 - a. 1-28 – Wind Design
 - b. 1-28R – Roofing Systems
 - c. 1-29 – Roof Deck Securement and Above-Deck Roofing Components
 - d. 1-31 – Metal Roof System

- e. 1-54 – Roof Loads for New Construction
- C. Provide roofing materials, components, and assemblies that meet the following criteria:
 - 1. Durability: Meet ASTM G 155 at 2000 hours exposure without change in (reinforcing) breaking strength.
 - 2. Fire Classification: Class A (ASTM E 108)
 - 3. Impact Resistance: Meet FM 4470, specifically Section 5.5 “Resistance to Foot Traffic”.
 - 4. Wind Resistance Classification: FM 1-90 (FM 4450 and FM 4470).
 - a. Hail Resistance: SH.
 - b. Install to withstand 90 mph peak gust or 25psf (EMTN Standards) whichever is greater.
- D. Provide roof specialties that meet the following criteria:
 - 1. Wind Resistance: Wind Zone for project location (FM Loss Prevention Sheet 1-49)
 - 2. Wind Resistance Classification: FM 1-90 (FM 4450 and FM 4470)
 - 3. SPRI RE-1, RE-2, RE-3: Tested to FM 1-90 equivalents
 - 4. Impact Resistance: Meet FM 4470, specifically Section 5.5 “Resistance to Foot Traffic”.

1.6 SUBMITTALS

- A. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - 1. Structural-steel-framing system.
 - 2. Metal roof panels.
 - 3. Metal wall panels.
 - 4. Metal liner panels.
 - 5. Insulation and vapor retarder facings.
 - 6. Flashing and trim.
 - 7. Accessories.
- B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Anchor-Bolt Plans
 - a. Submit anchor-bolt plans and templates at least 4 weeks before foundation bid package is issued to HSC. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Provide final column reactions for all loading cases at each location no later than four (4) weeks after bid is awarded. Also provide maximum and minimum reactions transferred by steel frame to the foundations.
 - b. Provide the Structural Engineer with the preliminary foundation loads within one (1) week of the award of bids. Also provide, with the loads, the minimum and maximum loads transferred to the foundation from the steel frame.

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- c. Provide column base plate shear keys designed per AISC Steel Design Guide Series 7 Industrial Buildings only for those columns where 2 anchor bolts out of the cluster of anchor bolts cannot transfer the full shear load in combination with their calculated uplift load. All columns will have grouted base plates.
 - 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 - a. Include provisions for attaching Intermediate Level and individual pipes.
 - 3. Metal Roof and Wall Panel Layout Drawings (Base Bid): Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including pipe supports and penetrations and lighting fixtures.
 - b. Show wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - d. Service walkways.
- C. Samples for Initial Selection: For units with factory-applied color finish.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Metal Panels (Base Bid): Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 - 2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
 - 3. Vapor-Retarder Facings: Nominal 6-inch- square Samples.
 - 4. Accessories: Nominal 12-inch- long Samples for each type of accessory.
- E. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Qualification Data: For qualified erector, manufacturer, and professional engineer. For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Owner's Representatives and Owners, and other information specified.
- G. Welding certificates.
- H. Metal Building System Certificates: For each type of metal building system, from manufacturer.

1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - a. Name and location of Project.
 - b. Order number.
 - c. Name of manufacturer.
 - d. Name of Contractor.
 - e. Building dimensions including width, length, height, and roof slope.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, and auxiliary loads (hoist monorails).
 - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
 - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
- I. Erector Certificates: For each product, from manufacturer. Signed by manufacturer certifying that erectors comply with requirements.
- J. Manufacturer Certificates: For each product, from manufacturer. Signed by manufacturers certifying that they comply with requirements. Include evidence of manufacturing experience.
- K. Material Test Reports: For each of the following products:
 1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shop primers.
- L. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- M. Source quality-control reports.
- N. Field quality-control reports.
- O. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
- P. Maintenance Data: For metal panel finishes include in maintenance manuals.
- Q. Warranties: Sample of special warranties.

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1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
 - 1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- F. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- G. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions.
 - 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for secondary roof framing conditions, including flatness and attachment to main structural members.
 - b. Structural limitations of secondary roof framing during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.

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3. Review methods and procedures related to metal wall panel assemblies (Base Bid) including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package panels for protection during transportation and handling.
- B. Unload, store, and erect panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store panels to ensure dryness, with positive slope for drainage of water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements:
 1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
 2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- C. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak proof, secure, and noncorrosive installation.

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1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Warranty on Panels: Written warranty, executed by manufacturer agreeing to repair or replace roof panels that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.
- C. Special Weathertightness Warranty for Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 OWNER-PROVIDED PRODUCTS – None.

2.2 CONTRACTOR-PROVIDED PRODUCTS – All materials, equipment, services, and labor required to perform the work of this section.

2.3 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Butler Manufacturing Company; a BlueScope Steel company.
 - 2. Nucor Building Systems.
 - 3. STAR Building Systems; an NCI company

2.4 METAL BUILDING SYSTEMS

- A. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
 - 1. Provide metal building system of size and with bay spacing, roof slopes, and spans indicated.
- B. Primary-Frame Type:
 - 1. Rigid Modular: Solid-member, structural-framing system with interior columns.
 - 2. Truss-Frame Modular: Truss-member, structural-framing system with interior columns.
 - 3. Lean to: Solid- or truss-member, structural-framing system without interior columns, designed to be partially supported by another structure.

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- C. End-Wall Framing: Provide Manufacturer's standard end-wall framing as indicated on drawings for the following types:
 - 1. End-wall framing not required to be expandable at ends, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns load-bearing end-wall and corner columns and rafters.
 - 2. Engineer end walls to be expandable at ends indicated on drawings. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed bypass girts.
- E. Eave Height: As shown on drawings.
- F. Bay Spacing: As shown on drawings.
- G. Roof Slope: As shown on drawings.
- H. Roof System: Manufacturer's standard trapezoidal-rib, metal roof panels with field-installed insulation, or manufacturer's standard foam-insulation-core metal roof panels. See drawings.
- I. Exterior Wall System: Manufacturer's standard tapered-rib, exposed-fastener metal wall panels with field-installed insulation or manufacturer's standard foam-insulation-core metal wall panels. See drawings.

2.5 METAL BUILDING SYSTEM PERFORMANCE

- A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual".
 - 1. Design Loads: As shown on drawings or as required by ASCE 7, whichever is greater.
 - 2. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/360 of the span.
 - b. Girts: Horizontal deflection of 1/240 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
 - d. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - 3. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
 - a. Lateral Drift: Maximum of 1/400 of the building height. Consider load combinations of Dead Load, Live Load, and Wind Loads (Larger of ASCE 7 loads, EMTN standard loads)
 - 4. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.

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- C. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 100 deg F.
- D. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft.
- E. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at static-air-pressure difference of 1.57 lbf/sq. ft.
- F. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft.
- G. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a wind-load design pressure of not less than 2.86 lbf/sq. ft.
- H. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class FM 1-90.
- I. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:
 - 1. Metal Roof Panel Assemblies:
 - a. R-Value: (R-19).
 - 2. Metal Wall Panel Assemblies:
 - a. R-Value: (R-13).

2.6 STRUCTURAL-STEEL FRAMING

- A. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
 - 2. The vendor supplied steel frame configuration shall utilize any of the following:
 - a. Roof Framing:
 - i. Rafter frames fabricated from joists and joist girders.
 - ii. Rafter frames fabricated from shop-welded, built-up steel plates or structural steel shapes.
 - iii. Rafter Type: Uniform depth or tapered.
 - b. Building Columns
 - i. Columns fabricated from round steel tubes, shop-welded built-up steel plates or structural steel shapes.

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- ii. Exterior Column Type: Uniform depth or tapered.
 - iii. Wind Column Type: Uniform depth or tapered.
 - iv. Column base plates: Column base plates shall have shear key plates designed per AISC Steel Design Series 7 Industrial Buildings only for those columns where 2 anchor bolts out of the cluster of anchor bolts cannot transfer the full shear load in combination with their calculated uplift load
 - v. Pinned Columns: All columns shall be designed as pinned bases unless noted otherwise. Fabricate from shop welded, built-up steel plates or structural steel shapes of size required to withstand design loads.
- B. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
- 1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 - 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded built-up steel plates or structural-steel shapes.
- C. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
- 1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch wide flanges or steel joists.
 - a. Depth: As needed to comply with system performance requirements.
 - 2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch wide flanges.
 - a. Depth: As required to comply with system performance requirements.
 - 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 - 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 - 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 - 6. Base or Sill Angles: Minimum 3-by-3-inch zinc-coated (galvanized) steel sheet.
 - 7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 - 8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from structural-steel sheet.
 - 9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.

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10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- D. Canopy framing where indicated: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
 1. Type: As required to comply with system performance requirements.
- E. Bracing: Provide adjustable wind bracing as follows:
 1. Rods: ASTM A 36; minimum 1/2-inch diameter steel; threaded a minimum of 6 inches at each end.
 2. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 3. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 4. Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 5. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- F. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated or hot-dip galvanized bolts for structural-framing components that are galvanized.
- G. Materials:
 1. W-Shapes: ASTM A 992, Grade 50.
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36.
 3. Plate and Bar: ASTM A 36; ASTM A 572, Grade 50.
 4. Steel Pipe: ASTM A 53, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
 6. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for primary framing.
 7. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, LH-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for secondary framing.
 8. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
 - a. Finish: Plain.

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9. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - a. Finish: Plain.
10. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with spline ends; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
11. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
 - a. Finish: Plain.
12. Unheaded Anchor Rods: ASTM F 1554, Grade 36 minimum.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A 36 carbon steel.
 - d. Washers: ASTM F 436 hardened carbon steel.
 - e. Finish: Plain.
13. Headed Anchor Rods: ASTM F 1554, Grade 36 minimum, ASTM A 307, Grade A.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A 36 carbon steel.
 - d. Washers: ASTM F 436 hardened carbon steel.
 - e. Finish: Plain.
14. Threaded Rods: ASTM A 36, ASTM A 307, Grade A .
 - a. Nuts: ASTM A 563 heavy-hex carbon steel.
 - b. Washers: ASTM F 436 hardened carbon steel.
 - c. Finish: Plain.
- H. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
 1. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.
 2. Prime galvanized members with specified primer after phosphoric acid pretreatment.
 3. Primer: SSPC-Paint 15, Type I, red oxide.

2.7 METAL ROOF PANELS

- A. Tapered-Rib-Profile, Lap-Seam Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

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1. Material: Zinc-coated (galvanized) steel sheet, 0.022-inch nominal thickness.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Major-Rib Spacing: 12 inches o.c.
 3. Panel Coverage: 36 inches.
 4. Panel Height: 1.5 inches.
- B. Materials:
1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
 - b. Surface: Smooth, flat finish.
- C. Finishes:
1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.8 METAL LINER PANELS

- A. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
1. Material: Zinc-coated (galvanized) steel sheet, 0.022-inch nominal thickness.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Major-Rib Spacing: 12 inches o.c.
 3. Panel Coverage: Minimum 36 inches.
 4. Panel Height: 1.25 inches.
- B. Materials:
1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
 - b. Surface: Smooth, flat finish.
- C. Finishes:
1. Exposed Coil-Coated Finish:

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- a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.9 METAL WALL PANELS

- A. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 1. Material: Zinc-coated (galvanized) steel sheet, 0.022-inch nominal thickness.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Major-Rib Spacing: 12 inches o.c.
 3. Panel Coverage: Minimum 36 inches.
 4. Panel Height: 1.25 inches.
- B. Materials:
 1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
 - b. Surface: Smooth, flat finish.
- C. Finishes:
 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.10 FOAM-INSULATION-CORE METAL WALL AND ROOF PANELS

- A. Description: Provide factory-formed and -assembled, metal wall and roof panels fabricated from two metal facing sheets and an insulation core foamed in place during fabrication, with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
 1. Concealed-Fastener, Foam-Insulation-Core Metal Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
 - a. Facings: Fabricate panel with exterior and interior facings of same material and thickness.

- b. Exterior Surface: See drawings.
 - c. Panel Coverage: Minimum 36 inches.
 - d. Panel Thickness: See drawings.
- B. Panel Performance:
- 1. Flatwise Tensile Strength: 30 psi when tested according to ASTM C 297.
 - 2. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at 140 deg F and 100 percent relative humidity according to ASTM D 2126.
 - 3. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at 200 deg F according to ASTM D 2126.
 - 4. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus 20 deg F according to ASTM D 2126.
 - 5. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. positive and negative wind load and with deflection of L/180 for two million cycles.
 - 6. Autoclave: No delamination when exposed to 2-psi pressure at a temperature of 212 deg F for 2-1/2 hours.
 - 7. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
- C. Polyisocyanurate Insulation-Core Performance:
- 1. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.
 - 2. Compressive Strength: Minimum 20 psi when tested according to ASTM D 1621.
 - 3. Shear Strength: 26 psi when tested according to ASTM C 273.
- D. Materials:
- 1. Polyisocyanurate Insulation: Modified polyisocyanurate foam using a non-CFC blowing agent, foamed-in-place or board type as indicated, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - 2. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
 - b. Surface: Smooth, flat finish.
- E. Finishes:
- 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

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2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.11 METAL SOFFIT PANELS (where indicated)

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
 1. Material: Zinc-coated (galvanized) steel sheet, 0.022-inch nominal thickness.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Major-Rib Spacing: 12 inches o.c.
 3. Panel Coverage: 36 inches.
 4. Panel Height: 1.25 inches.
- B. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch- wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.
 1. Material: Zinc-coated (galvanized) steel sheet, 0.028-inch.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Panel Coverage: 12 inches.
 3. Panel Height: 1 inch.

2.12 THERMAL INSULATION

- A. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.6-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- B. Unfaced Metal Building Insulation: ASTM C 991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.6-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- C. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96, Desiccant Method.
 1. Composition: White vinyl film facing 2 mil (0.002 inch), 6 x 6 fiberglass scrim reinforcement, and 1 mil (0.001 inch) metallized-polyester film backing.
 2. The glass fiber shall be flexible, resilient, odorless, incombustible, and shall not contribute to corrosion of steel or aluminum.
- D. Retainer Strips: 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.13 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible,

by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fascia, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or cross linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or cross linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Formed from 0.022-inch nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Formed from 0.022-inch nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating.

Trim head and jamb of door openings, and head, jamb, and sill of other openings.

- E. Gutters: Formed from 0.022-inch nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
 - 1. Gutter Supports: Fabricated from same material and finish as gutters.
 - 2. Strainers: Bronze or copper wire ball type at outlets.
- F. Downspouts: Formed from 0.022-inch nominal-thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.
 - 1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- H. Materials:
 - 1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 - b. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels.
 - c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 - 2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - 3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 - 4. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.14 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to evaluate product.

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- B. Testing: Test and inspect shop connections for metal buildings according to the following:
1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- C. Product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

2.15 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with base plates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
1. Make shop connections by welding or by using high-strength bolts.
 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 4. Weld clips to frames for attaching secondary framing.
 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with base plates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
1. Make shop connections by welding or by using non-high-strength bolts.

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2. Shop Priming and Painting: Prepare uncoated surfaces for shop priming and painting according to SSPC-SP 2. Shop prime and paint uncoated secondary framing with specified primer and paint after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 3. Promptly pack grout solidly between bearing surfaces and shear key plates (if applicable) so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

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- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 2. Locate and space wall girts to suit openings such as doors and windows.
 3. Locate canopy framing as indicated.
 4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Steel Joists and Steel Trusses or Joist Girders: Install joists, joist girders, steel trusses and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.
1. Before installation, splice joists delivered to Project site in more than one piece.
 2. Space, adjust, and align joists accurately in location before permanently fastening.
 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 4. Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
 5. Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
 6. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated

Note: No vertical bracing to be located in open bays, or open areas as shown on floor plans.

- J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 - 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 - 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
 - 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
 - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.

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3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - 1. Install ridge caps as metal roof panel work proceeds.
 - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
 - 1. Install clips to supports with self-drilling or self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 - 4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
 - 6. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge caps.
- C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
 - 1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 - 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 - 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 - 4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- E. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

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1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When two rows of metal panels are required, lap panels 4 inches minimum.
 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
 6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Install screw fasteners in predrilled holes.
 8. Install flashing and trim as metal wall panel work proceeds.
 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Insulated Metal Wall Panels: Install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint using concealed clip and fasteners at maximum 42 inches o.c., spaced not more than manufacturer's recommendation. Fully engage tongue and groove of adjacent insulated metal wall panels.
1. Install clips to supports with self-tapping fasteners.
 2. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels as weather seal.
- D. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet nonaccumulative, on level, plumb, and on location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.8 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.

