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FOR

C-42 ATRIUM GARAGE STORMWATER CISTERN  
ONONDAGA COUNTY

**TECHNICAL SPECIFICATIONS**

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with a cistern system capable of intercepting stormwater flow from an existing 4-inch diameter cast iron downspout, and discharging the flow through a one-inch diameter orifice plate back into the existing floor drain system. The work shall include a 500-gallon, cone-bottomed polyethylene tank and stand, bypass piping system and valves, concrete equipment pad, and all related appurtenances, as shown on the drawings and as specified herein.
- B. The Atrium Garage is located at 201 South Franklin Street, Syracuse, New York.
- C. Contractor to coordinate with property owner prior to mobilization.

1.2 WORK CONSTRAINTS

- A. Parking garage will remain in use by the public during construction. Contractor to provide Owner with maintenance of traffic plan prior to mobilization.
- B. Hours of construction are 7:00 A.M. to 6:00 P.M., Monday through Friday.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 DEFINITIONS

- A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.
- B. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.2 PROCEDURES

- A. Comply with General Specifications S-013 and S-014.
- B. Direct submittals to Engineer at the following, unless specified otherwise:
  - 1. CH2M HILL  
Attn: Andy Seddon, P.E.  
430 East Genesee Street  
Syracuse, NY 13202
  - 2. Available at preconstruction conference.
  - 3. E-mail: andy.seddon@ch2m.com
- C. Electronic Submittals: Submittals shall, unless specifically accepted be made in electronic format.
  - 1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
  - 2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
  - 3. PDF files shall be set to open "Bookmarks and Page" view.
  - 4. Add general information to each PDF file, including title, subject, author, and keywords.
  - 5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
  - 6. Submit new electronic files for each resubmittal.
  - 7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
  - 8. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
- D. Transmittal of Submittal:
  - 1. Contractor shall:
    - a. Review each submittal and check for compliance with Contract Documents.
    - b. Stamp each submittal with uniform approval stamp before submitting to Engineer.

- 1) Stamp shall include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
  - 2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
  2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form in format approved by Engineer.
  3. Identify each submittal with the following:
    - a. Numbering and Tracking System:
      - 1) Submittals shall be numbered thus:  
C-42-nnnnnn-mmm-xxx, where:
        - a) C42 – Watershed code (assigned to this project by Engineer)
        - b) nnnnnn – Specification section to which submittal relates
        - c) mmm – Submittal sequence number (assigned by Contractor)
        - d) xxx – Submittal revision number (initial submittals are revision "000")
      - 2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
    - b. Specification section and paragraph to which submittal applies.
    - c. Project title and Engineer's project number.
    - d. Date of transmittal.
    - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
  4. Identify and describe each deviation or variation from Contract Documents.
- E. Format:
1. Do not base Shop Drawings on reproductions of Contract Documents.
  2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
  3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
  4. Index with labeled tab dividers in orderly manner.
- F. Timeliness: Schedule and submit in accordance Schedule of Submittals, and requirements of individual specification sections.
- G. Processing Time:
1. Time for review shall commence on Engineer's receipt of submittal.
  2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
  3. Resubmittals will be subject to same review time.
  4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.
- H. Resubmittals: Clearly identify each correction or change made.
- I. Incomplete Submittals:

1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
  2. When any of the following are missing, submittal will be deemed incomplete:
    - a. Contractor's review stamp; completed and signed.
    - b. Transmittal of Contractor's Submittal; completed and signed.
    - c. Insufficient number of copies.
- J. Submittals not required by Contract Documents:
1. Will not be reviewed and will be returned stamped "Not Subject to Review."
  2. Engineer will keep one copy and return submittal to Contractor.

### 1.3 ACTION SUBMITTALS

- A. Prepare and submit Action Submittals required by individual specification sections.
- B. Shop Drawings:
1. Copies: Eight.
  2. Identify and Indicate:
    - a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
    - b. Equipment and Component Title: Identical to title shown on Drawings.
    - c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
    - d. Project-specific information drawn accurately to scale.
  3. Manufacturer's standard schematic drawings and diagrams as follows:
    - a. Modify to delete information that is not applicable to the Work.
    - b. Supplement standard information to provide information specifically applicable to the Work.
  4. Product Data: Provide as specified in individual specifications.
  5. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.
- C. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:
1. Approved:
    - a. Contractor may incorporate product(s) or implement Work covered by submittal.
    - b. Distribution: Electronic.
      - 1) One copy furnished Owner.
      - 2) One copy furnished Resident Project Representative.
      - 3) One copy retained in Engineer's file.
      - 4) Remaining copies returned to Contractor appropriately annotated.
  2. Approved as Noted:
    - a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
    - b. Distribution: Electronic.
      - 1) One copy furnished Owner.
      - 2) One copy furnished Resident Project Representative.
      - 3) One copy retained in Engineer's file.

- 4) Remaining copies returned to Contractor appropriately annotated.
3. Revise and Resubmit:
  - a. Contractor may not incorporate product(s) or implement Work covered by submittal.
  - b. Distribution: Electronic.
    - 1) One copy furnished Resident Project Representative.
    - 2) One copy retained in Engineer's file.
    - 3) Remaining copies returned to Contractor appropriately annotated.

#### 1.4 INFORMATIONAL SUBMITTALS

##### A. General:

1. Copies: Submit eight copies, unless otherwise indicated in individual specification section.
2. Refer to individual specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.

##### B. Certificates:

1. General:
  - a. Provide notarized statement that includes signature of entity responsible for preparing certification.
  - b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 43 33, Manufacturers' Field Services.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

##### C. Closeout Submittals: Comply with General Provisions.

##### D. Contractor-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.

7. Name and version of software.
  8. Information requested in individual specification section.
- E. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.
- F. Payment:
1. Application for Payment: Comply with General Provisions
- G. Test, Evaluation, and Inspection Reports:
1. General: Shall contain signature of person responsible for test or report.
  2. Factory:
    - a. Identification of product and specification section, type of inspection or test with referenced standard or code.
    - b. Date of test, Project title and number, and name and signature of authorized person.
    - c. Test results.
    - d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
    - e. Provide interpretation of test results, when requested by Engineer.
    - f. Other items as identified in individual specification sections.
  3. Field:
    - a. As a minimum, include the following:
      - 1) Project title and number.
      - 2) Date and time.
      - 3) Record of temperature and weather conditions.
      - 4) Identification of product and specification section.
      - 5) Type and location of test, Sample, or inspection, including referenced standard or code.
      - 6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
      - 7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
      - 8) Provide interpretation of test results, when requested by Engineer.
      - 9) Other items as identified in individual specification sections.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 34 00

SPECIAL PROJECT COORDINATION

PART 1 GENERAL

1.01 UTILITY NOTIFICATION AND COORDINATION

- A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, and if conflicts or emergencies arise during Work.