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2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
1. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.9 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed

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within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Tie downspouts to underground drainage system indicated.
- E. Louver Framing: Locate and place louver framing level, plumb, and at indicated alignment with adjacent work.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.10 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Inspection of fabricators.
 - 2. Steel construction.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Tests and Inspections:
 - 1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

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- C. Touchup Painting: After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- E. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

ENGINEERING**SPECIFICATION**

REVISION NUMBER:	2.0	EFFECTIVE DATE:	02-DEC-2016
DOCUMENT TYPE:	Engineering	MANDATORY:	Yes
DISCIPLINE:	CIV-ARC	APPLICABLE SITES:	HSC
DOC CLASS:	SPC	ISSUED/OWNED BY:	HSC CSA Eng TL
DOC SUBCLASS:	SSG	STATUS:	Effective
SECURITY CLASS:	Internal	DOCUMENT NO:	HSG-SPC-09900013

TITLE: GLOBAL SPECIFICATION – PROTECTIVE COATINGS

Revision	Date	By	Description of Change
2.0	02-DEC-2016	M. Williams/S. Wegener	Revised contents to eliminate coatings information not specific to HSC site. Updated DC-20, DC-80, and DC-204 specs to match latest available information. Added DC-61 spec. Deleted DC-50. Added alternate coating specs back into document. General formatting upgrade.
	23-OCT-2014	Protective Coatings EET	Fix SSG Number in the footer (was missing a zero). No revision Change
1.0	19-DEC-2013	Protective Coatings EET	Incorporated comments from 30-day review and finalized for upload to EngDocs, replaces obsoleted document 0000-STD-09900013. Other revision tracking during development: On 18-NOV-2013: Issued for 30-day review prior to formal adoption, 24-OCT-2013: Attached all spec. sheets for coatings systems: Asia, Europe, and U.S., 21-OCT-2013: Updated document numbers, 27-AUG-2013: Draft of global coating specification, incorporated comments from initial review)

1. SCOPE

- 1.1. This document lists the required coatings systems for Hemlock Semiconductor facilities. It is intended for use by engineers, designers, and tradesmen to easily select and apply coating system specifications.
- 1.2. This document includes general information regarding what does and does not get coated, good practice for coating operations, surface preparation, mixing, and application. Further information can be found in reference SSGs (see Section 4. Related SSG Documents). Several provisions of this document are included to share learnings from previous coating projects.
- 1.3. This document does not include requirements for concrete coatings, namely those applied for corrosion resistance of containment slabs and structures.
- 1.4. This document does not include material or application requirements for intumescent fireproofing.
- 1.5. This document does not include requirements for internal lining of vessels or other continuous immersion services (e.g. agitators, tanks, or other wetted process equipment).
- 1.6. Note: Local standards supplementary to this standard may be permitted, but they must not be contradictory to or in any way lessen the requirements of this standard.
- 1.7. The entire scope of this document is Mandatory. Non-mandatory provisions are labeled as such.
- 1.8. In cases where the specification cannot be followed, refer to HSG-STD-00400003 Global Engineering Standard or Specification Variance Request Procedure.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**2. DISCUSSION**

2.1. General

- A. The attached tables are intended to assist designers in selecting the correct coating system for their specific application. There will be occasional instances where none of the documented systems are appropriate. This may be due to product unavailability, work in or around areas where incompatible coatings were previously applied, or other constraints dictated by plant or project conditions.
- B. In situations where selection of the correct coating system is unclear, or specified products cannot be used, consult with local coatings subject matter expert. Follow the Variance Request Procedure (item 1.6 above) as required.
- C. The Protective Coatings EET is continually evaluating our existing coatings systems for efficacy, ease of use, and cost efficiency. Suggestions for new or revised coatings systems should be brought to the attention of the local subject matter expert or Protective Coatings EET.

2.2. Work Included

- A. Furnish all supervision, labor, materials, and equipment necessary to complete all surface preparation, prime, intermediate, finish coating, and touch up coating after installation of all piping, equipment, structural steel and masonry, pipe supports, and pipe hangers as specified herein and on the line list.
- B. Coat pipe hangers and supports prior to installation.
- C. Coat instrument brackets and support structures.
- D. Coordinate timing with piping and structural steel contractor(s). Do not finish coat field welds until after the piping has been pressure tested. After testing has occurred, apply coating per touch-up procedure and manufacturer's datasheet.
- E. Lead Coating Awareness: Coatings that pre-date 1992 should be tested for lead content prior to removal. Contact site Industrial Hygienist to conduct this testing. Since 1992, U.S. coating manufacturers have not used lead containing pigments, nor lead chromate as a corrosion resistant pigment in primers. However, there are countries outside the U.S. that still use leaded pigments. The only other material where lead may be found is in zinc dust. In the US, manufacturers conform to ASTM D520 Type II, which permits no more than .005 ppm leachable lead, a quantity which is statistically unmeasurable.
- F. Minimum one coat inside pipe flange and equipment base plate bolt holes. Use first coat listed for relevant coating spec. No drips, runs or buildup allowed inside bolt holes.
- G. Blast and coat S-OP (typically, expanded metal that provides personnel protection from hot surfaces where insulation might previously have been used) on both sides.
- H. Except as noted below, all bolts, studs, and nuts are coated after installation as long as the adjacent surface is coated. PTFE-coated bolts, studs, and nuts should not be coated.

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2.3. Work Excluded

Component	Sandblast	Coat	Notes
flange faces and bolt holes	yes	yes	coat prior to flange assembly; protect gasket sealing surface
gasket sealing surfaces	no	no	
vessel anchor bolts/studs/nuts	no	yes	apply coating over factory-finish hot-dip galvanization
uncoated bolts/studs/nuts	no	yes	coat after leak check or hot torque
PTFE-coated bolts/studs/nuts	no	no	
valve bodies	no	yes	surface preparation using wire wheel or hand prep only
valve actuators, stems, packing bolts	no	no	do not coat any part except the valve body itself
aluminum-coated Kitz valves	no	no	
Keystone butterfly valves	no	no	factory finish: blue
Fisher control valves	no	no	factory finish: green actuator, valve varies
relief valves	no	no	coating is not required for factory-coated valves
non-valve instrumentation	no	no	

2.4. Storage and Protection – Refer to 09900015 Global Protective Coatings Standard.

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2.5. Coatings Specification Systems Summary

DC coating system No.	Description	Location/Duty	Service Temperature		Insulated	Coating type	Surface Preparation	Materials		
			°F	°C			SSPC SP-	1 st	2 nd	3 rd
DC-1A	Fast Dry Shop Application	Carbon Steel, Stainless Steel, Galvanized Steel	-20 to 200	-29 to 93	N	EpoxyHB/Polyurethane	1,6,7	Intercure 200HS	Interthane 990FD	
DC-1B	New Construction and Maintenance Application	Carbon Steel, Stainless Steel, Galvanized Steel	-20 to 200	-29 to 93	N	EpoxyHB/Polyurethane	1,6,7	Interseal 670HS	Interthane 990 HS	
DC-1C	HAPS-Free	Carbon Steel, Stainless Steel, Galvanized Steel	-20 to 200	-29 to 93	N	EpoxyHB/Polyurethane	1,6,7	Intertuf 262	Interthane 990HS	
DC-2	Brush and Roll Version of DC-1	Carbon Steel, Stainless Steel, Galvanized Steel	-20 to 200	-29 to 93	N	Epoxy HB/Isocyanate-free Acrylic	1,6,7	Interseal 670HS	Interfine 629HS	
DC-3	Low Temperature Applications of DC-1	Carbon Steel, Stainless Steel, Galvanized Steel - can be applied at temps. ss low as 35°F	-20 to 200	-29 to 93	N	Epoxy HB/Polyurethane	1,6,7	Interseal 670HS (LTC)	Interthane 990 HS (LTC)	
DC-5	Structural Steel and Equipment - Interior	Interior Applications in Non-Corrosive Environments I	Up to 200	-29 to 93	N	Alkyd	1,6,7	Interlac 789	Interlac 789	
DC-10	High Temperature	Carbon Steel, Stainless Steel, Chrome/Moly Alloy, and Copper	250 to 400 (wet/dry heat resistance)	121 to 204	Y or N	Phenolic Epoxy	1,6,10	Intertherm 228	Intertherm 228	
DC-11	2-Coat Epoxy	Carbon Steel, Stainless Steel, Galvanized Steel	-150 to 120	-101 to 49	Y or N	Epoxy HB	1,6,7	Interseal 670HS	Interseal 670HS	
DC-12	Acid Detecting	Water-Based Acid Detecting Coating for Piping and Equipment	-40 to 200	-40 to 93	N		1,2,3	White Primer #315	RAMCO On Guard Acid Detecting Coating	
DC-13	High Temperature	Non-Insulated Carbon Steel and Chrome/Moly Alloy	400 to 500	204 to 260	N	Zinc/Silicone Acrylic	1,10 (7)	Interzinc 22	Intertherm 875	
DC-14	Vessel Internals	Carbon Steel Vessel Internals	40 to 380	4 to 193		Vinyl Ester Resin	1,5,10	Carboline PLASITE 4310	Carboline PLASITE 4310	
DC-15	2-Coat Epoxy	Carbon Steel, Stainless Steel, Chrome/Moly Alloy, and Masonry	-150 to 250	-101 to 121	Y or N	Epoxy	1,7,10	Bar-Rust 235	Bar-Rust 235	
DC-16	Specialty Applications	Carbon Steel	0°F to 175	-18 to 79		Epoxy	1,10	Chesterton ARC S1	Chesterton ARC S1	
DC-17	New Construction and Maintenance Application – broader temp. range than DC-1	Carbon Steel, Stainless Steel, Galvanized Steel	-150 to 250	-101 to 121	N	EpoxyHB/Polyurethane	1,6,7	Bar-Rust 235	Devthane 379H	
DC-20	High Temperature	Carbon Steel, Stainless Steel, Chrome-Moly Alloy	400 to 1000	204 to 537	Y or N	Single-component polymeric	1,6,7	PPG Hi-Temp 1027	PPG Hi-Temp 1027	
DC-30	Masonry	Exterior/Interior Masonry, waterproofe system	Ambient	Ambient		Semi-Gloss Acrylic Finish		DeVoe Bloxfil 4000	DeVoe Devflex 4216HP	DeVoe Devflex 4216HP

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DC coating system No.	Description	Location/Duty	Service Temperature		Insulated	Coating type	Surface Preparation	Materials		
			°F	°C			SSPC SP-	1 st	2 nd	3 rd
DC-40	SS/EW	Safety Showers and Eyewashes				Safety Showers and Eyewashes		White semi-gloss enamel, undercoat, or primer/sealer	Day-GloSunbonded Brushing Coating 215-15 (Blaze Orange)	Day-Glo Sunbonded Filteray Type "D" Overcoat 215-08 (Clear)
DC-50	Primered Sheet Metal	Topcoat for Factory Primered Sheet Metal	-	-	-	Gloss Acrylic Finish	±	"Grip" primer	Intertherm 530	-
DC-60	Hot-service insulating coating for operator protection & energy retection	Carbon Steel, Stainless Steel	140 to 400	60 to 204	N	Insulating Acrylic	1,6,10	Intertherm 228	Mascoat DTI	
DC-61	Cold-service nsulating coating for condensation- and frost-prevention	Carbon Steel, Stainless Steel	-60 to 300	-51 to 149	N	Insulating waterborne epoxy	1,10	Carboline Carbomastic 615	Carboline Carbomastic 615	Carboline Carbotherm 551
DC-70	Stainless Steel	Stainless steel, stress-corrosion cracking prevention	-150 to 450	-101 to 232	Y or N	Amine-cured novolac epoxy	1,16	Carboline Thermaline 450	Carboline Thermaline 450	
DC-80	Non-Skid	Skid resistance on steel and concrete surfaces: for walkways, stairs, ladder rungs, grating, tops of tanks, some floor areas, or other areas where a non-skid surface is required.	Ambient	Ambient			1,6,7	Interseal 670HS (steel) Sherwin Williams Setfast (concrete)	American Safety AS-150 (steel) Sherwin Williams Setfast (concrete)	
DC-204	High-temperature and thermal cycling	Carbon Steel, Stainless Steel, Chrome-Moly Alloy	-321 to 750	-196 to 399	Y or N	Titanium-modified inorganic copolymer	1,6,10	Intertherm 751CSA	Intertherm 751CSA	
Alternate Coatings – Must Receive Written Approval from HSC Engineering Prior to Specification and Usage										
DC-101	Alternate for DC-1	See spec sheet.						Bar-Rust 235	Devthane 379UVA	
DC-102	Alternate for DC-2	See spec sheet.						Bar-Rust 235	Devran 229H	
DC-105	Alternate for DC-5	See spec sheet.						Devguard 4160	Devguard 4308	
DC-110	Alternate for DC-10	See spec sheet.						Devoe HT-403	Devoe HT-403	
DC-120	Alternates for DC-20	See spec sheet.						Multiple	Multiple	
DC-130	Alternate for DC-30	See specsheet.						Tru-Glaze-WB 4015	Devflex 4216	
DC-161	Alternate for DC-61	See spec sheet. Good for thermal cycling services						Carboline Thermaline 450	Carboline Thermaline 450	Carboline Carbotherm 551

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2.6. Procedures and Workmanship

- A. Floors and areas adjacent to coating operations shall be kept free from drips, spatters, and smears. All overlapping on uncoated surfaces or adjacent coatings of a different color shall be cleaned to the satisfaction of the Owner's Representative.
- B. Furnish flame-resistant protective drop cloths. No flammable or asbestos material is permitted.
- C. See 09900014 Protective Coatings Quality Assurance document for inspection and documentation requirements.
- D. Prior to grit blasting, water blasting, or spray coating, it is necessary to mask or provide other means of protection which will preserve the identification and operating condition of items against surface damage. In addition to the following specific items, protect any items as directed by the Owner's Representative.
 - 1. Glass:
 - a. Pressure gauges
 - b. Rotometers
 - 2. Nameplates and tags
 - a. Site specific property tag numbers
 - b. Manufacturer's name plates
 - c. Rupture disk identification tags
 - d. Relief valve plates and tags
 - e. Instrument tags
 - f. Pipe spool tags
 - 3. Machined surfaces
 - a. Valve stems
 - b. Sheaves
 - c. Flange face gasket sealing surfaces
 - e. All piping/components internals shall be protected during coating.
 - 4. Plastic-lined pipe
 - a. Do not coat weep holes in lined pipe.
 - b. Do not insert sharp objects into weep holes as this can damage the plastic lining, leading to failure and the potential for chemical release.
- E. After coating is complete, all means of protection such as drop cloths, visqueen, and masking shall be removed. Flange protectors shall remain in place until removed during start-up.

2.7. Surface Preparation Procedures – Refer to Society for Protective Coatings (SSPC) standards

- A. See also SSPC-VIS1 Guide and Reference Photographs for Steel Surfaces.
- B. SP-1: Solvent Cleaning and degreasing in accordance with SSPC SP-1: All surfaces to be coated prior to blast cleaning or hand cleaning.
- C. SP-2: Hand Tool Cleaning in accordance with SSPC SP-2. To be the minimum surface preparation for areas designated as “non-corrosive areas”. SP-1 required as a first step.

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- D. SP-3: Power Tool Cleaning in accordance with SSPC SP-3. Required to remove hard rust wherever simple hand tool cleaning is not adequate. Designated for use in "non-corrosive areas" only. SP-1 required as a first step. Some sites have had success using 3M Scotch-Brite Clean & Strip Discs Pads (Purple: Stock # 048011-25790 or Black: stock # 048011-00949). Do not use needle guns without prior written approval.
- E. SP-5: White Metal Blast Cleaning in accordance with SSPC SP-5. For high temperature and lining service surface areas. SP-1 required prior to blasting and thorough removal of all abrasive and foreign matter after cleaning is required. Vacuum cleaning vessels is mandatory before lining begins.
- F. SP-6: Commercial Blast Cleaning in accordance with SSPC SP-6. This specification requires total removal of all mill scale, rust, oxides and foreign matter. SP-1 required prior to blast cleaning. Color of steel shall be gray to near-white.
- G. SP-7: Brush-Off Blast Cleaning in accordance with SSPC SP-7. May be performed to remove hard rust to sound surface condition. This specification is ideal for laitance removal from concrete surfaces prior to coating for lining surface. SP-1 required as first step.
- H. SP-10: Near-White Metal Blast Cleaning in accordance with SSPC SP-10. Blast cleaning nearly to white metal cleanliness until at least 95% of each element of surface area is free of all visible residues. SP-1 required as first step. Swedish standard Sa2½ is equivalent.
- I. SP-11: Power Tool Cleaning to Bare Metal in accordance with SSPC SP-11. Power tool cleaning to produce a bare metal surface and to retain or produce a minimum 25 micrometer (1.0 mil) surface profile. SP-1 required as first step. Experience has shown success using 3M Scotch-Brite Clean & Strip Discs Pads (Purple: Stock # 048011-25790 or Black: stock # 048011-00949) or the MBX Bristle Blaster System. Do not use needle guns without prior written approval.
- J. SP-12: High-energy waterjetting in accordance with SSPC SP-12. Waterjetting using high-energy water (only) stream to strip off existing coatings and remove contaminants. To be used as a surface cleaning process only, not to create a surface profile.
- K. Alternate Surface Preparation: Water Blast Cleaning, Maintenance applications only. Min. 3500 psi water blast with oscillating head. To be used at discretion of engineering and owner's representative for recoat of existing carbon, stainless, and galvanized steel.
- L. Sa2.5: Near White Metal Blast cleaning. Comparable to SSPC SP-10.

2.8. Application/Execution

- A. Refer to documents 09900014 Protective Coatings Quality Assurance and 09900015 Protective Coatings Global Standard for additional information.
- B. Prepare, prime, and finish coat all newly constructed surfaces and those existing surfaces damaged during the course of construction.

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- C. All work shall be done by experienced coating applicators.
- D. Coat all surfaces immediately after surface preparations are complete.
- E. Apply coating materials evenly. Finished surfaces are to be free from sags, runs, crawls, and other film defects.
- F. Ensure that each coat is thoroughly dry prior to application of successive coats, in accordance with the Manufacturer's recommended recoat windows.
- G. Follow coating manufacturer's directions in mixing and applying coats.
- H. Do not thin coatings unless approved in writing by HSC Engineering.
- I. Tint intermediate coats of two or more successive applications of the same color sufficiently to produce enough contrast to indicate complete coverage. The tinting material is to be compatible with the coating and not detrimental to its service life.
 - 1. Apply light color primer under safety yellow.