1.02 WORK SEQUENCING/CONSTRAINTS

- A. Site Security: The construction site shall be secured by the Contractor from unauthorized entry at the start of construction until completion acceptance by the Onondaga County Department of Water Environment Protection (OCDWEP) and the Atrium Garage property owner (Owner), 24 hours per day, 7 days per week. Any failure of the Contractor's security system that results in loss of materials or equipment, project delays, rework, or injury is the responsibility of the Contractor. Discovery of an unauthorized entry requires the Contractor to immediately convene a full audit of all measures in place at the time of unauthorized entry, identify the failure point within the security system, prepare a written report to OCDWEP and the Owner describing the failure of the system, and a proposed immediate redesign/upgrade to solve the problem within 24 hours of the discovery so the system meets the required specification. All redesign/upgrade work must be accomplished in a timely manner. Immediate temporary measures are to be in place to prevent unauthorized entry during the audit and the subsequent redesign/upgrade of the Contractor's security system. Further unauthorized entry requires the same procedures to be followed by the Contractor to remedy problems with the system in a timely manner. The Contractor is responsible for all cost associated with securing the site from unauthorized entry.
- B. Include the following work sequences and constraints in the Progress Schedule:
  - 1. Construction activities must be coordinated by OCDWEP and the Owner.
  - 2. Parking garage will remain in use by the public during construction. Contractor to provide Owner with maintenance of traffic plan prior to mobilization.
  - 3. Hours of construction are 7:00 A.M. to 6:00 P.M., Monday through Friday.
  - 4. Access to the Atrium Garage parking lot must be available at all times, unless noted otherwise herein. The area surrounding the work must have adequate "No Parking" signage during construction and must maintain two-way traffic at all times.
  - 5. The construction site must be enclosed with a temporary fence and adequate signage at all times (i.e. 24 hours per day, 7 days per week). The fence setback from areas of work must be at least 8 feet at all times.



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6. Any construction on site should minimize the use of existing parking spaces.
7. After all work is complete, coordination with the Owner on re-stripping of the parking lot must occur.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 03 21 00

REINFORCING STEEL

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI):
    - a. 318, Building Code Requirements for Structural Concrete and Commentary.
    - b. SP-66, Detailing Manual.
  2. American Welding Society (AWS): D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
  3. ASTM International (ASTM):
    - a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
    - b. A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
    - c. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
    - d. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
    - e. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
    - f. A767/767M, Standard Specification for Zinc-Coated (Galvanized) Steel bars for Concrete Reinforcement
    - g. A775/A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
  4. Concrete Reinforcing Steel Institute (CRSI):
    - a. Placing Reinforcing Bars.
    - b. Manual of Standard Practice.
  5. International Code Council (ICC): Evaluation Services Report.
  6. Wire Reinforcement Institute (WRI): WWR-500, Manual of Standard Practice, Structural Welded Wire Reinforcement.

1.2 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66:
    - a. Bending lists.
    - b. Placing drawings.
  2. Welded, metallic sleeve splice, and mechanical threaded connection.
- B. Informational Submittals:
1. Lab test reports for reinforcing steel showing stress-strain curves and ultimate strengths.
  2. Mechanical Threaded Connections:

- a. Current ICC Evaluation Services Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
  - b. Verification device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.
  - c. Manufacturer's instructions.
3. Test results of field testing.

### 1.3 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.1 MATERIALS

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

### 2.2 ACCESSORIES

- A. Tie Wire:
  1. Black, soft-annealed 16-gauge wire.
  2. Nylon-, epoxy-, or plastic-coated wire.
- B. Bar Supports and Spacers:
  1. Use precast concrete bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
  2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
  3. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.
  4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to reinforcing steel.
  5. In Beams, Columns, Walls, and Slabs Exposed to View after Form Removal: Use small precast concrete blocks made of same color as concrete in which they are embedded.
  6. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
  7. Precast Concrete Supports: Total bond precast high performance concrete bar supports as supplied by Con Sys Inc., Pinawa, MB, Canada, or equal.

## 2.3 FABRICATION

- A. Follow CRSI Manual of Standard Practice.
- B. Bend bars cold.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.
- B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.
- C. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.

### 3.2 INSTALLATION

- A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.
- B. Spacing and Positioning: Conform to ACI 318.
- C. Location Tolerances: In accordance with CRSI publication, "Placing Reinforcing Bars".
- D. Splicing:
  - 1. Follow ACI 318.
  - 2. Use lap splices, unless otherwise shown or permitted in writing by Engineer.
  - 3. Stagger splices in adjacent bars where indicated.
- E. Tying Reinforcing Bars:
  - 1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
  - 2. Bend tie wire away from concrete surface to provide clearance of 1 inch from surface of concrete to tie wire.
- F. Straightening and Rebending: Field bending of reinforcing steel bars is not permitted.
- G. Unless permitted by Engineer, do not cut reinforcing bars in field.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American Concrete Institute (ACI):
    - a. 117, Specification for Tolerances for Concrete Construction and Materials.
    - b. 301, Specifications for Structural Concrete.
    - c. 305.1, Specification for Hot Weather Concreting.
    - d. 306.1, Standard Specification for Cold Weather Concreting.
    - e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.
    - f. CP-1, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1.
  2. ASTM International (ASTM):
    - a. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
    - b. C33/C33M, Standard Specification for Concrete Aggregates.
    - c. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
    - d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
    - e. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).
    - f. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
    - g. C150/C150M, Standard Specification for Portland Cement.
    - h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
    - i. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
    - j. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
    - k. C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
    - l. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
    - m. C595/C595M, Standard Specification for Blended Hydraulic Cements.
    - n. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
    - o. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
    - p. C979/C979M, Standard Specification for Pigments for Integrally Colored Concrete.
    - q. C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
    - r. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
    - s. C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

- t. C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method.
  - u. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
  - v. C1218/C1218M, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
  - w. C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.
  - x. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
  - y. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
  - z. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
  - aa. C1582/C1582M, Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.
  - bb. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
  - cc. D4580, Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding.
  - dd. E329, Standard Specification for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
  - ee. E1155, Standard Test Method for Determining  $F_F$  Floor Flatness and  $F_L$  Floor Levelness Numbers.
3. National Ready Mixed Concrete Association (NRMCA).