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2.9. Color Schedule

Item	Color	Color Reference	Notes
Piping			
process and utility pipe; pipe supports	Temple Gray	International Color 88015	coating manufacturer's standard gray is also acceptable
instrument air piping identification	blue	International Color 71032	last 3' of drops + banding minimum every 100'
nitrogen piping identification	Vista Green	International Color 74130	last 3' of drops + banding minimum every 100'
natural gas piping identification	Mexican Orange	International Color 80700	banding only
breathing air piping	magenta	International Color 71386	
3.5% Ni piping with PWHT	Signal Green	International Color 71015	
fire sprinkler system piping	OSHA Safety Red	International Color 71007	
Equipment			
tanks, heat exchangers, columns	Temple Gray	International Color 88015	coating manufacturer's standard gray is also acceptable
compressors	white	International Color B000	
conveyors	white	International Color B000	
pumps	as supplied		
refrigeration units and other skid equipment	as supplied		
Infrastructure			
exterior structural steel, trusses, bents, building walls	Temple Gray	International Color 88015	
interior structural steel	white	International Color B000	
building trim	Autumn Brown	International Color 89484	
ladders + cages, handrails, equipment guards, thermal protection screening (S-OP), bollards, crane/hoist rails	OSHA Safety Yellow	International Color 71038	
Safety			
fire extinguisher identification	OSHA Safety Red	International Color 71007	
safety shower / eye wash steel	Blaze Orange	see DC-40 spec for color reference	
muster location, first aid kit, breathing air station, and gas mask location designation	OSHA Safety Green	International Color 71017	
radiation designation	OSHA Safety Purple	International Color 71009	

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2.10. Coatings Selection Matrix

Temp. Range		Service	Insulated	Uninsulated	Comments
General	Specific (°F)		U.S.	U.S.	
Ambient	-20 to 200	Steel, Pipe, Equipment		DC-1A	Shop Applied
	-20 to 200			DC-1B	New and Maint.
	-20 to 200			DC-1C	HAPS-free
	-20 to 200			DC-2	Brush/roll version of DC-1
	-20 to 200			DC-3	Low temp. DC-1 (can be applied at 35°F)
	-20 to 200			DC-5	Interior, non-corrosive envir.
	-40 to 200			DC-12	Acid-detecting
	0 to 175	Equipment		DC-16	Specialty
		Masonry		DC-30	
		Safety Showers		DC-40	
		Sheet Metal		DC-50	Over factory primer
		Non-skid		DC-80	Apply to steel and concrete surfaces
		Under Fireproofing		DC-11	
Cold to Ambient	-60 to 100	Pipe, Equipment		DC-61	Insulating coating for condensation and frost prevention
	-150 to 120		DC-11	DC-11	Alt. to DC-1 or DC-2 for interior structural steel, piping, and equipment
	-150 to 250		DC-15		
	-150 to 250			DC-17	
Ambient to Hot	40 to 380	Equipment	DC-14	DC-14	Internal Coating
Hot	140 to 400	Pipe, Equipment		DC-60	Insulating coating for operator protection or energy retention
	250 to 400		DC-20	DC-10	
	400 to 500			DC-13	
	400 to 750		DC-204	DC-204	Thermal cycling
	400 to 1000		DC-20	DC-20	Carbon, stainless, and alloy steels, copper
Cold to Hot	-150 to 450	Stainless Steel	DC-70	DC-70	Protection from stress corrosion cracking

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-1A, Fast Dry Shop Application**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL, NOT INSULATED.
 SERVICE TEMPERATURES -20°F TO 200°F. EPOXY HB/POLYURETHANE

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel, Galvanized Steel: Epoxy Primer/Polyurethane Semi-Gloss: A low-VOC two coat system consisting of a two component, epoxy based coating and a two component acrylic polyurethane finish.

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION. DO NOT USE A URETHANE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC SP-6 Commercial Blast Cleaning (New installation)
 SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Intercure 200HS	7.5-10	6-8	214
2ND	Interthane 990FD	3.5-5.3	2-3	457
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	8-11	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- This system is not to be used under insulation. See DC-15.
- Intercure 200HS is only available in Sand, Gray, and Red colors.
- The Interthane polyurethane is for U.V. protection of the epoxy and intended for outdoor exposures only. Due to the isocyanates in the polyurethane, use of it is site-restricted (some sites do not allow spray application of the polyurethane on site). It can be sprayed off-site only. See other DC-1 systems and DC-2 Maintenance Application for alternatives to this system. Proper PPE is required for all application methods.
- Do not apply Interthane 990FD at steel temperatures below 41°F.
- Application to PVC pipe requires SP-2 surface preparation.
- Highly corrosive environments sometimes warrant a 2-coat epoxy system (DC-11 or DC-15), despite potential for chalking. Consult coatings subject matter expert for guidance.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Base coat with Interseal 670HS and top coat with Interfine 629 HS for interior applications.
- Base coat with Interseal 670HS and top coat with Interthane 990 HS for exterior applications.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-1B, New Construction and Maintenance Application**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL, NOT INSULATED
 SERVICE TEMPERATURES -20°F TO 200°F. EPOXY HB/POLYURETHANE

1. SYSTEM DESCRIPTION:

Carbon Steel, Stainless Steel, and Galvanized Steel: Epoxy Primer/Polyurethane Semi-Gloss: A low-VOC two coat system consisting of a two component, high build surface tolerant epoxy and a two component acrylic polyurethane finish.

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION. DO NOT USE A URETHANE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC SP-6 Commercial Blast Cleaning (New installation)
 SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

ALTERNATE SURFACE PREPARATION:

Water Blast Cleaning (Recoat Existing & Galvanized Steel) (Min. 3500 psi water blast w/ oscillating head)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Interseal 670HS	4.9-12.2	4-10	263
2ND	Interthane 990 HS	3.0-4.4	2-3	545
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	6-13	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- This system is not to be used under insulation. See DC-15.
- The Interthane polyurethane is for U.V. protection of the epoxy and intended for outdoor exposures only. Due to the isocyanates in the polyurethane, use of it is site-restricted (some sites do not allow spray application of the polyurethane on site). It can be sprayed off-site only. See other DC-1 systems and DC-2 Maintenance Application for alternatives to this system. Proper PPE is required for all application methods.
- Application to PVC pipe requires SP-2 surface preparation.
- Highly corrosive environments sometimes warrant a 2-coat epoxy system (DC-11 or DC-15), despite potential for chalking. Consult coatings subject matter expert for guidance.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Base coat with Interseal 670HS and top coat with Interfine 629 HS for interior applications.
- Base coat with Interseal 670HS and top coat with Interthane 990 HS for exterior applications.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-1C HAPS-Free**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL, NOT INSULATED
 SERVICE TEMPERATURES -20°F TO 200°F. EPOXY HB/POLYURETHANE

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel, Galvanized Steel: Epoxy Primer/Polyurethane Semi-Gloss: A low-VOC two coat system consisting of a two component, corrosion inhibitive surface tolerant epoxy and a two-component acrylic polyurethane finish.

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION. DO NOT USE A URETHANE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC SP-6 Commercial Blast Cleaning (New installation)
 SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Intertuf 262	5.6-8.3	4-6	231
2ND	Interthane 990HS (Optional and Site-Restricted)	3.0-4.4	2-3	545
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	6-9	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- This system is not to be used under insulation. See DC-15.
- The Interthane polyurethane is for U.V. protection of the epoxy and intended for outdoor exposures only. Due to the isocyanates in the polyurethane, use of it is site-restricted (some sites do not allow spray application of the polyurethane on site). It can be sprayed off-site only. See other DC-1 systems and DC-2 Maintenance Application for alternatives to this system. Proper PPE is required for all application methods.
- Intertuf 262 is only available in Gray, Off-white, Red, Buff, and Black
- Intertuf 262 may also be top coated with Interfine 629HS, but 629HS is not HAPS-free.
- Interseal 670HS may be used as an alternate primer in cases where Intertuf 262 is unavailable.
- Application to PVC pipe requires SP-2 surface preparation.
- Highly corrosive environments sometimes warrant a 2-coat epoxy system (DC-11 or DC-15), despite potential for chalking. Consult coatings subject matter expert for guidance.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Base coat with Interseal 670HS and top coat with Interfine 629 HS for interior applications.
- Base coat with Interseal 670HS and top coat with Interthane 990 HS for exterior applications.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-2, Brush and Roll Version of DC-1**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL, NOT INSULATED.

SERVICE TEMPERATURES -20°F TO 200°F.

BUSH AND ROLL APPLICATIONS, EPOXY HB/ISOCYANATE-FREE ACRYLIC

1. SYSTEM DESCRIPTION:

This system is used as an alternative to DC-1. It is much better suited for brush and roll applications, when spray application is not permitted, but may be used in shop spray applications. The topcoat is an isocyanate-free material and protects the epoxy from ultraviolet degradation, wear, and splash-spill exposures.

Carbon Steel and Stainless Steel, Galvanized Steel: A low-VOC two coat system consisting of a two component, high-build surface tolerant epoxy and a two component acrylic topcoat.

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)

SSPC SP-6 Commercial Blast Cleaning (New installation)

SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Interseal 670HS	4.9-12.2	4-10	263
2ND	Interfine 629HS	3.1	2.0	521
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	6-12	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- This system is not to be used under insulation. See DC-15.
- Application to PVC pipe requires SP-2 surface preparation.
- Highly corrosive environments sometimes warrant a 2-coat epoxy system (DC-11 or DC-15), despite potential for chalking. Consult coatings subject matter expert for guidance.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Base coat with Interseal 670HS and top coat with Interfine 629 HS

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-3, Low Temperature Applications of DC-1**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL, NOT INSULATED
 SERVICE TEMPERATURES -20°F TO 200°F
 LOW TEMPERATURE APPLICATIONS, EPOXY HB/POLYURETHANE

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel: Epoxy Primer/Polyurethane Semi-Gloss: A low-VOC two coat system consisting of a two component, high-build surface tolerant epoxy primer and a two component polyurethane finish with low temperature curing (LTC) catalyst for applications at temperatures down to 35°F.

Galvanized Steel: A one coat finish coating of treated galvanized steel.

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION. DO NOT USE A URETHANE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC SP-6 Commercial Blast Cleaning (New installation)
 SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Interseal 670HS (LTC)	4.9-12.2	4-10	263
2ND	Interthane 990 HS (LTC)	2.9	2-3	545
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	6-13	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- The Interthane polyurethane is for U.V. protection of the epoxy and intended for outdoor exposures only. Due to the isocyanates in the polyurethane, use of it is site-restricted (some sites do not allow spray application of the polyurethane on site). It can be sprayed off-site only. See other DC-1 systems and DC-2 Maintenance Application for alternatives to this system. Proper PPE is required for all application methods.
- Highly corrosive environments sometimes warrant a 2-coat epoxy system (DC-11 or DC-15), despite potential for chalking. Consult coatings subject matter expert for guidance.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Base coat with Interseal 670HS and top coat with Interthane 990 HS (LTC).

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-5, Structural Steel and Equipment - Interior**

INTERIOR APPLICATIONS IN NON-CORROSIVE ENVIRONMENTS.
SERVICE TEMPERATURES UP TO 200°F . ALKYD SYSTEM.

1. SYSTEM DESCRIPTION:

Alkyd system for protection of structural steel and equipment. Limited to interior applications and non-corrosive areas such as warehouses and finishing buildings.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Cleaning (all)
SSPC SP-6 Commercial Blast Cleaning (new installation)
SSPC SP-7 Brush-off Blast Cleaning (re-coat existing equipment)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1 st	Interlac 789	6.4	4	253
2 nd	Interlac 789	6.4	4	253
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	8	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- When applied over galvanized substrates, use SP-3 surface preparation and a base coat of 2-3 mils of Interseal 670HS.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Single coat with Interlac 789.

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DC-10, High Temperature

CARBON STEEL, STAINLESS STEEL, CHROME/MOLY ALLOY, AND COPPER, INSULATED.
SERVICE TEMPERATURE 250°F TO 400°F (WET/DRY HEAT RESISTANCE). PHENOLIC EPOXY

1. SYSTEM DESCRIPTION:

Amine cured epoxy phenolic. Suitable for buried service. This material has excellent resistance to thermal shock experienced during rapid temperature cycling. This material requires 50°F to cure. This system is usable for insulated carbon steel and alloy pipe and equipment operating between -100°F and 400°F. **This system should be used in cases where DC-15 spec cannot be met (ex: 250°F < op. temp. < 400°F).**

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
SSPC SP-6 Commercial Finish (Uninsulated Steel Surfaces)
SSPC SP-10 Near White Finish with 2-3 mil profile. (Insulated Steel Surfaces)

3. MATERIALS, COVERAGE

Coat	Material Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Intertherm 228 HS	5.7-8.6	4.0 - 6.0	269
2ND	Intertherm 228 HS	5.7-8.6	4.0 - 6.0	269
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	8 – 10** (max 12)	

4. PRODUCT APPLICATION PARAMETERS

- Alternate coatings must receive prior written approval from coatings subject matter expert.
- All applications are to be in accordance with the manufacturer's latest product data sheets.
- **Maximum film build for 2 coats of Intertherm 228 **shall not exceed 12 mils DFT**. Thermal cycling conditions lead to premature coating failures in conditions of excessive thickness.
- Intertherm 228 is available in only a limited range of colors (gray).
- Past experience has shown that proper millage can be achieved for Intertherm 228 using brushes, rollers, and conventional sprayers in place of airless sprayers.
- While this coating will chalk over time this chalking is not detrimental to the coating performance.

5. TOUCH-UP

- Surface preparation to be SP-11.
- Base coat and top coat with Intertherm 228.
- Touchup of in-service hot piping and equipment may require the use of an alternate coating. Consult with HSC Engineering.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-11, 2-Coat Epoxy**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL, INTERIOR
SERVICE TEMPERATURES -150°F TO 120°F, EPOXY HB

1. SYSTEM DESCRIPTION:

This two-coat epoxy system is an alternative to DC-1 and DC-2 for interior structural steel, pipe, and equipment not exposed to UV. DC-11 is an alternate to DC-3 for cold weather applications.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
SSPC SP-6 Commercial Blast Cleaning (New installation)
SSPC SP-7 Brush-off Blast Cleaning (Recoat existing)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Interseal 670HS	4.9-12.2	4-10	263
2ND	Interseal 670HS	4.9-12.2	4-10	263
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	8-20	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Application to PVC pipe requires SP-2 surface preparation.
- Alternate coatings must receive prior written approval from coatings subject matter expert.
- One coat of 670HS at 3 mils DFT is acceptable as primer under Chartek 1709 fireproofing.

5. TOUCH-UP

- Surface preparation to be SP-3.
- Base coat and top coat with Interseal 670HS.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-12, Acid Detecting**

WATER BASED ACID DETECTING COATING FOR PIPING & EQUIPMENT
 SERVICE TEMPERATURES -40°F TO 200°F

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel: RAMCO ON GUARD acid detecting coating is an industrial coating with an acid-sensitive component. The surface changes from yellow to red/purple when exposed to acid or acid vapors pH 3 or lower. The coating is an acrylic modified alkyd enamel. Latex primer such as White Primer #315 should be used under RAMCO ON GUARD.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC SP-2 Hand tool Cleaning (New Applications)
 SSPC SP-3 Power tool cleaning (New Applications or Recoat existing)
 In case of existing applications use a transition coating or scuff-sand overly smooth surfaces for best adhesion.

Note: Can be used over existing coating if the user is assured that the sub coating is stable and the surface is clean, dry, and free of rust, dust, oil and contamination. Degrease, SSPC SP-1 prior to SSPC SP-7. Prime while free of rust bloom. REMOVE ALL MILL SCALE.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	RAMCO ON GUARD White Primer #315	4-7	2-3.5	295
2ND	RAMCO ON GUARD Acid Detecting Coating	8.5	4.0	250-300
¹ Coverage values are theoretical; allow for surface irregularities and application losses. Coverage can be achieved with 2-3 brush coats.		DFT Range (min-max)	6-7.5	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- THIS SYSTEM IS NOT TO BE USED UNDER INSULATION.
- The RAMCO ON GUARD is intended for outdoor exposures as well as indoor.

5. TOUCH-UP

- Surface preparation to be SP-3 minimum.
- Base coat with White Primer #315 and top coat with RAMCO On Guard Acid Detecting Coating

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-13, High Temperature**

NON-INSULATED CARBON STEEL AND CHROME/MOLY ALLOY
 SERVICE TEMPERATURES 400°F TO 500°F. ZINC/SILICONE ACRYLIC.

1. SYSTEM DESCRIPTION:

This two-coat system is usable for non-insulated carbon steel and alloy pipe and equipment operating between -20°F and 500°F. **This system is similar to DC-10 and should be used in cases where DC-10 spec cannot be met (ex: 400°F < op. temp. < 500°F).**

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC-SP-10 Near-White Blast Cleaning (New installation)
 SSPC-SP-7 Brush-off Blast Cleaning (Recoat existing)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Coverage 1 Sq. Ft./Gal.
		Wet	Dry	
1ST	Interzinc 22	3.2-5.1	2-3.2	337
2ND	Intertherm 875	2.6-4.1	1-1.6	417

¹ Coverage values are theoretical; allow for surface irregularities and application losses.

DFT Range (min-max)	3-4.8
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4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Spraying is preferred application method for Interzinc 22. Do not apply with brush or roller.
- Do not apply Intertherm 875 with airless sprayer.
- Intertherm 875 is available in only White, Black, and Aluminum colors. Use aluminum unless specifically directed otherwise.
- At relative humidity below 55%, curing will be retarded for Interzinc 22. Consult manufacturer.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 or SP-3 with a maximum 1-2 mil surface profile.
- Base coat and top coat with Intertherm 875.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-14, Vessel Internals**

CARBON STEEL VESSEL INTERNALS

SERVICE TEMPERATURES 40°F TO 380°F. VINYL ESTER RESIN

THIS SYSTEM IS ONE POSSIBLE VESSEL LINING. CONSULT WITH HSC ENGINEERING TO CONFIRM WHETHER THIS SYSTEM IS APPROPRIATE FOR INTENDED USE.

1. SYSTEM DESCRIPTION:

This system is usable for internal coating of carbon steel equipment operating between 40°F and 380°F. It is intended as a highly chemical-resistant thick film for tank lining service and as a maintenance coating for severe exposure and abrasive conditions. This is a two (2) coat system with no primer needed.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC-SP-5 White Metal Blast Cleaning with 4.0 mil surface profile.
 SSPC-SP-10 Near-White Blast Cleaning (Recoat existing)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Coverage 1 Sq. Ft./Gal.
		Wet	Dry	
1ST	Carboline PLASITE 4310	18.4-23.7	17.5-22.5	55
2ND	Carboline PLASITE 4310	18.4-23.7	17.5-22.5	55

¹ Coverage values are theoretical; allow for surface irregularities and application losses.

DFT Range (min-max)	35-45
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4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- HSC application experience has shown that a surface profile of 2.0-3.0 mils using site-standard Starblast abrasive media provides suitable surface preparation without affecting pipe and vessel cleanliness and purity requirements in quality-sensitive process areas.
- Surface must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminations that could interfere with adhesion of the coating.
- Carboline PLASITE 4310 can handle brief temperature excursions to 460°F.
- Carboline PLASITE 4310 is available only in Charcoal Gray.
- Brush application is not recommended, but may be used for repairs or touch-up.
- International also offers Ceilcote 282AR Flakeline for tank lining application. SSPC SP-5 surface prep, 370HT primer, and 282AR topcoat for final DFT of 30-50 mils. Consult with HSC Engineering if these or alternate coatings are desired.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-10 minimum, feathering edges per manufacturers data sheet.
- Base coat and top coat with PLASITE 4310.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-15, 2-Coat Epoxy**

CARBON STEEL, STAINLESS STEEL, AND CHROME/MOLY ALLOY, AND MASONRY,
SERVICE TEMPERATURES -150°F TO 250°F, EPOXY

1. SYSTEM DESCRIPTION:

This system is usable for insulated carbon steel and alloy pipe and equipment operating between -150°F and 275°F. It is not suitable for cyclical service above 250°F. It can also be used on structural steel and uninsulated pipe and equipment in interior applications (not rated for UV exposure). Do not insulate if operating over 120°F.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
SSPC-SP-10 Near-White Blast Cleaning (New installation)
SSPC-SP-7 Brush-off Blast Cleaning (Recoat existing)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Coverage 1 Sq. Ft./Gal.
		Wet	Dry	
1ST	BAR-RUST 235	5.9-11.8	4.0-8.0	170
2ND	BAR-RUST 235	5.9-11.8	4.0-8.0	170
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	8-16	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- While contradictory to the manufacturer's data sheet, this coating can be used at temperatures to 275°F in areas without significant thermal cycling.
- Spraying is preferred application method for BAR-RUST 235.
- Bar Rust 235 is available in red, white, black, buff, gray, and Temple Gray (finish coat).
- While this coating will chalk over time this chalking is not detrimental to the coating performance.
- Some discoloration may be noted if BAR-RUST 235 is heated above 235°F and is not detrimental to the coating performance.
- As an alternative for extended recoat window, 2 coats of BAR-RUST 231 may be used.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Base coat and top coat with BAR-RUST 235.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-16, Specialty Applications**

CARBON STEEL

SERVICE TEMPERATURES 0°F TO 175°F, EPOXY

1. SYSTEM DESCRIPTION:

This system is intended for steel surfaces and is only used in special applications. 2 component modified epoxy resin with polyamidoamine curing agent. This system is NOT to be used for structural steel or piping. Contact coatings subject matter expert for limited cases where this system is applicable. Example: refer to HSC drawing # HW1-39908.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
SSPC-SP-10 Near-White Blast Cleaning (New installation)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Chesterton ARC S1PW	10-15	10-15	160
2ND	Chesterton ARC S1PW	10-15	10-15	160
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	20-30	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Chesterton ARC S1 is available in light gray/white (primer) and blue (finish coat) only. Do not tint.
- Chesterton ARC S2 may be used as an alternative coating in some cases.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-10.
- Base coat and top coat with Chesterton ARC S1.

ENGINEERING

SPECIFICATION

REVISION NUMBER: 2.0

EFFECTIVE DATE: 02-DEC-2016

DC-17, New Construction and Maintenance Application

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL, UNINSULATED
SERVICE TEMPERATURES -150°F TO 250°F. EPOXY HB/POLYURETHANE

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel: Epoxy Primer/Epoxy H.B. Semi-Gloss: A two (2) coat system consisting of a two-component, high-build surface tolerant epoxy primer and a two-component polyurethane finish. **This system should be used in cases where DC-1 spec cannot be met (ex: -150°F < op. temp. <-20°F or 200°F < op. temp. <250°F).**

Galvanized Steel: A (1) coat finish coating of treated galvanized steel.

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION. DO NOT USE A URETHANE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)

SSPC SP-6 Commercial Blast Cleaning (New installation)

SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Bar-Rust 235	5.9-11.8	4.0-8.0	170
2ND	Devthane 379H	2.9-4.4	2.0-3.0	401
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	6-11	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- The Devthane polyurethane is for U.V. protection of the epoxy and intended for outdoor exposures only. Due to the isocyanates in the polyurethane, use of it is site-restricted (some sites do not allow spray application of the polyurethane on site). It can be sprayed off-site only. See other DC-1 systems and DC-2 Maintenance Application for alternatives to this system. Proper PPE is required for all application methods.
- Brushing and rolling with Bar-Rust 235 may require additional coats to achieve required thickness.
- The use of the 70A0000 low temperature accelerator for the Devthane 379H is at the discretion of the coatings subject matter expert. With the accelerator this coating can be applied to 20°F as long as the surface temperature is 5°F above the dew point.
- Devthane 379H is available in white and custom colors. See section 2.9.
- This system is not to be used under insulation. See DC-15.
- Highly corrosive environments sometimes warrant a 2-coat epoxy system (DC-11 or DC-15), despite potential for chalking. Consult coatings subject matter expert for guidance.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

5. TOUCH-UP

- Surface preparation to be SP-2 minimum.
- Base coat with Bar-Rust 235 and top coat with Devthane 379H.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-20, High Temperature**

CARBON STEEL, STAINLESS STEEL, AND CHROME MOLY ALLOY

SERVICE TEMPERATURES 400°F TO 1000°F. HIGH TEMPERATURE POLYMERIC COATING

ALSO CRYOGENIC SERVICE (-320°F)

1. SYSTEM DESCRIPTION:

For steel surfaces, one-component inert polymeric coating. Air temperature cure. Suitable for insulated and uninsulated carbon steel, chrome moly steel, and stainless steel pipe and equipment operating between -320°F and 1000°F. Suitable for cycling and cryogenic services. **For high temp service, this system should be used only in cases where DC-10 spec cannot be met (ex: 400°F < op. temp. < 1000°F).**

2. SURFACE PREPARATION

SSPC SP-1 Solvent Clean (All)
 SSPC SP-6 Commercial Blast Cleaning, 1.0-2.0 mil profile (carbon/alloy steel)
 No anchor profile (stainless steel)
 SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS AND COVERAGE:

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	PPG Hi-Temp 1027	6.9-8.3	5.0-6.0	231
2ND	PPG Hi-Temp 1027	6.9-8.3	5.0-6.0	231
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	10-12	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- This product is intended to be self priming. DO NOT use a different primer without first consulting HSC Engineering.
- Alternate coatings must receive prior written approval from HSC Engineering.
- Because we have limited experience and data on the performance of these coatings, it is important to capture within the SAP FL the coating product(s) used. This will allow us to track performance, durability, and longevity of the different systems, leading to specification improvements.
- For uninsulated applications, stencil application date, surface prep, product used, and applicator/contractor.
- For insulated applications, stencil or apply stick-on label with date, surface prep, product used, and applicator/contractor.
- Regarding narrow DFT ranges, consult HSC Engineering – it may be possible to work with the manufacturer to extend application ranges depending on service and application temperatures

5. TOUCH UP

- Surface prep to be SP-2 minimum.
- Topcoat with PPG Hi-Temp 1027.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-30, Masonry**EXTERIOR/INTERIOR MASONRY
WATERPROOF SYSTEM, SEMI-GLOSS ACRYLIC FINISH**1. SYSTEM DESCRIPTION:**

Waterborne Acrylic finish: A two-coat system consisting of an acrylic prime coat and a single component semi-gloss acrylic finish. For exterior and interior masonry block and precast concrete.

2. SURFACE PREPARATION:

New Work: Remove mortar tags and foreign matter from surface. Allow concrete or masonry to cure 30 days (temperature >50F) before coating. High pressure wash to a clean condition.

Recoating: Remove mortar tags and foreign matter from surface. High pressure wash to decontaminate and remove chalk to a clean condition. Recoat dry surface with the finish coating.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	DeVoe Bloxfil 4000	15.5-32.0	7.0-14.5	50-100
2ND	DeVoe Devflex 4216HP	4.0-11.6	1.5-4.0	384
3RD	DeVoe Devflex 4216HP	4.0-11.6	1.5-4.0	384
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	10.0-22.5	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Alternate coatings must receive prior written approval from coatings subject matter expert.
- Do not coat caulk.
- Note: TRU-GLAZE-WB 4015 may be needed as alternate primer on porous block. Failure to adequately prime substrate may result in coating failure. Reference DC-130 and consult with HSC Engineering for instances of very porous block.
- Measure and record substrate moisture levels and pH prior to applying coating.
- Precast Concrete
 - For clean surfaces: Brush and sand as needed to roughen surface. Use no water.
 - For all other surfaces: High pressure wash to decontaminate and remove chalk to a clean condition.
 - Base coat with Bond Prep 3030 and top coat with Fortis 350.

5. TOUCH-UP

- Touch-up per original application guidelines.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-40, SS/EW**SAFETY SHOWERS & EYEWASHES
BLAZE ORANGE**1. SYSTEM DESCRIPTION:**

Single-component, semi-transparent, fluorescent, brush-on alkyd.

2. SURFACE PREPARATION:

Best applied over white semi-gloss enamel, undercoat, or primer/sealer.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	White semi-gloss enamel, undercoat, or primer/sealer.	NA	NA	NA
2ND	Day-Glo** Sunbonded Brushing Coating 215-15 (Blaze Orange)		1.5	250
3RD	Day-Glo Sunbonded Filteray Type "D" Overcoat 215-08 (Clear)***		1.5	250
4TH	Day-Glo Sunbonded Filteray Type "D" Overcoat 215-08 (Clear)***		1.5	250
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		Minimum Total D.F.T.	4.5	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- ** "Day-Glo" is the company name; distributed by Sherwin-Williams.
- ***Filteray Type "D" is not recommended for interior use where coatings are exposed to black light or artificial ultraviolet light sources; intended for UV protection on exterior applications.

5. TOUCH-UP

- Touch-up per original application guidelines.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-60, Hot-Service Insulating****CARBON STEEL AND STAINLESS STEEL**

140°F TO 400°F FOR OPERATOR PROTECTION & ENERGY RETENTION. CERAMIC & SILICA BASED ACRYLIC

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel: Ceramic and Silica based insulating coating provide insulating barrier, personnel protection, and corrosion blocking under insulation (CUI). This coating is water based low-VOC multi coat based on operating temperature. There is no upper limitation for number of layers. Mascoat DTI is a composite ceramic insulator providing thermal protection and can be applied to surfaces that operate up to 400°F.

This coating is not intended for applications where heat dissipation is required.

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)

SSPC SP-10 Near White Metal Blast Cleaning for carbon steel (new installation)

Mascoat DTI is self-priming over non-ferrous metals. For carbon steel, surface must be primed with Intertherm 228. For existing pipe or equipment, solvent cleaning (SP-1) or water blast cleaning is usually sufficient.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Intertherm 228	6-8	4-6	250
2ND	Mascoat DTI (for number of layers see chart below)	20-24*	16-20	50-55
¹ Coverage values are theoretical; allow for surface irregularities and application losses. * Refer to manufacturer product data sheet		DFT Range (min-max)	20-200*	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Surface temperature for applications should be greater than 60 deg F. Allow full curing of each coat (3-4 hours) at 75 deg F. If top coating is needed full cure time of at least 72 hours required prior to top coating.
- Mascoat DTI is available only in White and Gray colors.
- May be finish coated with Interthane 990. See DC-1 topcoat for further details.
- Surface to be stenciled with "Operator Protection" DC-60.

5. TOUCH-UP

- Surface should be solvent cleaned or with soap water and must be free of visible or non-visible contaminants. Feather area to provide smooth transitions.
- Roughen non-DTI surfaces prior to coating.
- Brushing and Rolling is not recommended except for very small touch-ups less than 0.5 square feet.

THICKNESS CHART

ENGINEERING

SPECIFICATION

REVISION NUMBER: 2.0

EFFECTIVE DATE: 02-DEC-2016

- Depending on desired results, one of the two charts below may be employed to obtain approximate required thickness. For more details, consult Mascoat personnel for a detailed thermal analysis study.
- Thickness requirements to be determined by engineering.
- For surfaces above 350°F consult manufacturer.

ENERGY RETENTION THICKNESS CHART FOR MASCOAT INDUSTRIAL-DTI INSULATING COATING

MAXIMUM OPERATING TEMP °F.	ENERGY RETENTION THICKNESS CHART NOMINAL PIPE SIZES AND SIMILAR CYLINDRICAL EQUIPMENT															
	1/2"	3/4"	1"	1-1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24" +
150°	50	50	50	50	50	50	50	50	50	50	50	50	50	60	60	60
175°	60	60	60	60	60	60	60	60	60	60	60	60	60	70	70	70
200°	80	80	80	80	80	80	80	80	80	80	80	90	90	90	90	90
225°	100	100	100	100	100	100	100	100	100	100	100	110	110	110	110	110
250°	120	120	120	120	120	120	120	120	120	120	130	130	130	130	130	130
275°	140	140	140	140	140	140	140	140	140	140	150	150	150	150	150	150
300°	150	150	150	150	150	150	150	150	150	150	160	160	160	160	160	160
325°	160	160	160	160	160	160	160	160	160	180	180	180	180	180	180	180
350°	180	180	180	180	180	180	180	180	180	190	190	190	190	190	190	190
This chart represents estimated thickness of the coating at personnel protection limits of 160F or less. Ambient conditions 75F. Actual results may vary depending on other circumstances.																

PERSONNEL PROTECTION THICKNESS CHART FOR MASCOAT INDUSTRIAL-DTI INSULATING COATING

MAXIMUM OPERATING TEMP °F.	PERSONNEL PROTECTION THICKNESS CHART NOMINAL PIPE SIZES AND SIMILAR CYLINDRICAL EQUIPMENT															
	1/2"	3/4"	1"	1-1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24" +
150°	40	40	40	40	40	40	40	40	40	40	40	40	40	50	50	50
175°	50	50	50	50	50	50	50	50	50	50	50	50	50	60	60	60
200°	60	60	60	60	60	60	60	60	60	60	60	60	60	70	70	70
225°	70	70	70	70	70	70	70	70	70	70	70	70	70	80	80	80
250°	80	80	80	80	80	80	80	90	90	90	90	90	100	100	100	100
275°	100	100	100	100	100	100	100	100	110	110	110	110	110	110	110	110
300°	110	110	110	110	110	120	120	120	120	120	120	120	120	120	120	120
325°	120	120	120	120	130	130	130	130	130	130	130	140	140	140	140	140
350°	140	140	140	140	140	150	150	150	150	150	150	150	160	160	160	160
375°	170	170	170	170	180	180	180	180	180	180	190	190	190	200	200	200
400°	200	200	200	200	200	200	200	200	200	210	210	210	210	220	220	220
This chart represents estimated thickness of the coating at personnel protection limits of 160F or less. Ambient conditions 75F. Actual results may vary depending on other circumstances.																

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-61, Cold-Service Insulating****CARBON STEEL AND STAINLESS STEEL****-60°F TO 100°F FOR CONDENSATION AND FROST PREVENTION. WATERBORNE EPOXY.****1. SYSTEM DESCRIPTION:**

Carbon Steel and Stainless Steel: Waterborne epoxy-based insulative coating for the prevention of condensation and frost on cold-service piping and equipment. Can be applied to surfaces that operate up to 300°F with the specified primer coat, but refer to DC-60 spec for insulative coatings in applications above ambient temperatures (100°F and above)

THIS SYSTEM IS NOT INTENDED FOR USE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)

SSPC SP-10 Near White Metal Blast Cleaning for carbon steel, 2.0-3.0 mil profile (new installation)

For carbon steel, surface must be primed with Carbomastic 615 per below. Carboline 551 is self-priming over non-ferrous metals with an abrasive-blast surface profile of 1.0-1.5 mil.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1 st	Carboline Carbomastic 615	6.3-12.5	5-10	257
2 nd	Carboline Carbomastic 615	6.3-12.5	5-10	257
3 rd	Carboline Carbotherm 551	6.1-12.2	5-10	175
4 th +	Carboline Carbotherm 551	42.7-48.8	35-40	38

¹ Coverage values are theoretical; allow for surface irregularities and application losses.

DFT Range (min-max)	Consult manufacturer
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4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Surface temperature for applications should be greater than 50°F. Follow manufacturer's cure time and recoat window recommendations.
- Carboline Carbotherm 551 is available only in Off White (0800).
- Surface to be stenciled with DC-61 to aid in future identification.

5. TOUCH-UP

- Surface should be solvent cleaned or with soap water and must be free of visible or non-visible contaminants. Feather area to provide smooth transitions.
- Roughen non-Carbotherm 551 surfaces prior to coating.
- Rolling is not recommended. Brushing is only recommended for very small touch-ups less than 0.5 square feet.