## 1.2 DEFINITIONS

- A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.
- B. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.
- C. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- D. Hot Weather: As defined in ACI 305.1.
- E. Hydraulic Structure: Liquid containment structure.
- F. New Concrete: Less than 60 days old.

- G. Slurry Mixture: Mixture of sand, 3/8-inch maximum nominal aggregate size, cement, and water for wall construction joints with waterstop.

### 1.3 SUBMITTALS

#### A. Action Submittals:

1. Mix Designs:
  - a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
  - b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
  - c. Manufacturer's Certificate of Compliance for the following:
    - 1) Portland cement.
    - 2) Fly ash.
    - 3) Aggregates, including specified class designation for coarse aggregate.
    - 4) Admixtures.
    - 5) Concrete producer has verified compatibility of constituent materials in design mix.
  - d. Test Reports:
    - 1) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
  - e. Aggregates:
    - 1) Coarse Aggregate Gradation: List gradings and percent passing through each sieve.
    - 2) Fine Aggregate Gradation: List gradings and percent passing through each sieve.
    - 3) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 1.
    - 4) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 3.
    - 5) Test Reports:
      - a) Alkali Aggregate Reactivity: Aggregate shall be classified as nonpotentially reactive in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.
  - f. Admixtures:
    - 1) Manufacturer's catalog cut sheets and product data sheets for each admixture used in proposed mix designs.
2. Product Data: Specified ancillary materials.
3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
  - a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
  - b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
  - c. Methods for temperature protection during placement.
  - d. Types of covering, insulation, housing, or heating to be provided.
  - e. Curing methods to be used during and following protection period.
  - f. Use of strength accelerating admixtures.
  - g. Methods for verification of in-place strength.

- h. Procedures for measuring and recording concrete temperatures.
      - i. Procedures for preventing drying during dry, windy conditions.
    4. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
      - a. Procedures for measuring, and recording temperatures of reinforcement and other embedded items prior to concrete placement.
      - b. Use of retarding admixture.
      - c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
      - d. Types of shading and wind protection to be provided.
      - e. Curing methods, including use of evaporation retardant.
      - f. Procedures for measuring and recording concrete temperatures.
      - g. Procedures for preventing drying during dry, windy conditions.
  - B. Informational Submittals:
    1. Manufacturer's application instructions for bonding agent and bond breaker.
    2. Manufacturer's Certificate of Compliance to specified standards:
      - a. Bonding agent.
    3. Statement of Qualification:
      - a. Batch Plant: Certification as specified herein.
      - b. Mix designer.
      - c. Installer.
      - d. Testing agency.
    4. Field test reports.
    5. Recorded temperature data from concrete placement where specified.
    6. Concrete Delivery Tickets:
      - a. For each batch of concrete before unloading at Site.
      - b. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
      - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

#### 1.4 QUALITY ASSURANCE

- A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.
- B. Qualifications:
  1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
  2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.



PART 2 PRODUCTS

2.1 MATERIALS

- A. Cementitious Materials:
1. Cement:
    - a. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
    - b. Blended Hydraulic Cement:
      - 1) Unless otherwise specified, conform to requirements of ASTM C595/C595M.
      - 2) Portland cement used in blended hydraulic cement, conform to requirements of ASTM C150/C150M.
    - c. Furnish from one source.
  2. Supplementary Cementitious Materials (SCM):
    - a. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
      - 1) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
- B. Aggregates: Furnish from one source for each aggregate type used in a mix design.
1. Normal-Weight Aggregates:
    - a. In accordance with ASTM C33/C33M, except as modified herein.
      - 1) Class Designation: 4S unless otherwise specified.
    - b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
    - c. Alkali Silica Reactivity: See Article Concrete Mix Design.
  2. Fine Aggregates:
    - a. Clean, sharp, natural sand.
    - b. ASTM C33/C33M.
    - c. Limit deleterious substances in accordance with ASTM C33/C33M, Table 1 and as follows:
      - 1) Limit material finer than No. 200 sieve to 3 percent mass of total sample.
      - 2) Limit coal and lignite to 1.0 percent.
  3. Coarse Aggregate:
    - a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
    - b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 3 for specified class designation.
- C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.
1. Characteristics:
    - a. Compatible with other constituents in mix.
    - b. Contain at most, only trace amount chlorides in solution.
    - c. Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
  2. Air-Entraining Admixture: ASTM C260/C260M.
  3. Do not use calcium chloride as an admixture.
  4. Admixtures with no standard, ASTM or other, designation may be used where permitted.

- D. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
    - a. Chloride Content: 500 ppm.
    - b. Sulfate Content as  $\text{SO}_4$ : 3,000 ppm.
    - c. Alkalis as  $(\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O})$ : 600 ppm.
    - d. Total Solids by Mass: Less than 50,000 ppm.

## 2.2 ANCILLARY MATERIALS

- A. Bonding Agent: Unless otherwise specified, in accordance with the following:
1. ASTM C881/C881M, Type V.
  2. Two-component, moisture insensitive, 100 percent solids epoxy.
  3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
  4. Manufacturers and Products:
    - a. BASF Building Systems Inc., Shakopee, MN; Concreive Standard LVI.
    - b. Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
    - c. Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
    - d. Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

## 2.3 CONCRETE MIX DESIGN

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

B. Potential alkali-aggregate reactivity of concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C260/C260M or ASTM C1567.
  - a. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C227 or ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less than 0.04 percent expansion at 2 years for combinations with pozzolan or slag.
  - b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.
  - c. Use low-alkali cement or incorporate pozzolans into concrete mixture as necessary to satisfy testing for potential alkali reactivity.

C. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.
2. Where fly ash is included in mix, minimum fly ash content shall be 15% to 25% of weight of total cementitious materials. Cement shall be replaced at a ratio of 1 pound cement to 1.5 pound fly ash.