THICKNESS CHART

- Thickness requirements to be determined by HSC Engineering with input from manufacturer.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-70, Stainless Steel****STAINLESS STEEL**

SERVICE TEMPERATURES -150°F TO 450°F, AMINE-CURED NOVOLAC EPOXY

1. SYSTEM DESCRIPTION:

Highly cross-linked glass-flake filled system for austenitic stainless steels requiring protection from stress corrosion cracking. Suitable for insulated and uninsulated (with UV-protectant topcoat) piping operating up to 450°F.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Cleaning
SSPC SP-16 Brush-Off Blast Cleaning to surface profile of 2.0 - 3.0 mils.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Carboline Thermaline 450	5.7-14.3	4.0-10.0	140
2ND	Carboline Thermaline 450	5.7-14.3	4.0-10.0	140
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	8.0-20.0	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets. Notify Owner's representative if any conflicts are found between the product data sheets and this specification.
- Spray application is recommended. Brush application is only recommended for striping and touchup of small areas. Roller application is not recommended.
- Manufacturer recommends a final total DFT in the range of 8.0-15.0 mils for use under insulation, with acceptable millage up to 30 mils if applying two coats. Manufacturer cautioned that DFT below 8.0 mils per coat may be difficult to achieve, so a two-coat application of Thermaline 450 will likely result in millage on the higher end of the DFT range.
- Carboline Thermaline 450 is available only in Carboline Gray (5742) and Red (0500). As of 2016, the use of green tinting is not recommended due to difficulty in application.
- Alternate coatings must receive prior written approval from coatings subject matter expert.
- If uninsulated, a clear coat is recommended to improve UV resistance. Carboline Thermaline 450 is compatible with epoxy and polyurethane topcoats. Typical use at HSC is for insulated lines, so topcoating is not usually required. Consult with Owner's representative prior to applying any topcoat or for uninsulated applications where a topcoat has not been specified.

5. TOUCH-UP

- Surface preparation to be SP-3 minimum, SP-7 or SP-11 preferred to develop a profile of 2.0 - 3.0 mils. Base coat and top coat with Carboline Thermaline 450.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**DC-80, Non-Skid****NON-SKID****1. SYSTEM DESCRIPTION:**

Single-component epoxy ester containing aluminum oxide, used for skid resistance on steel and concrete surfaces. It is also used for walkways, stairs, ladder rungs, grating, tops of tanks, some floor areas, or other areas where a non-skid surface is required.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Cleaning
 SSPC SP-6 Commercial Blast for Steel Surfaces
 SSPC SP-7 Brush-off Blast for Concrete Surfaces (new and existing)
 Refer to manufacturer's datasheet for detailed surface preparation requirements regarding concrete and asphalt curing.

3a. MATERIALS, COVERAGE Steel Surfaces

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Interseal 670HS	4.9-12.2	4-10	263
2ND	American Safety AS-150		15-20	40-60
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	19-30	

3b. MATERIALS, COVERAGE Concrete Surfaces

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1 st	Sherwin Williams Setfast Premium Alkyd Zone Marking Paint with aluminum oxide grit added via broadcast spreader	10-15	5.0-7.5	110
2 nd	Sherwin Williams Setfast Premium Alkyd Zone Marking Paint	10-15	5.0-7.5	110
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	10.0-15.0	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Roller, trowel, and conventional sprayer only. Do not use brush or airless sprayer.
- Second coat of Sherwin Williams Setfast as "locking coat" for grit adder was approved by Mario Moscone of Sherwin Williams on 11/16/2016. Apply second coat after first coat is tack-free.
- As an alternate, Interzone 485 with broadcast aggregate may be used: SSPC SP-6 surface prep, 40-120 mils DFT. Interzone 485 is available in gray only. Written approval from HSC Engineering is required prior to using this or any other alternate.

5. TOUCH-UP

- Surface preparation to be SP-3.
- Coat with American Safety AS-150.

ENGINEERING

SPECIFICATION

REVISION NUMBER: 2.0

EFFECTIVE DATE: 02-DEC-2016

DC-204, High Temperature and Thermal Cycling

INSULATED AND UNINSULATED CARBON STEEL, STAINLESS STEEL, AND CHROME/MOLY ALLOY
 SERVICE TEMPERATURES: 400°F TO 750°F (WET/DRY HEAT RESISTANCE)
 TITANIUM MODIFIED INORGANIC COPOLYMER

1. SYSTEM DESCRIPTION:

This system is usable for carbon steel, stainless steel, and alloy pipe and equipment operating between -321°F and 750°F. **This system should be used in cases where DC-10 spec cannot be met (ex: 400°F < op. temp. < 750°F) and high thermal cycling is expected.** This material has good resistance to thermal cycling shock experienced during rapid temperature changes.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)
 SSPC SP-6 Commercial Blast for Steel Surfaces.
 SSPC SP-10 Near White Finish with 2-3 mil profile. (Insulated Steel Surfaces)

3. MATERIALS, COVERAGE

Coat	Material Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Intertherm 751CSA (cold spray aluminum)	6.6-13.1	4.0 - 7.0	130
2ND	Intertherm 751CSA (cold spray aluminum)	6.6-13.1	4.0 - 7.0	130
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	8 – 14	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Alternate coatings must receive prior written approval from HSC Group Engineer or designate.
- Intertherm 751CSA is available in aluminum color only.
- Intertherm 751CSA can be applied to surfaces at elevated temperatures up to 248F (122C). For surface temperatures above 176F (80C), the product must be spray applied.

5. TOUCH-UP

- Surface preparation to be SP-11.
- Base coat and top coat with Intertherm 751CSA

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**Alternate coating for DC-1 – must receive prior written approval from HSC Engineering****DC-101, Epoxy HB/Polyurethane**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL FOR USE -40°F TO 200°F

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel: Epoxy Primer/Epoxy H.B. Semi-Gloss: A two (2) coat system consisting of a two (2) component, high build surface tolerant epoxy and a two (2) component acrylic polyurethane finish.

Galvanized Steel: A (1) coat finish painting of treated galvanized steel.

THIS SYSTEM IS NOT INTENDED FOR UNDER INSULATION. DO NOT USE A URETHANE UNDER INSULATION.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)

SSPC SP-6 Commercial Blast Cleaning (New installation)

SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Bar-Rust 235 (Bar Rust 231 optional for extended recoat)	5.9-11.7	4-8	272
2ND	Devthane 379UVA (Optional and Site-Restricted)	3.2-4.8	2-3	505
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	6-11	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- This system is not to be used under insulation. See DC-15.
- Brushing and rolling with Bar-Rust 235 may require additional coats to achieve required thickness.
- The Devthane polyurethane is for U.V. protection of the epoxy and intended for outdoor exposures only. Due to the isocyanates in the polyurethane, use of it is site-restricted (i.e.: HSC does not allow spray application of the polyurethane on site. It can be sprayed off-site only.) Proper PPE is required for brush/roll application.
- Application to PVC pipe requires SP-2 surface preparation.
- Alternate coatings must receive prior written approval from HSC Engineer.

5. TOUCH-UP

- Surface preparation to be SP-3 minimum.
- Base coat with Bar-Rust 235 and top coat with Devthane 379H (brush/roll only).

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**Alternate coating for DC-2 – must receive prior written approval from HSC Engineering****DC-102, Epoxy HB/Isocyanate-Free Acrylic**

CARBON STEEL, STAINLESS STEEL, AND GALVANIZED STEEL FOR USE -40°F TO 200°F

6. SYSTEM DESCRIPTION:

This system is used as an alternative to DC-1. The topcoat is an isocyanate-free material and protects the epoxy from ultraviolet degradation, wear, and splash-spill exposures.

Carbon Steel and Stainless Steel: A two (2) coat system consisting of a two (2) component, high-build surface tolerant epoxy and a two (2) component acrylic topcoat.

Galvanized Steel: A (1) coat finish painting of treated galvanized steel.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)

SSPC SP-6 Commercial Blast Cleaning (New installation)

SSPC SP-7 Brush-off Blast Cleaning (Recoat Existing & Galvanized Steel)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Bar-Rust 235 (Bar Rust 231 optional for extended recoat)	5.9-11.7	4-8	272
2ND	Devran 229H	2.7-3.6	1.5-2.0	588

¹ Coverage values are theoretical; allow for surface irregularities and application losses.

DFT Range (min-max)	5.5-10.0
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4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Brushing and rolling with Devran 229H may require additional coats to achieve required thickness.
- Brushing and rolling with Bar-Rust 235 may require additional coats to achieve required thickness.
- Application to PVC pipe requires SP-2 surface preparation.
- Alternate coatings must receive prior written approval from HSC Group Engineer or designate.

5. TOUCH-UP

- Surface preparation to be SP-3 minimum. Base coat with Bar-Rust 235 and top coat with Devran 229H.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**Alternate coating for DC-5 – must receive prior written approval from HSC Engineering****DC-105, alkyd system**

INTERIOR APPLICATIONS IN FINISHING AND NON-CORROSIVE ENVIRONMENTS, UP TO 200F

1. SYSTEM DESCRIPTION:

Two coat alkyd system for protection of structural steel and equipment. Limited to interior applications in finishing buildings and non-corrosive areas.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Cleaning (all)
 SSPC SP-6 Commercial Blast Cleaning (new installation)
 SSPC SP-7 Brush-off Blast Cleaning (re-coat existing equipment)

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Devguard 4160	4.0-5.0	2.0-2.5	410
2ND	Devguard 4308	4.5-5.5	2.0-2.5	361
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	4.0-5.0	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Devguard 4160 is only available in White, Gray, and Red
- Alternate coatings must receive prior written approval from HSC Group Engineer or designate.

5. TOUCH-UP

- Surface preparation to be SP-3 minimum.
- Base coat with Devguard 4160 and top coat with Devguard 4308

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**Alternate coating for DC-10 – must receive prior written approval from HSC Engineering****DC-110, Heat-Resistant Epoxy**CARBON STEEL, STAINLESS STEEL, CHROME/MOLY ALLOY, AND COPPER FOR USE 250°F TO 400°F
(WET/DRY HEAT RESISTANCE)**1. SYSTEM DESCRIPTION:**

Heat resistant epoxy coating. This material requires 50°F to cure.

2. SURFACE PREPARATION:SSPC SP-1 Solvent Clean (All)
SSPC SP-6 Commercial Finish (Uninsulated Steel Surfaces)
SSPC SP-10 Near White Finish with 2-3 mil profile (Insulated Steel Surfaces)**3. MATERIALS, COVERAGE**

Coat	Material Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Devco HT-403	8-12	6.0-8.0	187
2ND	Devco HT-403	8-12	6.0-8.0	160
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	12-16	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- HT-403 is available in Black only
- Alternate coatings must receive prior written approval from HSC Group Engineer or designate.
- Spray only. Do not use brushes or rollers to apply.

5. TOUCH-UP

- Surface preparation to be SP-3 minimum.
- Base coat and top coat with HT-403

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REVISION NUMBER: 2.0

EFFECTIVE DATE: 02-DEC-2016

Alternate coating for DC-20 – must receive prior written approval from HSC Engineering**DC-120, High Temperature**

CARBON STEEL, STAINLESS STEEL, AND CHROME MOLY ALLOY

SERVICE TEMPERATURES 400°F TO 1000°F. HIGH TEMPERATURE POLYMERIC COATING(S)

CRYOGENIC SERVICE (-300°F) – some product options

1. SYSTEM DESCRIPTION:

For steel surfaces, polymeric coating. Air temperature cure, unless otherwise noted. Suitable for insulated and uninsulated carbon steel and stainless steel pipe and equipment operating between -320°F and 1000°F. **For high temp service, this system should be used only in cases where DC-10 spec cannot be met (ex: 400°F<op. temp.<1000°F).**

The products listed below have not been widely used within Dow Corning. Select the proper system based on project needs and conditions. Protective Coatings EET is available for assistance or advice.

2. SURFACE PREPARATION, MATERIALS, AND COVERAGE:

Mfr/Product	Description	Surface Prep	1 st Coat (DFT)	2 nd Coat (DFT)	Services			Comments
					Cycling	Cryogenic	Max Hot Surface Application	
Carboline Thermaline 4001	Single-component inert multi-polymeric matrix coating	CS: SP-10, 2.5-3.5 mil profile. SS: non-metallic abrasive blast, 1-2 mil profile	3.5-5.0 mils	3.5-5.0 mils	Yes	No	500°F	
International Paint Interbond 1202 UPC	Two-component titanium modified inorganic copolymer	CS: SP-10, 2 mil profile. SS Non-metallic abrasive, 1.5-2 mil profile	2.0-4.0 mils	2.0-4.0 mils	Yes	Yes. Must fully cure at 300°F for 1 hr before being placed into cryo service.	No	Better for shop than field applications. Fully cures at 300°F for 1 hr.
Dampney ThurmaloX 225HD	Two-component modified silicone co-polymer	CS: SP-10, 1.5-3.0 mil profile. SS: non-metallic abrasive blast, 1.5-2 mil profile.	4.0-5.0* mils	4.0-5.0* mils	Requires 350°F cure before put into thermal cycling service.	No	No	Requires 7 day air dry before insulating.
Sherwin-Williams Heat-Flex Hi-Temp 1200	Single-component inert multipolymeric matrix coating	CS: SP-6, 1.5-2.5 mil profile. SS: SP-1	5.0-6.0* mils	5.0-6.0* mils	Yes	Yes	500°F	NOT RECOMMENDED. Very fragile and susceptible to damage during handling.

3. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- These products are intended to be self priming. **DO NOT** use a different primer without first consulting Protective Coatings EET.
- Follow manufacturer's instructions regarding thinning, including appropriate thinners.
- Alternate coatings must receive prior written approval from coatings subject matter expert.

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- **Because we have limited experience and data on the performance of these coatings, it is important to capture within the SAP FL the coating product(s) used. This will allow us to track performance, durability, and longevity of the different systems, leading to specification improvements.**
- For uninsulated applications, stencil application date, surface prep, product used, and applicator/contractor.
- For insulated applications, stencil or apply stick-on label with date, surface prep, product used, and applicator/contractor.

*Regarding narrow DFT ranges, consult Protective Coatings EET – it may be possible to work with manufacturer to extend application ranges depending on service and application temperatures.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**Alternate coating for DC-30 – must receive prior written approval from HSC Engineering****DC-130, Epoxy/Semi-Gloss Acrylic Finish****EXTERIOR/INTERIOR MASONRY WATERPROOF SYSTEM****1. SYSTEM DESCRIPTION:**

Epoxy/Waterborne Acrylic finish: A two-coat system consisting of a epoxy prime coat and a single component semi-gloss acrylic finish. For exterior and interior masonry block.

2. SURFACE PREPARATION:

New Work: Remove mortar tags and foreign matter from surface. Allow concrete or masonry to cure 30 days (temperature >50F) before coating. High pressure wash to a clean condition.

Recoating: Remove mortar tags and foreign matter from surface. High pressure wash to decontaminate and remove chalk to a clean condition. Recoat dry surface with the finish paint.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils)		Theoretical Coverage ¹ Sq. Ft./Gal.
		Wet	Dry	
1ST	Tru-Glaze-WB 4015	17-21	9-11	60-100
2ND	DeVoe Devflex 4216	4.0-11.6	1.5-4.0	384
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	10.5-15.0	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Alternate coatings must receive prior written approval from HSC Group Engineer or designate.
- Do not paint caulk
- Precast Concrete
 - High pressure wash to decontaminate and remove chalk to a clean condition.
 - Base coat with Bond Prep 3030 and top coat with Diamond 350

5. TOUCH-UP

- Touch-up per original application guidelines.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**Alternate coating for DC-61 – must receive prior written approval from HSC Engineering****DC-161, Cold-Service Insulating for Cyclic Services**

CARBON STEEL AND STAINLESS STEEL

-60°F TO 300°F FOR CONDENSATION AND FROST PREVENTION ON THERMAL CYCLING SERVICES.

WATERBORNE EPOXY.

1. SYSTEM DESCRIPTION:

Carbon Steel and Stainless Steel: Waterborne epoxy-based insulative coating for the prevention of condensation and frost on cold-service piping and equipment. Can be applied to surfaces that operate up to 300°F with the specified primer coat, but refer to DC-60 spec for insulative coatings in applications above ambient temperatures (100°F and above)

This coating is not intended for applications where heat dissipation is required, or for use under insulation.

THIS ALTERNATE IS FOR THERMAL CYCLING APPLICATIONS – REFER TO DC-61 FOR NON-CYCLING USE.

2. SURFACE PREPARATION:

SSPC SP-1 Solvent Clean (All)

SSPC SP-10 Near White Metal Blast Cleaning for carbon steel, 2.0-3.0 mil profile (new installation)

For carbon steel, surface must be primed with Carbomastic 615 per below. Carboline 551 is self-priming over non-ferrous metals with an abrasive-blast surface profile of 1.0-1.5 mil.

3. MATERIALS, COVERAGE

Coat	Materials Number & Name	Film Thickness (mils) Wet Dry		Theoretical Coverage ¹ Sq. Ft./Gal.
1 st	APPLY TWO COATS OF CARBOLINE THERMALINE 450 PER DC-70 SPECIFICATION			
2 nd				
3 rd	Carboline Carbotherm 551	6.1-12.2	5-10	175
4 th +	Carboline Carbotherm 551	42.7-48.8	35-40	38
¹ Coverage values are theoretical; allow for surface irregularities and application losses.		DFT Range (min-max)	Consult manufacturer	

4. PRODUCT APPLICATION PARAMETERS

- All applications are to be in accordance with the manufacturer's latest product data sheets.
- Surface temperature for applications should be greater than 50°F. Follow manufacturer's cure time and recoat window recommendations.
- Carboline Carbotherm 551 is available only in Off White (0800).
- Surface to be stenciled with DC-61 to aid in future identification.

5. TOUCH-UP

- Surface should be solvent cleaned or with soap water and must be free of visible or non-visible contaminants. Feather area to provide smooth transitions.
- Roughen non-Carbotherm 551 surfaces prior to coating.

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- Rolling is not recommended. Brushing is only recommended for very small touch-ups less than 0.5 square feet.

THICKNESS CHART

- Thickness requirements to be determined by HSC Engineering with input from manufacturer.

ENGINEERING**SPECIFICATION****REVISION NUMBER:** 2.0**EFFECTIVE DATE:** 02-DEC-2016**3. DEFINITIONS AND ACRONYMS**

The terms outlined here do not necessarily appear in this document, but are widely used within the protective coatings systems documents.

Term	Definition
Product Data Sheet (PDS)	Document issued by coating manufacturer outlining information about the coating: chemical make-up; applicable uses; surface preparation, mixing, application, and curing information. It is imperative that the manufacturer's PDS be followed to ensure a quality application.
NACE	National Association of Corrosion Engineers: generally accepted as industry experts on corrosion protection. Multiple Dow Corning and HSC sites now have coatings inspections routinely conducted by NACE-certified inspectors. High quality coatings applicators also employ NACE-certified inspectors.
ICORR	Institute of Corrosion, formerly the British Association of Corrosion Engineers (BACE). Similar in scope and mandate to NACE.
HAPS	Hazardous Air Pollutants – environmental designation of coating components; relevant to air permitting.

4. RELATED SSG DOCUMENTS

SSG Document No.	SSG Title
HSG-STD-00400003	Global Engineering Standard or Specification Variance Request Procedure
HSG-STD-09900014	Protective Coatings Quality Assurance
HSG-SPC-09900015	Global Protective Coatings Standard

5. REFERENCES

None	

6. APPENDICES / ATTACHMENTS

6.1. Appendices

Document No.	Title
None	

6.2. Attachments

Document No.	Title
None	

* * * END OF SECTION * * *

ENGINEERING**STANDARD**

REVISION NUMBER	3.0	EFFECTIVE DATE:	02-DEC-2016
DOCUMENT TYPE:	Engineering	MANDATORY:	Yes
DISCIPLINE:	CIV-ARC	APPLICABLE SITES:	HSC
DOC CLASS:	SSG	ISSUED/OWNED BY:	HSC CSA Eng TL
DOC SUBCLASS:	STD	STATUS:	Effective
SECURITY CLASS:	Internal	DOCUMENT NO:	HSG-STD-09900014

TITLE: PROTECTIVE COATINGS QUALITY ASSURANCE

Revision	Date	By	Description of change
3.0	02-DEC-2016	M. Williams/S. Wegener	Reclassified as HSC document and made clerical updates to this effect. No change in document revision.
3.0	15-FEB-2016	Protective Coatings EET	Replaced Appendix 1 <ul style="list-style-type: none"> Removed Coatings/Lining QC Acknowledgement section and accompanying documentation Added All Daily/Weekly forms required by Owner of the Applicator (Including Nonconformance, Variance, and Asset Release Forms) Wording/Grammar Changes: <ul style="list-style-type: none"> 3.1.A.4 "enclosed" added to text 3.1.A.5 added Added 3.2.A.1 3.2.C changes 3.3.E changes Moved 3.3 I-J to 3.4 D-E 3.4.E Revised to include change in scope at discretion of owner/owner's rep. 3.4.G Text Added Multiple Changes to 3.5.A Inspection Table
2.0	29-JAN-2014	Protective Coatings EET	Upload of revisions to EngDocs 01-NOV-2013: Reformatting, replacing "painting" with "protective coating" throughout text. Additions to responsibilities of "Protective Coating Applicator" and "Quality Inspector". Section 3.6 "Responsibilities"
1.0	15-NOV-2012	Protective Coatings EET	New document

1 PURPOSE

- 1.1 To provide guidance to assure the quality of coating application, to reduce incidents of corrosion on process plant and to optimize the life span of coatings applied either as a requirement of capital projects or maintenance programs.

2 SCOPE

- 2.1 The following requirements will apply to all applications of protective coatings unless specifically excluded within the following text or a variance has been applied for and approved under the instructions of the Engineering Standard and Specification Variance Request procedure.
- 2.2 This standard will apply corporation wide, to **all** HSC plants. It will apply to the application of protective coatings during the construction phase of capital projects and to the application of coatings during routine maintenance works.
- 2.3 Protective Coatings EET or local coatings subject matter expert shall be consulted for applicability to small maintenance coatings projects.

ENGINEERING**STANDARD****REVISION NUMBER** 3.0**EFFECTIVE DATE:** 02-DEC-2016**3 DISCUSSION****3.1 Atmospheric Conditions**

- A. Before any protective coating is applied, the atmospheric conditions should be within the following parameters:
1. Temperature: - Between 10°C (50°F) and 49°C (120°F), or within the range recommended by the manufacturer. These temperatures apply to the ambient, substrate, and coating materials.
 2. Humidity: - The ambient or substrate temperature must be more than 3°C (5°F) above the dew point, or within the range recommended by the manufacturer.
 3. Particularly when spraying, coatings shall not be applied during strong winds or gusty conditions. With agreement of Owner, enclosures may be employed to optimize productivity during high winds.
 4. Application shall not be undertaken during rain, fog, snow, or hail when not enclosed, or onto substrates that may be frosted or damp.
 5. Enclosures, when applicable, will be monitored to maintain temperature range approved by manufacturer specifications. Improper equipment may overheat the enclosure or impact maintenance of minimum recommended temperature.

3.2 Surface Preparation.

- A. Any welds on the surface to be prepared shall be relatively smooth while still retaining the manufacturer's recommended profile to ensure that the coating will bond, without any sharp edges, and free of weld splatter or slag before any blasting takes place. There shall be no deep laminations or significant deterioration requiring structural replacement. Any visible deposits of oil or grease shall be removed using high pressure water jetting or steam cleaning. Solvents may be used only if cleaning by other methods is not practicable. Salts may be removed from the surface to be coated by water washing. High pressure water jetting will remove salts trapped in cracks or rust from most surfaces if used effectively. It should be understood that welds shall be abrasive blasted along with steel/pipe/equipment surfaces prior to first application of coating. Subsequent coating (maintenance/repair) of the same weld could be hand-tool prepared, given that the weld already has a surface profile from the initial blast. In all cases shall a surface profile suitable for the coating be achieved.
1. All lining projects will be subjected to salt testing by the contractor in presence of Owner's QA representative, and shall be brought to an acceptable level determined by the manufacturer, unless otherwise specified by Owner.
- B. All steel, where blasted prior to installation in the field, must be cleaned to the degree called for in specifications. If blasting is undertaken in the field it will be prepared to an agreed standard. If blasting is used as the preparation method it must be undertaken using a clean, sharp grade of abrasive. After completion of blasting, all residual dust, etc. shall be removed by air blowing, vacuum cleaning, or brushing prior to application of the first coat. Other methods of preparation may include hand tool cleaning, power tool cleaning, or UHP water jetting. The method of preparation will be agreed by Owner with the protective coating applicator and will be dependent upon the surface to be prepared, the extent of the preparation to be undertaken, ease of access, and/or the potential for damage to adjacent equipment.

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- C. No area shall be left uncoated for more than 8 hours following surface preparation without being inspected by Owner's QA representative. Continual monitoring of humidity and other atmospheric conditions shall be undertaken by the protective coatings applicator to minimize the potential for flash rusting. It is Owner's expectation is that abrasive blasting and application of primer will be completed within a single shift. For large vessels, blasting and priming would be expected to be completed in multiple shifts.

3.3 Coating Application.

- A. All protective coating products will be obtained only through approved suppliers. No deviation from this requirement will be permitted, unless by approved variance HSG-STD-00400003.
- B. Protective coatings shall be provided only in the manufacturer's sealed containers. Those containers shall be clean, clearly marked and stored in appropriate conditions as per the manufacturer's guidance.
- C. Any materials that are beyond the manufacturer's shelf life shall not be used. Any coating that has exceeded the manufacturer's pot life will be disposed of. The pot will be emptied and cleaned and new materials will be mixed.
- D. Mixing of coatings shall be carried out as per the manufacturer's written requirements. Mixing shall be carried out in a clean environment, free of contaminants such as dust, grease, other coatings, etc. Any thinning shall not exceed the manufacturer's recommendations for permissible volatile organic compounds (VOC) for the coating, nor shall it exceed local government exposure guidelines.
- E. The type of thinner shall be selected in accordance with the coating, category and manufacturer's instructions. When the addition of thinners is required, they shall be added during mixing and stirring operations. When a suitable viscosity of the coating has been reached, addition of thinners shall stop. The addition of thinners must be monitored by a supervisor or applicator competent in the addition process and types of thinners and recorded on QC documents provided by Owner. Owner reserves the right to confirm the competency of individuals performing thinning work.
- F. Any previously coated surfaces shall be protected from contamination and overspray. Application of primer shall ensure a uniform thickness over welds, corners and edges. Primer shall not be applied within 100mm (4 inches) of unblasted surfaces or 50mm (2 inches) of edges to be field welded.
- G. Each coat of any multi-coat system must be allowed sufficient time to dry and to cure in accordance with manufacturer's instructions before further coats are applied. If the maximum recoat time has been exceeded, the previously applied coatings shall be roughened before top coating.
- H. Wet film thickness shall be measured during the application of each coat to ensure that the specified dry film thickness (DFT) is met. The DFT of each coat on carbon steel shall be checked in accordance with the appropriate procedures using an accurately calibrated magnetic gauge.
- I. Dry spray and overspray shall be removed before taking any measurements.

ENGINEERING**STANDARD****REVISION NUMBER** 3.0**EFFECTIVE DATE:** 02-DEC-2016**3.4 Identification and Elimination of Defects**

- A. Each subsequent coat of protective coating shall be of a uniform thickness, appearance, and free of any defects (blisters, sags, runs, pinholes, voids, mud cracking, bubbles and wrinkles).
- B. During the application of each coat, application to surfaces not intended to be coated will be prevented. Any overspray or spillage will be avoided. Overspray and dry spray will be removed.
- C. Each coat shall be within the specified DFT range.
- D. Thickness checks on non-magnetic substrates shall be undertaken using an approved Type 2 gauge.
- E. Unless otherwise specified or approved, sampling procedures for thickness measurements on non-magnetic coatings on magnetic substrates or coatings on non-magnetic substrates shall follow SSPC-PA 2 using ISO 2178 and 2360 respectively. At any time during the execution of contracted or Time & Material coatings projects, the Owner reserves the right to conduct any project related testing the Owner feels is necessary, including but not limited to more stringent thickness sampling.
- F. All defects and damage to previous coat(s) shall be repaired before the application of subsequent coats. Any damage to the finished work will be cleaned thoroughly and recoated.
- G. Damage to any area shall be hand tool cleaned, power tool cleaned or spot blasted as appropriate to restore the exposed steel to its original state of cleanliness and using approved methods, such as feathering, to ensure bonding.
- H. All cracked, loose or damaged coating shall be removed back to sound coating and feathered back approximately 50mm (2 inches) to form a smooth and uniform surface for application of the new coating. Feathering shall be carried out using hand or power sanding.
- I. The coating used for repair will be the same as the original where ever possible and will have the same DFT.

3.5 Inspection Table

- A. The table below summarizes the quality inspection requirements for all protective coating applications.

	Mandatory/ Optional	Criteria	How?	When?	Who?
Ambient Conditions	M	Measurement of ambient conditions. Temperature.	Surface temperature thermometer, direct reading thermocouple/ thermister, non-	Before work begins each day and at a minimum frequency of four hours,	Applicator/ Contractor QC

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	Mandatory/ Optional	Criteria	How?	When?	Who?
		Substrate temperature shall be 3°C (5°F) above the dew point. Ambient, substrate or coating material temps are between 10°C (50°F) and 49°C (120°F) or within the range recommended by the manufacturer.	contact thermometer	or sooner if weather conditions are worsening	Spot Verification Owner QA Inspector
Ambient Conditions	M	Humidity. Ambient or substrate temp. 3°C (5°F) above the dew point and inside the range recommended by the manufacturer.	Sling psychrometer/whirling hygrometer in conjunction with psychometric tables. Electronic instruments, i.e. digital hygrothermometer	Before work begins each day and at a minimum frequency of 4 hours, or sooner if weather conditions are worsening	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector
Ambient Conditions	O (Based on local conditions)	Others: <ul style="list-style-type: none"> Airborne industrial or chemical contamination. Water spray Leaking steam or chemical lines. Contamination by normal plant or adjacent operations. Wind speed/direction – no strong or gusty winds particularly during spraying. Rain, frost, snow or fog on, damp surfaces or on surfaces that may have frost. 	Visual	Before work begins each day and at a minimum frequency of 4 hours, or sooner if weather conditions are worsening	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector
Surface Preparation	M	Evaluating Surface Preparation Equipment. Compressed air for blasting and spraying	Visual	At the start and end of each shift and at intervals no	Applicator/ Contractor QC

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	Mandatory/ Optional	Criteria	How?	When?	Who?
		shall be tested for water and oil contamination.	Immerse gritblast in water and check for oil flotation	greater than 4 hours.	Spot Verification Owner QA Inspector
Surface Preparation	M	Pre-surface preparation. No heavy deposits of grease, soil, dust, dirt, cement splatter or other contaminants. No weld splatter or sharp edges. No deep laminations. No significant deterioration requiring structural replacement. Recirculated gritblast shall be tested for oil contamination	Residual traces of abrasive must be removed, especially fine dust held by static electricity. Any scaffolding, staging or support steel above the work area must be clean. Adjacent blast cleaning or protective coating should not be performed concurrently unless the area is sufficiently isolated.	At the start and end of each blasting and at intervals no greater than 4 hours.	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector
Surface Preparation	M	Cleanliness	The surface may be inspected to determine if it is chemically clean and free of detrimental concentrations of soluble salts.	At the start and end of each blasting and at intervals no greater than 4 hours.	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector
Surface Preparation	M	Surface Profile	Surface profile comparator, depth micrometer, or replica tape.	At the start and end of each blasting, and at intervals no greater than 4 hours.	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector

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	Mandatory/ Optional	Criteria	How?	When?	Who?
Coating Application	M	Inspecting Application Equipment. Compressed air for blasting and spraying shall be tested for water and oil contamination	Cleanliness of all spray application equipment should be verified prior to mixing the coating to avoid problems with clogging or contamination. Spray pot should be clean and in good order. Air and fluid gauges should be available and functional. Pressure relief valve should be operational. Should be equipped with diaphragm pressure regulators.	Before application starts.	Applicator/ Contractor QC
Coating Application	M	Protective Coating Material	Confirm that materials are as specified, are within shelf life and are correctly labeled. Confirm that thinning, mixing and induction times are per the manufacturer's instructions. Verify that the applicator is checking WFT during application	Before application starts and each time coatings are mixed or thinned	Applicator/ Contractor QC
Coating Application	M	Cleanliness Between Coats	Confirm that recoat times are being observed. Confirm that undercoats are sufficiently cured before application of further coats.	Between coats	Applicator/ Contractor QC

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	Mandatory/ Optional	Criteria	How?	When?	Who?
			Inspect each coat for uniform appearance and defects. Confirm that DFT for each coat is within the specified range.		Spot Verification Owner QA Inspector
Coating Application	M	Cleanliness Between Coats	A visual inspection looking for dirt, dust, dry spray or overspray.	Following final coat application	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector
Coating Application	O M (Immersion Coatings)	Pinhole and "Holiday" detection	A final inspection of the completed coating, used to find nicks, scrapes and pinholes in the coating. Carried out before the final cure. Typical instruments for detection are; low-voltage wet sponge, DC high voltage and AC electrostatic.	Final Inspection Component	Applicator/ Contractor QC
					<i>When Mandatory-</i> Spot Verification Owner QA Inspector
Coating Application	O M (When specified by Owner)	Adhesion Testing	Instruments are available for carrying out tensile adhesion strength of coatings.	Between Coats	Applicator/ Contractor QC
					<i>When Mandatory-</i> Spot Verification Owner QA Inspector

ENGINEERING**STANDARD****REVISION NUMBER** 3.0**EFFECTIVE DATE:** 02-DEC-2016

	Mandatory/ Optional	Criteria	How?	When?	Who?
Coating Application	M	Coating Thickness <ul style="list-style-type: none"> Determining Wet Film Thickness 	The wet film thickness gauge is usually a standard "notch" configuration. The longer one waits after application before taking a reading, the less reliable the result.	Repeatedly throughout application	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector
Coating Application	M	Coating Thickness <ul style="list-style-type: none"> Determining Dry Film Thickness 	Dry film thickness readings on steel substrates are commonly obtained non-destructively using magnetic gauges. Determining thickness of each coat in a multi-coat system should be a hold point. Dry film thickness instruments fall into four categories: magnetic pull off gauges, eddy-current constant pressure probe (for use on non-ferrous substrates), magnetic constant pressure probe and destructive.	As each coat is cured	Applicator/ Contractor QC
					Spot Verification Owner QA Inspector
Coating Application	M	Evaluating Cure	Cure time will be shown on the manufacturer's product information sheet. Final cure may take two to three weeks depending upon prevailing	Prior to recoat and loading/ transport	Applicator/ Contractor QC

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	Mandatory/ Optional	Criteria	How?	When?	Who?
			conditions. Handling may be performed when coating is “dry to handle” – must be agreed with Owner’s QA. Tests are available such as rubbing with sandpaper, color comparisons, pencil hardness and solvent rub test. The test will be dependent on the coating.		Spot Verification Owner QA Inspector (Communication with Owner’s Rep. Required)

3.6 RESPONSIBILITIES**A. Engineering Manager.**

1. The Engineering Manager (or equivalent) shall ensure that a protective coatings subject matter expert is nominated for their Dow Corning or Hemlock Semiconductor facility. They shall make available sufficient time and funding to allow that individual to become competent in their role and to apply that competency to the application of protective coatings, whether during capital or maintenance works.
2. For smaller sites without a NACE inspector, the Engineering Manager must be aware of inspection requirements and determine alternatives to an on-site, full-time NACE inspector, and possibly utilize a regional resource for this role.