D. Slump Range at Site:

1. Slump tolerance shall meet requirements of ACI 117.

2.4 CONCRETE MIXING

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

B. Truck Mixers:

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

2.5 SOURCE QUALITY CONTROL

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

PART 3 EXECUTION

3.1 PLACING CONCRETE

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

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

- C. Placement into Formwork:
1. Reinforcement: Secure in position before placing concrete.
  2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
  3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
  4. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
  5. Vertical Free Fall Drop to Final Placement:
    - a. Forms 8 Inches or Less Wide: 5 feet.
    - b. Forms Wider than 8 Inches: 8 feet, except as specified.
  6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
    - a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
  7. Do not use aluminum conveying devices.
  8. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
  9. Joints in Footings and Slabs:
    - a. Ensure space beneath plastic waterstop completely fills with concrete.
    - b. During concrete placement, make visual inspection of entire waterstop area.
    - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
    - d. Apply procedure to full length of waterstop.
  10. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
  11. Cure concrete as specified in Section 03 39 00, Concrete Curing.
- D. Conveyor Belts and Chutes:
1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
  2. Do not use chutes longer than 50 feet.
  3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
  4. Conveyor Belts:
    - a. Approved by Engineer.
    - b. Wipe clean with device that does not allow mortar to adhere to belt.
    - c. Cover conveyor belts and chutes.
- E. Retempering: Not permitted for concrete where cement has partially hydrated.
- F. Pumping of Concrete:
1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.

2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
  3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- G. Maximum Size of Concrete Placements:
1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
  2. Locate expansion, control, and contraction joints where shown on Drawings.
  3. Construction Joints: Unless otherwise shown or permitted, locate construction joints as follows:
    - a. Locate construction joints as shown on Drawings or where approved in joint location submittal required in Section 03 15 00, Concrete Joints and Accessories.
    - b. Provide vertical construction joints in walls and slabs at maximum spacing of 40 feet, unless shown or approved otherwise.
    - c. When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
    - d. Uniformly space vertical construction joints within straight sections of walls and slabs, avoiding penetrations.
  4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
  5. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.
- H. Minimum Time between Adjacent Placements:
1. Construction joint between top of footing or slab, and column or wall: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
  2. Expansion or Contraction Joints: 1 day.
- I. Consolidation and Visual Observation:
1. Consolidation Equipment and Methods: ACI 301.
  2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.
  3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
  4. Vibrate concrete in vicinity of joints to obtain impervious concrete.
- J. Cold Weather Placement:
1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
    - a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
    - b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Engineer.
    - c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
    - d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.

- e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
  - 1) Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.
2. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.

### 3.2 CONCRETE BONDING

- A. Construction Joints at Existing Concrete:
  1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 1/4 inch.
  2. Saturate surface with water for 24 hours prior to placing new concrete.

### 3.3 REPAIRING CONCRETE

- A. Tie Holes:
  1. Unless otherwise specified, fill with specified repair material.
    - a. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- B. Exposed Metal Objects:
  1. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
  2. Repair area of chipped-out concrete as specified for defective areas.

### 3.4 CONCRETE SLAB FINISHES

- A. General:
  1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
  2. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
  3. Finish slab in accordance with specified slab finish.
  4. Do not dust surfaces with dry materials nor add water to surfaces.
- B. Type S-1 (Steel Troweled Finish):
  1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.
  2. Wood float to true, even plane with no coarse aggregate visible.
  3. Use sufficient pressure on wood floats to bring moisture to surface.
  4. After surface moisture has disappeared, hand steel trowel concrete to produce smooth, smooth dense surface, free from trowel marks.
  5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.

6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
  7. Power Finishing:
    - a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.
    - b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
    - c. Do first steel troweling for slab S-1 finish by hand.
- C. Type S-5 (Broomed Finish):
1. Finish as specified for Type S-1 floor finish, except use only a light-steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
  2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.

### 3.5 FIELD QUALITY CONTROL

- A. General:
1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
- B. Cold Weather Placement Tests:
1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
    - a. Six extra test cylinders from last 100 cubic yards of concrete.
    - b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
  2. These specimens shall be in addition to those cast for lab testing.
  3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
  4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
  5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
  6. Use test results to determine specified strength gain prior to falsework removal or for prestressing.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
  2. American Galvanizers Association (AGA): Inspection of Products Hot-Dip Galvanized After Fabrication.
  3. American Institute of Steel Construction (AISC): S329, Allowable Stress Design Specification for Structural Joints using ASTM A325 or A490 Bolts.
  4. American Iron and Steel Institute (AISI): Stainless Steel Types.
  5. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
  6. American National Standards Institute (ANSI).
  7. American Society of Mechanical Engineers (ASME): B1.1, Unified-inch Screw Threads (UN and UNR Thread Form).
  8. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
  9. American Welding Society (AWS):
    - a. D1.1, Structural Welding Code - Steel.
    - b. D1.2, Structural Welding Code - Aluminum.
    - c. D1.6, Structural Welding Code - Stainless Steel.
  10. ASTM International (ASTM):
    - a. A36/A36M, Specification for Carbon Structural Steel.
    - b. A48, Specification for Gray Iron Castings.
    - c. A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - d. A108, Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
    - e. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - f. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
    - g. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - h. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
    - i. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
    - j. A240/A240M, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
    - k. A276, Specification for Stainless Steel Bars and Shapes.



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- l. A278, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degree.
- m. A283/A283M, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- n. A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile.
- o. A325, Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
- p. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- q. A384, Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- r. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- s. A489, Specification for Carbon Steel Lifting Eyes.
- t. A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- u. A501, Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- v. A563, Specification for Carbon and Alloy Steel Nuts.
- w. A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- x. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- y. A786/A786M, Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- z. A793, Specification for Rolled Floor Plate, Stainless Steel.
- aa. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- bb. A992/A992M, Specification for Steel for Structural Shapes for Use in Building Framing
- cc. B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- dd. B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- ee. B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
- ff. B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
- gg. D1056, Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- hh. F436, Specification for Hardened Steel Washers.
- ii. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
- jj. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- kk. F594, Specification for Stainless Steel Nuts.
- ll. F844, Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

- mm. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 11. International Code Council (ICC): Evaluation Reports for Concrete and Masonry Anchors.
- 12. NSF International (NSF).
- 13. Specialty Steel Industry of North America (SSINA):
  - a. Specifications for Stainless Steel.
  - b. Design Guidelines for the Selection and Use of Stainless Steel.
  - c. Stainless Steel Fabrication.
  - d. Stainless Steel Fasteners.