B. Protective Coating Applicator.

1. All applications of protective coatings shall comply with the requirements of this standard. Any protective coatings applicator will provide trained and competent labor for the application of protective coatings. All training records will be available for review upon request.
2. All protective coating applicators shall have available to them, at all times within their own organization, an individual qualified to at least NACE Level 1.
3. All protective coating applicators will have their own documented procedures ensuring the quality of preparation for and application of protective coatings. Records of quality inspections by the applicator will be retained and available for review. They will apply only coatings that have been previously approved by Owner, as documented within the Protective Coatings Standard.
4. The protective coatings applicator will be thoroughly familiar with the properties, quality and application methods for all protective coatings that they may be required to use. They will, as a matter of course, obtain product data sheets from the manufacturer for any of those products and retain those on record.

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5. The protective coatings applicator will coordinate with the Owner nominated Quality Inspector for all inspections, both those nominated by the local protective coatings subject matter expert and those routinely undertaken by the applicator.
 6. Coating work will be subject to periodic examination by the DC nominated Quality Inspector as defined within the Inspection Table.
- C. Quality Inspector.
1. Each site shall have a nominated quality inspector operating independently of the protective coatings applicator. That inspector shall be qualified to a minimum of NACE Level 2 or equivalent. That inspector shall carry out quality inspections at intervals agreed by and on works nominated by the local protective coatings subject matter expert. Inspections shall be carried out in accordance with the quality inspection table. These inspections shall be in addition to any undertaken by the protective coatings applicator. All reports will be provided to the local protective coatings subject matter expert. The quality inspector may be a direct or indirect Owner employee.
 - a) For smaller sites without a dedicated inspector, Engineering Manager shall consult Protective Coatings EET or coatings subject matter expert for assistance.
 2. The inspector shall verify that the coating applicator has completed the daily quality checks per the quality plan and that the records are available for review by the local protective coatings subject matter expert. Records include: ambient temperature; humidity; steel substrate temperature; and coating materials batch numbers. Refer to inspection table.
 3. For equipment fabricated off site, consult Protective Coatings EET or local coatings subject matter expert, and Reliability Team Leader regarding risk/benefit of on-site owner inspections. Ensure decision and justification are documented in the project file. There may be instances where non-critical equipment would not require owner's inspection. Declining to conduct owner inspections at fabrication site would not relieve the vendor/fabricator of meeting his required inspection and documentation obligations.
- D. Protective Coatings Subject Matter Expert.
1. Shall be responsible for the compliance with all protective coating standards as they apply to their site. Shall be sufficiently knowledgeable in the technical aspects of protective coatings, their specification and methods of application to be able to lead and advise on the selection of protective coatings, their application and the necessary quality assurance measures.
- E. Mechanical Engineer.
1. Will provide mechanical engineering technical input and advice during the design stages of capital projects or, if responsible, for the mechanical aspects of particular process plants during maintenance coating activities; such that it may benefit the selection of protective coating specifications, preparation or application methods. In particular, this input and advice will be critical to any novel situations such as the use of specialist metals, application of systems on unusual duties, etc.

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Mechanical Engineers will primarily be concerned with process equipment and pipe work.

2. Any variation to agreed protective coating specifications, for the purpose of trials or specialist coatings on particular duties, will be agreed by the local protective coating subject matter expert in writing, detailing any specific quality requirements. See also variance procedure HSG-STD-00400003 and HSG-GDL-09900017 Documentation of Coatings Trials.

F. Civil Engineer.

1. Will provide civil engineering technical input and advice during the design stages of capital projects or, if responsible, for the civil aspects of particular process plants during maintenance coating activities; such that it may benefit the selection of protective coating specifications, preparation or application methods. In particular this input and advice will be critical to any novel situations. Civil Engineers will primarily be concerned with structural steel and general building works.
2. Any variation to agreed protective coating specifications, for the purpose of trials or specialist coatings on particular duties, will be agreed by the local protective coating subject matter expert in writing, detailing any specific quality requirements. See also variance procedure HSG-STD-00400003 and HSG-GDL-09900017 Documentation of Coatings Trials.

G. Project Manager.

1. The Project Manager is responsible for the overall coordination of a capital project. A project manager may also be appointed for significant maintenance protective coating activities. Their responsibilities will include in particular the allowance of sufficient time and resources within the design and construction phases of a project for compliance with the requirements of this standard.

H. Construction Representative.

1. The construction representative will be knowledgeable in the practical requirements of protective coatings application and in the requirements of this standard. They will ensure that the requirements of this standard are applied in the field by the protective coatings applicator. Should they at any point recognize that this standard cannot be applied, they will bring it to the attention to the local protective coatings subject matter expert for discussion and resolution.

4

DEFINITIONS

Term	Definition
Cure	The applied film must be allowed to cure for a given length of time prior to being placed into service. The cure time is generally shown on the manufacturer's information sheet. Alternatively, forced heat curing may be used to reduce the time between final cure and service.
Dry Film Thickness (DFT)	DFT readings on steel substrates are commonly obtained non-destructively using magnetic gauges. DFT readings are taken to provide reasonable assurance that the specified or desired dry film thickness has been achieved.
(Engineering) Standard or Specification	See HSG-STD-00300003 'SSG Document (Standards, Specs, Guidelines) Definitions'

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Term	Definition
Owner	Dow Corning or Hemlock Semiconductor, direct and contracted employees thereof.
Surface Profile	Defined as the maximum average peak-to-valley depth created during surface preparation.
Variance	Sometimes referred to a 'waiver'. It means an 'exception to' the rule or mandatory standard.
Variance Request	A documented description and reason, using the required Form, for not following a mandatory Standard or Specification.
Wet Film Thickness (WFT)	Used to aid the applicator in determining how much material to apply in order to achieve specified dry film thickness. WFT on steel and most other metals are considered guidelines.

5 **RELATED SSG DOCUMENTS**

SSG Document No.	SSG Title
HSG-STD-00400003001	Global Engineering Standard or Specification Variance Request Form Template Example (for reference only) NOTE: Effective 01APR2012, the Global Variance Request form must be accessed from the EET Team Room in order to initiate a variance request.
HSG-STD-00300003	SSG Document (Standards, Specs, Guidelines) Definitions
HSG-SPC-09900013	Global Specification – Protective Coatings
HSG-STD-09900015	Global Protective Coatings Standard
HSG-GDL-09900017	Documentation of Coatings Trials

6 **REFERENCES**

Document No.	Title
PIP CTSE 1000	Process Industry Practices. Application of External Coatings
PIP CTCE 1000	Process Industry Practices. External Coating System Selection Criteria.
	NACE International, the Corrosion Society.

7 **APPENDICES AND ATTACHMENTS**

7.1 APPENDICES

Document No.	Title
Appendix 1	General Quality Control Requirements for Industrial Coatings

7.2 ATTACHMENTS

Document No.	Title
None	

* * * END OF SECTION * * *

Appendix 1:**General Quality Control Requirements for Industrial Coatings****1. Scope**

This section outlines contractor requirements for project quality control monitoring, reporting and documentation for all coating projects conducted at the Owner's facilities. In addition, all applicable associated coating work conducted by the contractor that is processed off site will also be subject to these requirements.

2. Responsibilities

- A. Unless otherwise specified or approved by the Owner, the contractor shall have on site during all production work at least one employee designated, whose primary responsibility is to perform as the "Contractor Quality Control Representative", (henceforth known as QC) with a minimum (current) NACE Coating Inspector Program (CIP) Level One or SSPC Protective Coatings Inspector Program (PCI) Level One certification, to monitor, document and act as a contractor liaison between the Owner or the Owner's representative (henceforth known as QA).
- B. Unless otherwise specified or approved, the contractor QC shall be responsible for insuring that all production work shall be conducted strictly in accordance with all specification requirements and the latest edition/revision of the materials (coatings) manufacturer's product data sheets. Any deviation from the specification requirements or the coatings manufacturer's product data sheet/s must be approved by the owner using the "Project Specification Change Request" form. This form must be initiated by the contractor, submitted to the QA for processing and must include written documentation from the coating/s manufacturer stating that the deviation in question will not adversely impact the designed performance of the installed coating system. (The Owner retains the right to accept, modify or reject all "Project Specification Change Requests" regardless of any documentation or statements provided or submitted by the coating/s manufacturer.)
- C. At any time during the execution of contracted or Time & Materials coatings projects, the Owner reserves the right to conduct any project related testing the owner feels is necessary, including but not limited to: ASTM D5162 (current edition) Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates and ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers. All test guidelines will be obtained from the materials (coating) manufacture technical service department representative.
- D. Unless otherwise specified or approved, upon request and during contract scheduled start and stop dates, the contractor's QC shall make available for review to the Owner or QA, all quality control documentation relating to this contract and will submit to the Owner or QA copies, either hard or electronic, on a weekly basis to be used at the Owner's discretion.

3. Specific Production Requirements

- A. Unless otherwise specified or approved, all work shall meet the requirements of applicable sections listed in SSPC Painting Manual, Volume 1, 4th Edition "Good Painting Practice" and SSPC Painting Manual, Volume 2, "Systems and Specifications" May 2013 Edition.

- B. Unless otherwise specified or approved, a minimum surface preparation will be conducted on all coatings work in accordance with "SSPC-SP 1 Solvent Cleaning" prior to the commencement of any mechanical surface preparation operations (including hand tool, sanding or abrasive blast cleaning operations or any other process not listed in the specification designed to prepare surfaces for coating application).
- C. All compressed air coming into direct contact with any surface to be blasted/coated shall be tested daily or after the utilized compressor shuts down and sufficient time has elapsed for the compressor to cool to ambient temperature, in accordance with ASTM D4285 (current edition) Standard Test Method for Indicating Oil or Water in Compressed Air.
- D. Regarding product mixing, the contractor QC will be responsible for ensuring the proper mixing of all coatings used during the implementation of this contract. In order to lower material cost, the practice of deviating from the manufacturer's product data sheets during product mixing, also known as "splitting the kit", is a common industry occurrence during field coating application operations. This practice is typically a deviation from product data sheet requirements and is not authorized unless no restrictions are stated. The contractor is encouraged to order proper kit sizes and quantities to minimize cost when practical but can request a waiver for this requirement providing the manufacturer provides in writing procedures to accomplish the mixing process accurately.
- E. Unless otherwise specified or approved, all weld seams, edges and angles will receive a stripe coat (specified primer) between the primer and finish coat.

4. Documentation, Inspection and Testing Requirements

- A. Unless otherwise specified or approved, the contractor QC will be responsible for completing and submitting to the Owner or QA for review and acceptance the applicable "Dow Corning Quality Control Documentation" provided in this specification package. A completed project "Inspection Plan" shall be submitted for review and must be approved by the Owner prior to the commencement of any project work. Daily QC reports shall be submitted to the Owner on a weekly basis and will be due on the first day of the proceeding work week, normally Mondays, with remaining reports completed, submitted and reviewed on a recurring basis. Failure of the contractor QC to submit reports as required can be grounds for stop work directives with any additional cost associated with such a directive to be the sole responsibility of the contractor.
- B. All work associated with the implementation of this contract shall be subject to continuous monitoring and inspection by the Owner or QA.
- C. At all times, all test equipment/gauges utilized in the performance of this contract shall have current calibration documentation available on site for review and verification by the Owner or QA. Upon request, the contractor shall also make available said test equipment/gauges to the Owner or the QA for inspection and testing verification.
- D. Due to unique operational requirements, it may become necessary at times to conduct testing for soluble salts on surfaces prior to surface preparation and/or coating application. The contractor QC shall have available a supply of an approved testing kit and shall use SSPC-Guide 15: Field Methods for Extraction and Analysis of Soluble Salts on Steel and Other Nonporous Substrates (current edition) as a guideline for testing when required.

- E. Unless otherwise specified or approved, all DFT (Dry Film Thickness) inspections shall be conducted in accordance with the latest edition/revision of SSPC-PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements.
- F. Unless otherwise specified or approved, all blast-cleaned steel surface profile measurements shall be conducted in accordance with ASTM D4417 (current edition, method C) Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.

Quality Control Documents for Industrial Coating Contractors

1. Scope

This section is the actual contractor reporting documentation for all coating projects conducted at Dow Corning and Hemlock Semiconductor. In addition, all applicable associated coating work conducted by the contractor that is processed off site will also be subject to these requirements. They are submitted to the Owner's representative responsible for following the work.

Coating Inspection Report Form Instructions



There are several forms included in this documentation package that are available to assist the coating applicator and inspector during coating/lining projects. Daily and Weekly QA/QC reports are **MANDATORY**. Inspection Plan is **MANDATORY** for coating work on insulated process piping and equipment, fireproofing, and immersion linings; it may be used on other work at the discretion of the Owner's representative. Nonconformance Report shall be completed if any nonconformance is found. All other forms are available for use as deemed necessary by Owner.

Coating Inspection Report Filing Instructions

- 1 All completed reports shall be submitted to the responsible Owner's NACE Inspector for final review and to file in the appropriate equipment folder, along with any other documentation that is part of the coating/lining project.
- 2 Reports shall be saved using the following naming convention....
 - Vessels - XXXXXXXX Coating Report Name (MM-DD-YY)*
 - Example - 10021552 Coating Daily QAQC (05-08-14)*
 - Piping - Line# or P&ID Coating Report Name (MM-DD-YY)*
 - Example - HW1-15847 Coating Daily QAQC (05-08-14) or 78494-BL Coating Daily QAQC (05-08-14)*

Coating Inspection Plan

Dow Corning INTERNAL

		Coatings Project Inspection Plan					
Work Order Number:		Specification Number:			Prepared By:		
Contractor:		Scope of Work:			Date Prepared:		
Contractor Phone Number:					(DCC/HSC) Reviewed By:		
Contractor QC:					(DCC/HSC) Date Approved:		
Contractor QC Phone Number:					(DCC/HSC) Phone Number:		
Contractor Job No.							
Item No.	Inspection Line Items/Check Points	Specification Requirements	Inspection Requirements			Document Requirements	Comments
			Frequency (1)	Method/Standard (2)	Equipment (3)		
1.1	Pre-Job Concerns						
1.1.1	Contractor Equipment						
1.1.2	Documentation On Site						
1.1.3	Material Storage						
1.1.4	Inaccessibility Issues						
1.1.5	Lighting Requirement Issues						
1.1.6	Safety Concerns						
1.2	Pre-Surface Preparation Inspections						
1.2.1	Surface Cleanliness						
1.2.2	Edges, Weld Spatter and Slivers						
1.2.3	Protective Coverings/FME						
1.2.4	Metal Loss or Pitting Issues						
1.2.5	Compressed Air Cleanliness						
1.2.6	Abrasive Size, Type and Cleanliness						
1.3	Surface Preparation Inspections						
1.3.1	Surface Cleanliness						
1.3.2	Surface Profile						
1.3.3	Soluble Salt Testing/Remediation						

Coating Inspection Plan

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Item No.	Inspection Line Items/Check Points	Specification Requirements	Inspection Requirements			Document Requirements	Comments (* Indicates DCC/HSC QA Hold Point)			
			Frequency (1)	Method/Standard (2)	Equipment (3)					
1.4	Coatings									
1.4.1	Materials Receipt and Storage									
1.4.2	Mixing Requirements									
1.5	Coatings Application									
1.5.1	Surface Conditions Prior to Coating									
1.5.2	Compressed Air Cleanliness									
1.5.3	Coating Equipment Used									
1.5.4	Stripe Coat									
1.5.5	Caulking									
1.5.6	Wet Film Thickness									
1.5.7	Visual Appearance and Continuity									
1.5.8	Inter-Coat Cleanliness									
1.5.9	Recoat Windows Observed									
1.5.10	Dry Film Thickness									
1.5.11	Repairs and Tie-Coats									
1.6	Additional Required Testing and Final Inspection									
1.6.1	Cure Testing									
1.6.2	Adhesion Testing									
1.6.3	Destructive Testing of Dry Film									
1.6.4	Holiday Detection									
1.6.5	Final Dry Film Thickness									
1.6.6	Punch List and Repairs									
<i>Fill form out completely using manufacture's product data sheets and procurement documentation for reference, enter N/A if not applicable.</i>										
*** Key ***										
Frequency (1)			Method/Standard (2)		Equipment (3)					
D = Daily			List Method/Standards/ASTM		List Equipment used to Perform Testing					
I = Initial			V = Visual							
O = Occurrence-Based			DR = Document Review							
P = Periodic			T = Test							

Coatings Project Inspection Plan

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Coating Material Requirements				
(Use Additional Sheets as Needed)				
Item	1st Coat/Primer	2nd Coat	3rd Coat	Caulking/Pit Filler/Other Materials
Complete Product Name				
Product Number				
Manufacturer				
Type of Application (Full, spot, overcoat, etc.)				
Shelf Life				
Surface Temperature Requirements				
Dew Point Requirements				
Ambient Air Temperature Requirements				
Relative Humidity Requirements				
Mix Ratio Requirements				
Thinner Allowances				
Mix Coating Temperature Requirements				
Induction Time Requirements				
Pot Life				
Target Wet Film Thickness (un-thinned)				
Target Wet Film Thickness (with thinner)				
Dry Film Thickness Acceptable Ranges				
Recoat Window Requirements				
Application Method				
Stripe Coat Requirements				
Caulking Requirements				
Cure Time Requirements				
Other				
<i>Fill form out completely using manufacture's product data sheets and procurement documentation for reference, enter N/A if not applicable.</i>				
Notes:				



Weekly Report Form

Dow Corning INTERNAL

[illegible]