## 1.2 DEFINITIONS

- A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- B. Exterior Area: Location not protected from the weather by a building or other enclosed structure.
- C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.
- D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

## 1.3 SUBMITTALS

- A. Action Submittals:
  - 1. Shop Drawings:
    - a. Metal fabrications, including welding and fastener information.
    - b. Specific instructions for concrete anchor installation, including drilled hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems.
- B. Informational Submittals:
  - 1. Concrete and Masonry Drilled Anchors:
    - a. Manufacturer's product description and installation procedures.
    - b. Current test data or ICC Evaluation Report.
    - c. Adhesive Anchor Installer Certification.
  - 2. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Adhesive Anchor Installers: Trained and certified by manufacturer.
  2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as is practical, factory assemble items specified herein. Assemblies that due to necessity have to be shipped unassembled shall be packaged and tagged in manner that will protect materials from damage and will facilitate identification and field assembly.
- B. Package stainless steel items in a manner to provide protection from carbon impregnation.
- C. Protect painted coatings and hot-dip galvanized finishes from damage due to metal banding and rough handling. Use padded slings and straps.
- D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Shapes and Plates	A36/A36M
Steel Pipe	A501 or A53/A53M, Type E or S, Grade B
Structural Steel Tubing	A500, Grade B
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Condition CW
Nuts	F594, AISI Type 316, Condition CW

Item	ASTM Reference
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts
Anchor Bolts and Rods	F1554, Grade 55, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Aluminum Plates and Structural Shapes	B209 and B308/B308M, Alloy 6061-T6
Aluminum Bolts and Nuts	F468, Alloy 2024-T4
Cast Iron	A48, Class 35

- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

## 2.2 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

- A. Cast-In-Place Anchor Bolts:
1. Headed type, unless otherwise shown on Drawings.
  2. Material type and protective coating as shown in Fastener Schedule at end of this section.
- B. Anchor Bolt Sleeves:
1. Plastic:
    - a. Single unit construction with corrugated sleeve.
    - b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
    - c. Material: High density polyethylene.
    - d. Manufacturer: Sinco Products, Inc., Middletown, CT, (800) 243-6753.
  2. Fabricated Steel: ASTM A36/A36M.

## 2.3 CONCRETE AND MASONRY DRILLED ANCHORS

- A. General:

1. AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as called in the drawings.
  2. Current evaluation and acceptance reports by ICC or other similar code organization.
  3. Acceptable for use in potable water structures by EPA and local health agencies or NSF.
- B. Expansion Anchors:
1. Self-drilling anchors, snap-off or flush type, zinc-plated.
  2. Nondrilling Anchors: Flush type for use with zinc-plated or stainless steel bolt, or stud type with projecting threaded stud.
  3. Manufacturers and Products:
    - a. ITW Ramset/Red Head, Addison, IL; Multi-Set II Drop-In and Self Drill Anchor.
    - b. Hilti, Inc., Tulsa, OK; Hilti HDI Drop-In Anchor.
    - c. Powers Fasteners, New Rochelle, NY; Steel Drop-In Anchor.
    - d. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Drop-In Anchor.

## 2.4 ACCESSORIES

- A. Antiseizing Lubricant for Stainless Steel Threaded Connections:
1. Suitable for potable water supply.
  2. Resists washout.
  3. Manufacturers and Products:
    - a. Bostik, Middleton, MA; Neverseez.
    - b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.

## 2.5 FABRICATION

- A. General:
1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
  2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
  3. Conceal fastenings where practical; where exposed, flush countersink.
  4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
  5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
  6. Fit and assemble in largest practical sections for delivery to Site.
- B. Materials:
1. Use steel shapes, unless otherwise noted.
  2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 and 0.25 percent.
- C. Welding:
1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.

2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1, Section 5.
4. Aluminum: Meet requirements of AWS D1.2.
5. Stainless Steel: Meet requirements of AWS D1.6.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1, Section 7, and manufacturer's instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143, ASTM A384, and ASTM A385. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
7. Galvanized steel sheets in accordance with ASTM A653.
8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

F. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

G. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

## 2.6 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct any deficiencies.

1. Steel: AWS D1.1, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

2. Aluminum: AWS D1.2.
3. Stainless Steel: AWS D1.6.

**PART 3 EXECUTION**

**3.1 INSTALLATION OF METAL FABRICATIONS**

- A. General:**
1. Install metal fabrications plumb or level, accurately fitted, free from distortion or defects.
  2. Install rigid, substantial, and neat in appearance.
  3. Install manufactured products in accordance with manufacturer's recommendations.
  4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

**3.2 CONCRETE AND MASONRY DRILLED ANCHORS**

- A.** Begin installation only after concrete or masonry to receive anchors has attained design strength.
- B.** Install in accordance with manufacturer's instructions.
- C.** Provide minimum embedment, edge distance, and spacing as follows, unless indicated otherwise by anchor manufacturer's instructions or shown otherwise on Drawings:

Anchor Type	Min. Embedment (bolt diameters)	Min. Edge Distance (bolt diameters)	Min. Spacing (bolt diameters)
Wedge	9	6	12
Expansion and Sleeve	4	6	12
Undercut	9	12	16
Adhesive	9	9	13.5

- D.** Use only drill type and bit type and diameter recommended by anchor manufacturer. Clean hole of debris and dust with brush and compressed air.
- E.** For undercut anchors, use special undercutting drill bit and rotary hammer drill and apply final torque as recommended by anchor manufacturer.
- F.** When embedded steel or rebar is encountered in the drill path, slant drill to clear obstruction. If drill must be slanted more than 10 degrees to clear obstruction, notify Engineer for direction on how to proceed.

**3.3 PAINTING AND REPAIR OF GALVANIZED STEEL**

- A.** Painted Galvanized Surfaces: Prepare as specified on the drawings.

- B. Repair of Damaged Hot-Dip Galvanized Coating:
1. Conform to ASTM A780.
  2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780.
  3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780.
  4. Use magnetic gauge to determine that thickness is equal to or greater than the base galvanized coating.

END OF SECTION



SECTION 22 10 01

PLUMBING PIPING AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
1. American National Standards Institute (ANSI).
  2. American Society of Sanitary Engineering (ASSE):
    - a. 1010, Performance Requirements for Water Hammer Arresters.
    - b. 1050, Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems.
  3. ASTM International (ASTM):
    - a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
    - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - c. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
    - d. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
    - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - f. A179/A179M, Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes.
    - g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
    - h. A197/A197M, Standard Specification for Cupola Malleable Iron.
    - i. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
    - j. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
    - k. A518/A518M, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
    - l. A536, Standard Specification for Ductile Iron Castings.
    - m. A563, Standard Specification for Carbon and Alloy Steel Nuts.
    - n. A861, Standard Specification for High-Silicon Iron Pipe and Fittings.
    - o. A888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
    - p. B32, Standard Specification for Solder Metal.
    - q. B61, Standard Specification for Steam or Valve Bronze Castings.
    - r. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
    - s. B75, Standard Specification for Seamless Copper Tube.
    - t. B88, Standard Specification for Seamless Copper Water Tube.

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- u. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
  - v. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
  - w. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
  - x. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
  - y. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
  - z. B306, Standard Specification for Copper Drainage Tube (DWV).
  - aa. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  - bb. C1277, Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
  - cc. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
  - dd. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  - ee. D2000, Standard Classification System for Rubber Products in Automotive Applications.
  - ff. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - gg. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
  - hh. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
  - ii. E438, Standard Specification for Glasses in Laboratory Apparatus.
  - jj. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
  - kk. F1412, Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
4. American Water Works Association (AWWA):
- a. C104/A21.4, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
  - b. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings, 3-In. Through 48-In. (76 mm Through 1219 mm) for Water.
  - c. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - d. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
  - e. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
  - f. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot-Applied.
  - g. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In (100 mm Through 3,600 mm).
  - h. C606, Grooved and Shouldered Joints.

- i. C651, Disinfecting Water Mains.
5. Cast Iron Soil Pipe Institute (CISPI): 301, Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
6. Plumbing and Drainage Institute (PDI): WH 201, Water Hammer Arrester Standard.

## 1.2 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
  1. Building Service Piping: ASME B31.9, as applicable.

## 1.3 SUBMITTALS

- A. Action Submittals:
  1. Product data sheets.

## PART 2 PRODUCTS

### 2.1 PIPING

- A. Piping Schedule: Refer to Section 40 27 00, Process Piping - General.
- B. Piping Material: Refer to Piping Data Sheet(s), and Section 40 27 00, Process Piping - General.

### 2.2 PIPE HANGERS AND SUPPORTS

- A. Hangers:
  1. Clevis Type: MSS SP 58 and SP 69, Type 1 or 6.
    - a. Anvil; Figure 104 or 260, sizes 1/2 inch through 30 inches.
    - b. B-Line; Figure B3198H or B3100, sizes 3/8 inch through 30 inches.
  2. Hinged Split-Ring Pipe Clamp: MSS SP 58 and SP 69, Type 6 or 12.
    - a. Anvil; Figure 104, sizes 3/4 inch through 8 inches.
    - b. B-Line; Figure B3198H, sizes 3/8 inch through 3 inches.
  3. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.
  4. Attachments:
    - a. I-Beam Clamp: Concentric loading type, MSS SP 58 and SP 69, Type 21, 28, 29, or 30, which engage both sides of flange.
    - b. Concrete Insert: MSS SP 58 and SP 69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
- B. Saddle Supports:
  1. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
    - a. Nonadjustable Saddle: MSS SP 58 and SP 69, Type 37 with U-bolt.
      - 1) Anvil; Figure 259, sizes 4 inches through 36 inches.

- 2) B-Line; Figure B3090, sizes 2-1/2 inches through 36 inches.
  - b. Adjustable Saddle: MSS SP 58 and SP 69, Type 38 without clamp.
    - 1) Anvil; Figure 264, sizes 2-1/2 inches through 36 inches.
    - 2) B-Line; Figure B3093, sizes 2-1/2 inches through 36 inches.
- C. Wall Brackets:
  1. Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty).
    - a. Anvil; Figure 199, 3,000-pound rating.
    - b. B-Line; Figure B3067, 3,000-pound rating.
  2. One-Hole Clamp: Anvil; Figure 126, sizes 3/8 inch through 4 inches.
  3. Channel Type:
    - a. Unistrut.
    - b. Anvil; Power-Strut.
    - c. B-Line; Strut System.
    - d. Aickinstrut (FRP).
- D. Pipe Clamps:
  1. Riser Clamp: MSS SP 58 and SP 69, Type 8.
    - a. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
    - b. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.
- E. Channel Type Support Systems:
  1. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, 1-1/2-inch wide, minimum FRP.
  2. Members and Connections: Design for all loads with safety factor of 5.
  3. Manufacturers:
    - a. B-Line; Strut System.
    - b. Unistrut.
    - c. Anvil; Power-Strut.
    - d. Aickinstrut (FRP System).
- F. Accessories:
  1. Insulation Shields:
    - a. Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.
    - b. Manufacturers and Products:
      - 1) Anvil; Figure 167, sizes 1/2 inch through 24 inches.
      - 2) B-Line; Figure B3151, sizes 1/2 inch through 24 inches.
  2. Welding Insulation Saddles:
    - a. Type: MSS SP 58 and SP 69, Type 39.
    - b. Manufacturers and Products:
      - 1) Anvil; Figure Series 160, sizes 1 inch through 36 inches.
      - 2) B-Line; Figure Series B3160, sizes 1/2 inch through 24 inches.
- G. Galvanize hangers, rods, clamps, protective shields, and hanger accessories.
- H. Trapeze Hangers:

1. Assembly consisting of structure attachments with rod size dependent upon total weight supported, and spacing of assemblies determined by minimum pipe size included in group supported.
2. Trapeze Horizontal: Structural angle or channel section of sufficient size to prevent measurable sag between rods.
3. Manufacturers:
  - a. Unistrut.
  - b. B-Line; Strut System.
  - c. Anvil; Power-Strut.
  - d. Aickinstrut (FRP System).