Coatings Project Daily QA/QC Form

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		Coatings Project Daily QA/QC Report Form								
Work Order Number:		Specification Number/s:		Report Number:						
Contractor:		Contractor QC:		Date Prepared:						
Contractor Phone Number:		Contr. QC Phone Number:		(DCC/HSC) Reviewed By:						
Contractor Job No.		Start Shift Time:		(DCC/HSC) Phone Number:						
		End Shift Time:								
Summary of Work Completed:										
Inspection Line Items/Check Points	Performed by Contractor's QA/QC			Verified by DCC/HSC QA/QC				Status		Comments
	Yes	No	N/A	Document Review	Visual	Testing (see QA test plan)	Not Performed	SAT	UNSAT	
Protective Coverings in Place										
SSPC SP-1 Conducted										
Sharp Edges, Fins, Slivers, Pack Rust Removed										
Ambient Conditions										
Compressed Air Cleanliness										
Abrasive Size, Type, & Cleanliness										
Surface Cleanliness										
Surface Profile										
Soluble Salt Testing										
Soluble Salt Remediation										
Coating Storage and Mixing										
Coating Application										
Surface or Inter-Coat Cleanliness										
Recoat Times Observed										
Stripe Coat Applied										
Caulking Applied										
Wet Film Thickness Measurements										
Dry Film Thickness Measurements										
Repairs to Damaged Coatings Performed										

1 of 4

Coatings Project Daily QA/QC Form

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Work Order Number:			Specification Number/s:				Report Number:			
QA TESTING										
Ambient Conditions										
Location	Time	DB F°	WB F°	RH %	DP F°	ST F°	Delta T F°	SAT	UNSAT	Comments
Comments / Weather Forecast:										
SURFACE PREPARATION										
QA Testing Performed	N/A	Not Performe	Location(s)			Specified	Actual	SAT	UNSAT	Comments
Compressed Air Cleanliness										
Surface Cleanliness										
Surface Preparation Standard										
Surface Profile										
Soluble Salt Contamination										
Blast Media										
Comments / Testex Tape:										

Coatings Project Daily QA/QC Form

Dow Corning INTERNAL

Work Order Number:				Specification Number/s:				Report Number:			
COATING MATERIALS / MIXING DATA											
Mix No.	Coating Mfr. & Product Name	Component A		Component B		Component C or Thinner			Quantity Mixed	% Thinner Added	
		Batch No.	Exp. Date	Batch No.	Exp. Date	Type	Batch No.	Exp. Date		PDS	Actual
MIXING DATA CONT. / COATING APPLICATION											
Mix No.	Time of Mix	Mixed Coating Temp °F	Mixed By (Person performing task)	Induction Time	Pot Life	Application		Application Method		Location Applied	
						Start Time	Stop Time	Brush	Spray		
COATING APPLICATION CONT.											
Mix No.	Applied Coating (primer, mid, top, touchup)	Date & Time Surface Prep or Prior Coat Installed	WFT Measurements		Applicator(s)						
			Specified	Actual							
Comments:											

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Coatings Project Daily QA/QC Form

Dow Corning INTERNAL

[illegible]



Coatings Project Punch List

Dow Corning INTERNAL

[illegible]

NCR Form



Dow Corning INTERNAL

	Coatings Project Nonconformance Report	
Work Order Number:		NCR Number:
Contractor:		Date of NCR Generation:
Contractor Job No.		
Controlling Documentation:		Inspector:
Describe NC Condition:		
Manufactures Recommendations:		
Contractor's Proposed Corrective Action Plan:		
DCC/HSC Response to Proposed Contractor's CAP:		
Name of Owner Representative:		
Date:		
Disposition: Rework _____ Accept as is _____ Repair _____ Reject/Resubmit _____		
Contractor Corrective Action/s Implemented:		
Date/s of Rework or Repairs:		
Rework or Repairs Accepted? Yes _____ No _____ N Date Verified:		
NCR Closed? Yes _____ No _____ Resubmit _____ Inspector:		
DCC/HSC Representative Signature:		
Date:		Copies to: Owner _____ Contractor _____ Other _____

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Coatings RFI Form



Dow Corning INTERNAL

		Coatings Project Request for Information Form			
Work Order Number:			RFI Number:		
Contractor:			Date of RFI Generation:		
Contractor Phone Number:			Contractor Job No.		
Controlling Documentation:			Inspector:		
Describe Reason for RFI:					
Contractor's Proposed Change to Specification:					
Manufactures Recommendations:					
DCC/HSC Response to RFI Change Request:					
Name of Owner Representative:					
Date:					
Disposition: Accept Change as Submitted _____ Accept with Modification _____ Reject/Resubmit _____					
Additional Comments:					
Date:			Copies to: Owner _____ Contractor _____ Other _____		

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Asset Release to Customer Form

Dow Corning INTERNAL

	Asset Release to Customer Form	
Work Order Number:	Specification Number:	
Controlling Documentation:	Functional Location:	
Scope:	Contractor:	
	EMR:	

Asset equipment's installed coating/paint will be fully cured and can be returned to service or insulated any time after:

Date: _____ Time: _____

a) Asset was inspected to NACE/SSPC standards and best practices for coatings and liners.

b) The quality of work performed by the assigned contractor meets or exceeds all written specifications by the owner and coatings manufacture recommendations.

(To be signed in order.)

1) Inspector Signature: _____ Date: _____

2) Equipment owner or PES signature to approve of date and time required to fully cure the paint _____ Date: _____

* If date and time does not fit operation's schedule a TEAM LEADER of the area must sign this form.

* AREA TEAM LEADER signature: _____ Date: _____

* If date and time does not work for operations, this form must be signed by the responsible area team leader. The area team leader acknowledges that the coating was applied properly but has not been allowed the required time to fully cure prior to work proceeding or systems placed back into service. The installed coating's integrity will need to be reconfirmed at a later date (to be determined by the Dow Corning Integrity Group). The installed coating system may be required to be fully re-worked due to insufficient time allowed for full cure and by signing this form, the Dow Corning Area TEAM LEADER accepts all responsibility for any required re-work.

3) Contractor Rep. signature: _____ Date: _____

4) Signed copy of this form is to be placed on the Insulator's S&I reps desk for scheduling. The S&I representative will return this form to the NACE inspector for final

ENGINEERING**STANDARD**

REVISION NUMBER:	3.0	EFFECTIVE DATE:	02-DEC-2016
DOCUMENT TYPE:	Engineering	MANDATORY:	Yes
DISCIPLINE:	CIV-ARC	APPLICABLE SITES:	HSC
DOC CLASS:	STD	ISSUED/OWNED BY:	HSC CSA Eng TL
DOC SUBCLASS:	SSG	STATUS:	Effective
SECURITY CLASS:	Internal	DOCUMENT NO:	HSG-STD-09900015

TITLE: **Global Protective Coatings Standard**

Revision	Date	By	Description of change
3.0	02-DEC-2016	M. Williams/S. Wegener	Reclassified as HSC document and made clerical updates to this effect. No change in document revision.
	16-SEP-2014	Protective Coatings EET	Discipline changed from CA to MD for AESSG tool, no change in document revision.
1.0	29-JAN-2014	Protective Coatings EET	New document for upload to EngDocs

1. PURPOSE

1.1 This specification covers the general requirements for the materials and application of protective coating for buildings, steelwork, equipment, piping and other plant items.

2. SCOPE**2.1 Introduction**

- A. For stand alone, one off projects, this document will be issued to the applicator as part of the project package. Where the applicator may be the holder of a term maintenance contract, or may be required to carry out multiple projects, this document will be issued on a one off basis, followed by any updates as required.
- B. The following requirements will apply to all applications of protective coatings unless specifically excluded within the following text or a variance has been applied for and approved under the instructions of the Engineering Standard and Specification Variance Request Procedure – HSG-STD-00400003.
- C. This standard will apply corporation wide, to all HSC plants. It will apply to the application of protective coatings during the construction phase of capital projects and to the application of coatings during routine maintenance works.
- D. Note: Local standards supplementary to this standard may be permitted, but they must not be contradictory to or in any way lessen the requirements of this standard.
- E. The Protective Coatings Quality Assurance document, HSG-STD-09900014, shall apply to all applications of protective coatings.
- F. Protective coating applicators, whether HSC employees or contractors, must inspect the site to acquaint themselves with the scope of work.
- G. Unless stated to the contrary in contract documentation, the protective coating applicator is to furnish all supervision, labor, materials and equipment necessary to complete all surface preparation, prime, intermediate, finish protective coating, and touch-up protective coating as specified herein and in the specific project work package.

ENGINEERING**STANDARD****REVISION NUMBER:** 3.0**EFFECTIVE DATE:** 02-DEC-2016

- H. HSC protective coating specifications are selected to ensure 10-15 year coating life. Selecting the correct specification for the application will optimize the chances of achieving that life span.
- I. All protective coatings in the specification are lead free. Any proposed alternate protective coatings shall be lead free. Lead free is defined as having a lead content less than 0.01wt%.
- J. HSC protective coating systems are defined in Document HSG-SPC-09900013, Global Specification – Protective Coatings.

2.2 Materials

- A. Coatings are to be supplied by HSC-approved suppliers and distributors. All technical, Health & Safety and handling requirements are available from the protective coating manufacturer. These instructions shall be fully complied with for work on and off site using these materials.
- B. When ordering protective coating materials and supplies, be sure to identify the items as for HSC use in order to get the HSC global pricing structure and volume purchase credit.
- C. The protective coating applicator shall thoroughly familiarize himself with the quality, properties, and proper application of all materials concerned. The applicator will contact the protective coating manufacturer to obtain such information where this is not given in the specification. Where the owner's specification may differ from that of the manufacturer, the owner's specification will govern.

2.3 General

- A. Care must be taken to ensure that protective coating is not applied to moving parts of machinery, spindles and threads. Reference HSG-STD-09900014, Protective Coatings Quality Assurance document.
- B. Where item numbers or signs will be obscured by protective coating, these are to be replaced with new sign, writing, etc.

2.4 Standards

- A. All work is to conform to the latest editions of all necessary Standards. This may include, but is not limited to global HSC standards, local or regional HSC standards, national or regional quality standards, and recognized best practices.

2.5 Inspections

- A. The applicator shall submit an Inspection and Test Plan (ITP) identifying all inspections and will liaise with the Owner's nominated Protective Coating Inspector for all inspections. All inspection plans must be in line with document HSG-STD-09900014, Protective Coatings Quality Assurance.
- B. Work may be subject to periodic examination by the representatives of the owner and/or protective coating manufacturer who will report directly to HSC.

ENGINEERING**STANDARD****REVISION NUMBER:** 3.0**EFFECTIVE DATE:** 02-DEC-2016**3. DISCUSSION****3.1 Preparation of Surfaces****A. Steelwork**

1. All surfaces to be coated shall be prepared as per manufacturer's data sheet or specification.
2. All areas where blasting is taking place shall be isolated by erecting appropriate fire retardant screens. Signs shall be provided indicating that blasting is in progress. Dedicated blasting areas or areas so identified by the owner's representative may be exempt from this requirement.
3. All surfaces such as glassware, dials, rotating and reciprocating gear motors, etc. or any such item pointed out by the inspector, which may be damaged by grit, sand or water, or protective coating, shall be adequately protected by masking or other means (especially sprinkler heads). This protection must be removed at the completion of the work day and replaced before the next day's work or at such other intervals as may be agreed with owner's representative.
4. Areas covered by electric or instrument cables shall not be subject to blast cleaning, but an allowance for hand cleaning shall be included.
5. Existing Metal Surfaces - If abrasive blast is not specified because the existing primer, intermediate, or top coating is in sound condition, the following shall apply:
 - a. Remove dirt, grease or other foreign matter, by emulsion.
 - b. Clean the surface of all steelwork by high pressure water blast without removing the existing good coating. These areas will be agreed and documented during the contract. Otherwise, full preparation is required.
 - c. Where FULL PREPARATION is specified, the following will apply: When work is carried out in situ on the plant and water blast is specified, the applicator shall fresh water blast to an agreed cleanliness standard. It is important that with the above, the preparation is safeguarded against early rusting, either by the use of rust inhibitors introduced into the water or by the use of moisture cured primers OR BOTH. This will be confirmed by the nominated protective coating manufacturers and their specification must apply unless specified otherwise in writing by the owner's representative.
6. Piping Under Insulation and Steelwork. In a situation where abrasive blasting is being carried out due to the condition of the existing coating, then:
 - a. The surface is to be prepared as in shop blasting conditions in all cases. However, if work done in situ, it shall be done in phases using hand held grit blasting equipment.
 - b. Blasted surfaces must be coated within a period not to exceed 8 hours. However, where local conditions dictate or it has been mandated by the local subject matter expert, it shall be coated within a period not to exceed 4 hours.
7. Field welds on Piping: Any protective coating system is to be stopped 50 mm (2 inches) from the planned joint. Each coat is to be 50 mm short from the previous coat. The welded area shall be mechanically blasted per applicable coating specification.

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8. Pumps, motors and other ancillary equipment shall be prepared for protective coating in accordance with the requirements of the manufacturer, bearing in mind the parent metal, location and duty.
 9. Galvanized pipe, galvanized handrails, galvanized steel, etc. shall not be shot blasted. A brush off grit blast is typically called for in the preparation of galvanized surfaces.
- B. Brickwork and Concrete Surfaces (Internal and External)
1. Remove all oil, grease, dirt and any foreign matter, mortar fins, any laitance (fine particles from surface) or protrusions, and blast clean to sound surface. Fill in any crevices or holes with approved filler, and allow filler to properly cure before coating.
- C. Fiberglass Piping is not protective coated as a general rule. Consult coatings subject matter expert in cases where fiberglass coating is requested or indicated.
- D. Cleanliness and Housekeeping
1. All waste blast materials must be cleared as work progresses.
 2. All plants and buildings are to be left in clean and tidy condition, at end of working day and at completion of contract. Any over spray shall be removed.
 3. All waste must be cleared from the work area and placed in skips, which will be supplied by the Applicator. Drainage channels must be kept free of grit or other materials at all times.

3.2 Extent of Work

- A. Plant and Equipment
1. All vessels, columns, and heat exchanges shall be coated per the protective coating system called out in the equipment specification or data sheet.
 2. Flanges - All external surfaces, including bolt holes and flange annulus, are to be prepared and protective coating as specified. The machined joint face or CLA is not to be prepared or coated.
 3. Insulated pipe work, vessels and tanks shall be coated per protective coating specification. Where required by specification, every flange and/or weld shall be stripe coated to provide extra protection
 4. Pumps, compressors, motors and other machinery are normally supplied with manufacturer supplied coatings and colors. Project engineer shall verify that vendor coating is approximately equivalent to HSC specification. For assistance, consult coatings subject matter expert as needed.
- B. Piping (carbon steel, galvanized)
1. Uninsulated piping, flanges, valves and fittings shall be given primer, undercoats and finishing coats per the HSC protective coating system
 2. Valves, fittings, etc., shall be coated as for the parent line. Valve spindles shall not be coated.
 3. Insulated surfaces shall be coated as specified.
 4. Pipe supports shall be coated as for steelwork.

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1. Steel instrument supports, and junction box supports shall be coated as for steelwork.
2. Relief valves outside shall be coated as for the parent line, but particular attention must be made to moveable parts.
3. For actuated valves that are delivered uncoated, hand prepare and coat valve body only, as per parent line.

D. Electrical

1. Electrical motors, starter and switchgear will have received a protective coating by the manufacturer, suitable for location and duty. For colors, refer to HSG-SPC-09900013 Global Specification – Protective Coatings.
2. Electrical conduits, push button stations, welding and other electrical outlets, junction boxes, etc., will have received a protective coating by the manufacturer, suitable for location and duty. For colors, refer to HSG-SPC-09900013.
3. Steel supports for outdoor lighting fittings, sub-panels and the like shall be coated as for steelwork.

E. Fire Protection Equipment

1. All exposed lines to be coated: galvanized lines to be prepared as per the coating specification. See mechanical standard for underground piping.

F. Removable Beams

1. Removable beams shall be appropriately labeled/coated as per local requirements to indicate that they are intended to be removed.

3.3 Storage and Protection

- A. Deliver all coating materials to the job site in original unopened containers with labels attached. A space will be designated for storage of materials and equipment.
- B. Containers, when not in use, must be covered at all times to protect them from damage, exposure to UV, weather, potential contamination or spillage. They must be used and stored in conjunction with the manufacturer's recommendations.
- C. Remove oily and protective coating filled rags, wastes, etc. from the job site every night. Take adequate precautions to prevent fire. Keep all protective coating equipment such as brushes, spraying devices, thinners, pails, and coatings in an orderly fashion with all materials properly covered when not in use.

ENGINEERING**STANDARD****REVISION NUMBER:** 3.0**EFFECTIVE DATE:** 02-DEC-2016**4. DEFINITIONS**

Term	Definition
Owner	Refers to the owner of the manufacturing facility.
Protective Coating Applicator	Refers to the protective coating applicator, whether a direct HSC employee, contracted directly, or subcontracted through a general contractor.
Protective Coating Manufacturer	Refers to the actual manufacturer of the protective coating materials.
Steelwork	Refers both to structural steel and mechanical piping and equipment.

5. RELATED SSG DOCUMENTS

SSG Document No	SSG Title
HSG-STD-00300003	SSG Document (Standards, Specs, Guidelines) Definitions
HSG-STD-00400003001	Global Engineering Standard or Specification Variance Request Form Template Example (for reference only)
HSG-STD-00300003	SSG Document (Standards, Specs, Guidelines) Definitions
HSG-SPC-09900013	Global Specification – Protective Coatings
HSG-STD-09900014	Protective Coatings Quality Assurance Standard

6. REFERENCES

Document No	Title
PIP CTSE 1000	Process Industry Practices. Application of External Coatings
PIP CTCE 1000	Process Industry Practices. External Coating System Selection Criteria.
	NACE International, the Corrosion Society.

7. APPENDICES / ATTACHMENTS

7.1. Appendices

Document No.	Title
None	

7.2. Attachments

Document No.	Title
None	

* * END OF SECTION * * *