## 2.3 VALVES

- A. General:
  1. Furnish complete with necessary operating hand wheels.
  2. Renewable Parts Including Discs, Packing, and Seats: Types as recommended by valve manufacturer for intended service.
  3. Units shall have name of manufacturer and size of valve cast on body or bonnet or shown on a permanently attached plate in raised letters.
- B. Valve Actuators:
  1. Open by turning counterclockwise.
  2. Worm and Gear Operators On Manually Actuated Valves: Totally enclosed design, proportioned as to permit operation of valve under full operating head with maximum pull of 40 pounds on handwheel or crank.
  3. Self-locking type to prevent the disc or plug from creeping.
  4. Self-Locking Worm Gears:
    - a. One-piece design of gear bronze material, accurately machine cut.
    - b. Worm: Hardened alloy steel, with thread ground and polished.
    - c. Reduction gearing shall run in a proper lubricant.
- C. Ball Valves:
  1. Thermoplastic Ball Valves 2 Inches and Larger:
    - a. Rated 150 psi at 105 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride (PVC) body, ball, and stem.
    - b. End entry, double union design, with replaceable Teflon seats and EPDM O-ring stem seals.
    - c. Furnish with hand lever Actuator.
    - d. Manufacturers:
      - 1) Hayward Safe-Block.
      - 2) Asahi Duo-Bloc.
- D. Globe Valves:
  1. 3 Inches and Smaller:
    - a. Bronze body, replaceable composition disc, screwed ends, union bonnet, inside screw rising stem, and TFE disc.
    - b. Rated 150-pound SWP, 300-pound WOG.
    - c. Manufacturers and Products:

- 1) Crane; No. 7TF.
- 2) Nibco; No. T-235-Y.

## 2.4 MISCELLANEOUS PIPING SPECIALTIES

- A. Strainers:
1. PVC body, Y-pattern, with threaded PVC cap.
  2. Screen: Heavy-gauge stainless steel, 40 mesh.
  3. Joint: Socket, solvent weld.
  4. Manufacturers and Products:
    - a. Hayward, Y-Strainer.
    - b. Asahi, Sediment Strainer.
- B. Pipe Joint Sealer: Compound insoluble in water or Teflon tape; approved by NSF for use in potable water.
- C. Rubber Gaskets: ASTM C564.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Install plumbing systems to meet the applicable plumbing code.
- B. Field Obstructions:
1. Drawings do not attempt to show exact details of piping. Provide offsets around obstructions.
  2. Do not modify structural components, unless approved by Engineer.
- C. Sleeves:
1. Pipe sizes shown are nominal sizes, unless shown or specified otherwise.
  2. Provide piping passing through walls, floors, or ceilings with standard-weight pipe sleeves.
  3. Provide pipes passing through finished walls with chrome-plated canopy flanges.
  4. Dry pack sleeves in existing work in-place and provide finished appearance.
  5. Pack holes left by removal of existing piping with grout and finish to match adjacent surface.
- D. Provide unions in piping systems at connections to equipment, where shown.
- E. Provide insulating dielectric unions and flanges between ferrous and nonferrous piping and where otherwise required for electrically insulated connection.

### 3.2 INSTALLATION

- A. Rigid PVC:
1. Cut, make up, and install in accordance with pipe manufacturer's recommendations.

2. Ream, clean, and remove burrs from cut ends before joining pipe.
3. Lay in trench by snaking pipe from one side to other.
4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and final use.
5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
6. Shield ends to be joined from direct sunlight prior to and during laying operation.
7. Use strap wrenches only for tightening threaded plastic joints. Do not over tighten fittings.

- B. Valves: Install in accordance with manufacturer's recommendations.
- C. Miscellaneous Piping Specialties: Install in accordance with manufacturer's recommendations.

### 3.3 HANGERS AND SUPPORTS

- A. Install pre-engineered support equipment in accordance with manufacturer's recommendations.

- B. Hanger Rod Sizing and Spacing for:

1. Plastic Pipe:

Pipe Size	Min. Rod Size
1 inch and smaller	1/4"
1-1/4 through 2-1/2 inches	1/4"
3 and 4 inches	3/8"
6 inches	3/8"
8 inches	1/2"

- a. Spacing: As recommended by manufacturer and required by applicable plumbing code for flow and temperature in pipe.
- b. No metal portion of hanger shall contact pipe directly.

- C. Attach Support Rods For Horizontal Piping:

1. To steel beams with I-clamps.
2. To concrete with inserts or with flanges fastened with flush shells.
3. To wood with thickness of 2-1/2 inches or more with bolts or angle clips.

- D. Trapeze Hangers:

1. Trapeze hangers may be used in lieu of individual hangers where horizontal piping is arranged with two or more parallel lines.
2. Attach lines to horizontal with U-bolts or one-hole clamps.

- E. Vertical Piping:

1. Support by channel type support system and pipe clamps on 10-foot maximum centers.

2. Copper, and Plastic Piping: Isolate from channels and pipe clamps with pipe isolators.

### 3.4 INTERIM CLEANING

- A. As specified in Section 40 27 00, Process Piping - General.
- B. Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.
- C. Examine piping to assure removal of foreign objects prior to assembly.
- D. Shop cleaning may employ conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

### 3.5 TESTING

- A. General:
  1. Conduct pressure and leakage tests on newly installed pipelines.
  2. Provide necessary equipment and material, and make taps in pipe, as required.
  3. Test Pressures: As specified herein and in Piping Schedule.
  4. Test Records: Make records of each piping system installation during test to document the following:
    - a. Date of test.
    - b. Description and identification of piping tested.
    - c. Test fluid.
    - d. Test pressure.
    - e. Remarks, including:
      - 1) Leaks (type, location).
      - 2) Repairs made on leaks.
    - f. Certification by Contractor and signed acknowledgment by Engineer that tests have been satisfactorily completed.
- B. Testing New Pipe Connected to Existing Pipe: Isolate new pipe with grooved end pipe caps, spectacle blinds, or blind flanges.
- C. Preparation and Execution:
  1. Exposed Piping: Conduct tests after piping has been completely installed including supports, hangers, and anchors, but prior to insulation.

### 3.6 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are part of this Specification.
  1. Plumbing Piping Data Sheets.

Section Number	Title
40 27 00.10	Perforated Polyvinyl Chloride (PVC) Pipe and Fittings



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END OF SECTION

SECTION 40 27 00

PROCESS PIPING—GENERAL

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
1. Air Force: A-A-58092, Tape Antiseize, Polytetrafluorethylene.
  2. American Association of State Highway and Transportation Officials (AASHTO): HB-17, Standard Specifications for Highway Bridges.
  3. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
  4. American Society of Mechanical Engineers (ASME):
    - a. Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
    - b. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
    - c. B1.20.1, Pipe Threads, General Purpose (Inch).
    - d. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
    - e. B16.3, Malleable Iron Threaded Fittings Classes 150 and 300.
    - f. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
    - g. B16.9, Factory-Made Wrought Buttwelding Fittings.
    - h. B16.11, Forged Fittings, Socket-Welding and Threaded.
    - i. B16.15, Cast Bronze Threaded Fittings Classes 125 and 250.
    - j. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
    - k. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
    - l. B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500, and 2500.
    - m. B16.25, Butt Welding Ends.
    - n. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
    - o. B31.1, Power Piping.
    - p. B31.3, Process Piping.
    - q. B31.9, Building Services Piping.
    - r. B36.10M, Welded and Seamless Wrought Steel Pipe.
    - s. B36.19M, Stainless Steel Pipe.
  5. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
  6. American Water Works Association (AWWA):
    - a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

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- b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
  - c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings for Water.
  - d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
  - f. C116/A21.16, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
  - g. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
  - h. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
  - i. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
  - j. C606, Grooved and Shouldered Joints.
7. American Welding Society (AWS):
- a. Brazing Handbook.
  - b. A5.8/A5.8M, Specification for Filler Metals for Brazing and Braze Welding.
  - c. QC1, Standard for AWS Certification of Welding Inspectors.
8. ASTM International (ASTM):
- a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
  - d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
  - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - f. A135/A135M, Standard Specification for Electric-Resistance-Welded Steel Pipe.
  - g. A139/A139M, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
  - h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - i. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
  - j. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - k. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
  - l. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - m. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
  - n. A197/A197M, Standard Specification for Cupola Malleable Iron.

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- o. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- p. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- q. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- r. A276, Standard Specification for Stainless Steel Bars and Shapes.
- s. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- t. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- u. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- v. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
- w. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- x. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- y. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
- z. A409/A409M, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service.
- aa. A536, Standard Specification for Ductile Iron Castings.
- bb. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- cc. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
- dd. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
- ee. A744/A744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
- ff. A774/A774M, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
- gg. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
- hh. B32, Standard Specification for Solder Metal.
- ii. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- jj. B61, Standard Specification for Steam or Valve Bronze Castings.
- kk. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- ll. B75, Standard Specification for Seamless Copper Tube.
- mm. B88, Standard Specification for Seamless Copper Water Tube.
- nn. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.

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- oo. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
- pp. B464, Standard Specification for Welded UNS N08020, N08024, and N08026 Alloy Pipe.
- qq. B474, Standard Specification for Electric Fusion Welded Nickel and Nickel Alloy Pipe.
- rr. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
- ss. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension.
- tt. D413, Standard Test Methods for Rubber Property Adhesion to Flexible Substrate.
- uu. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
- vv. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- ww. D1330, Standard Specification for Rubber Sheet Gaskets.
- xx. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- yy. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- zz. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- aaa. D2310, Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- bbb. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- ccc. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- ddd. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- eee. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- fff. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
- ggg. D2996, Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- hhh. D3222, Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
- iii. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

- jjj. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
- kkk. D4894, Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.
- lll. D4895, Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion.
- mmm. F436, Standard Specification for Hardened Steel Washers.
- nnn. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- ooo. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- ppp. F441/F441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- qqq. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- rrr. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- sss. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 9. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought Stainless Steel Butt-Welding Fittings.
- 10. NSF International (NSF): 61 Drinking Water System Components—Health Effects.
- 11. National Electrical Manufacturers Association (NEMA): LI 1, Industrial Laminating Thermosetting Products.
- 12. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

## 1.2 SUBMITTALS

- A. Informational Submittals:
  - 1. Pipe and fittings.
  - 2. Factory applied resins and coatings.

## 1.3 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Independent Inspection and Testing Agency:
    - a. Ten years' experience in field of welding and welded pipe and fittings' testing required for this Project.
    - b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
    - c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
    - d. Testing Personnel: Qualified for nondestructive test methods to be performed.
    - e. Inspection Services: Qualified welding inspector.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. As specified on Piping Data Sheet(s), and:
  - 1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
  - 2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
  - 3. Linings and Coatings: Prevent excessive drying.
  - 4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
  - 5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

### PART 2 PRODUCTS

#### 2.1 PIPING

- A. As specified on Piping Data Sheet(s) located at the end of this section as Supplement.
- B. Diameters Shown:
  - 1. Standardized Products: Nominal size.

#### 2.2 JOINTS

- A. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.
- B. Mechanical connections of high-density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of the following:
  - 1. A polyethylene stub end thermally butt-fused to end of pipe.
  - 2. ASTM A240/A240M, Type 304 stainless steel backing flange, 125-pound, ASME B16.1 standard. Insulating flanges shall be used where shown.
  - 3. Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.
  - 4. Gaskets as specified on Data Sheet.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

### 3.2 PREPARATION

- A. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.
- B. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

### 3.3 INSTALLATION—GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- B. Remove foreign objects prior to assembly and installation.
- C. PVC Piping, Threaded Joints:
  - 1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
  - 2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
  - 3. Do not thread Schedule 40 pipe.
- D. PVC Piping, Solvent-Welded Joints:
  - 1. Joint assembly shall comply with ASTM D 2855.
  - 2. Pipe shall be cut square with a fine-toothed saw, then chamfered and deburred.
  - 3. Clean pipe and fittings in accordance with manufacturer's recommendations prior to the application of solvent cement.
  - 4. Test fit pipe and fitting prior to the application of solvent cement.
  - 5. Apply solvent cement in accordance with manufacturer's recommendations.
  - 6. Wipe joint clean of excess solvent cement.

### 3.4 INSTALLATION—EXPOSED PIPING

- A. Piping Runs:
  - 1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
  - 2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.
- B. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.
- C. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
- D. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.



3.5 SUPPLEMENTS

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

1. Piping Schedule.
2. Data Sheets.

Number	Title
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings

END OF SECTION

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SECTION 40 27 00.10		
POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
General	All	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ASME B16.1 drilling
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.  With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts and ASTM A563 Grade A heavy hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch-thick ethylene propylene (EPR) rubber.  Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656 and as recommended by pipe and fitting manufacturer.
Thread Lubricant	All	Teflon Tape.

END OF SECTION