CONTRACT DOCUMENTS

FOR

CONSTRUCTION OF

VINE STREET WTP CLEAR WELL REHABILITATION

FOR

CITY OF ALBANY

OCTOBER 23, 2020

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SECTION 00 01 07 - SEALS PAGE
FOR
VINE STREET WTP CLEAR WELL REHABILITATION
FOR
CITY OF ALBANY

ALEX M. BARGMEYER = AMB

RENEWS: 12-31-21

APPENDIX B: TECHNICAL SPECIFICATIONS

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Division 34 through Division 43
NOT USED

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This Section contains administrative and procedural requirements for submittals for review, information, and for Project closeout.

B. Section includes:

1. Schedule of Submittals.
2. Submittal requirements.
3. Submittal procedures.
4. Engineer review.
5. Resubmittal procedures.
6. Product data.
7. Shop Drawings.
8. Samples.
9. Design data.
10. Test reports.
11. Certificates.
12. Manufacturer's instructions.
13. Manufacturer's field reports.
14. Erection Drawings.
15. Construction progress schedules.
16. Breakdown of contract price.
17. Construction photographs.
18. Operation and maintenance (O&M) instructions.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SCHEDULE OF SUBMITTALS

A. Within 10 days after the effective date of the Contract, Contractor shall submit to Engineer a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of manufacturer, supplier, trade name, subcontractor and model number of each

product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

C. The list and schedule shall be updated and resubmitted when requested by the Engineer.

D. Contractor's Schedule of Submittals will be acceptable to the Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

1.4 SHOP DRAWING AND SAMPLE SUBMITTAL REQUIREMENTS

A. Before submitting a Shop Drawing or Sample, Contractor shall have:

1. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

3. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

B. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

C. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review of each such variation.

1.5 SUBMITTAL PROCEDURES

A. Contractor shall submit Shop Drawings and Samples to Engineer for review in accordance with the accepted Schedule of Submittals.

B. Transmit each submittal with Engineer-accepted transmittal form certifying compliance with requirements of Contract Documents.

C. Sequentially number transmittal forms. Mark transmittal forms for resubmittals with original number and sequential alphabetic suffix.

D. Show each Submittal with the following numbering and tracking system:

1. Submittals shall be numbered according to specification section. For example, the first product submittal for Section 05 50 00 would be “05 50 00-1”. Resubmittals of that submittal would be “05 50 00-1.1”, followed by “05 50 00-1.2”, and so on. The second product submittal for that Section would be “05 50 00-2”.

2. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.

3. Alternative method of numbering may be used if acceptable to Engineer.

E. Identify: Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.

F. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.

G. Coordinate submission of related items.

1. All shop drawings for interrelated items shall be scheduled for submission at the same time.

2. The Engineer may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Engineer will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.

H. When hard copies of submittals are provided by the Contractor, six copies of all materials shall be provided to the Engineer. Two copies of reviewed submittals will be kept by the Engineer, two copies of reviewed submittals will be transmitted to the Owner, and two copies of reviewed submittals will be returned to the Contractor. If the Contractor requests that more than two copies of the reviewed submittal be returned, then the Contractor shall submit the appropriate quantity of submittals.

I. When electronic transmittals of submittals are provided by the Contractor under established protocols described elsewhere in the Contract Documents or as jointly developed by the Owner, Engineer and Contractor, provide electronic submittals in portable document format (PDF) in addition to the source document format (Word, Excel, AutoCAD, etc.). Reviewed submittals will be returned to the Contractor as PDF electronic files.

J. For each submittal for review, allow not less than 14 days for Engineer review, excluding delivery time to and from Contractor.

K. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.

L. Allow space on submittals for Contractor and Engineer review stamps or comments.

M. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.

N. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.

O. Submittals not requested will not be recognized nor processed.

P. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.6 ENGINEER REVIEW

A. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.

B. The Engineer’s review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.

C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.

D. The Engineer will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item".

E. If more than two submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

F. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

G. Engineer's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

H. Engineer's review of a separate item as such will not indicate approval of the assembly in which the item functions.

I. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 1.4.C and Engineer has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such accepted variation from the requirements of the Contract Documents in a Field Order.

J. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 1.4 A. and B.

K. Engineer's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

L. Neither Engineer's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples, subject to the provisions of Paragraph 1.6.I.

1.7 RESUBMITTAL PROCEDURES

A. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples

for review. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Engineer will record Engineer's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS

2.1 PRODUCT DATA

A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents. Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

1. Note submittal will be returned to Contractor without review of submittal if products, models, options, and other data are not clearly marked or identified.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.2 SHOP DRAWINGS

A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer licensed in the state of Project responsible for designing components shown on Shop Drawings.

1. Include signed and sealed calculations to support design.

2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.

3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. All dimensioned shop drawings shall be scalable and provided as full-sized (22-inch x 34-inch) sheets. PDF electronic files shall print as scalable full-sized sheets.

E. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.3 DESIGN DATA

A. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.

B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

2.4 TEST REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.5 CERTIFICATES

A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

2.6 MANUFACTURER'S INSTRUCTIONS

A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.

B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.

C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

2.7 MANUFACTURER'S FIELD REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit report within 48 hours of observation to Engineer for information.

C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.8 ERECTION DRAWINGS

A. Informational Submittal: Submit Drawings for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

2.9 PROJECT HEALTH AND SAFETY PROGRAM

A. Develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. The written Safety Program shall be provided within 30 days after the receipt of the written Notice to Proceed. The Plan shall be assembled to address project specific health and safety issues to both the public and on-site personnel. The plan shall include at a minimum the following items when they apply:

1. Employee orientation
2. Safety inspections
3. Instruction and training
4. Accident reporting
5. Signs and barricades

6. Fire prevention and protection
7. Welding, cutting, and burning
8. Painting and surface treatment
9. Electricity
10. Machinery and mechanized equipment
11. Excavations
12. Sanitation
13. Chlorine safety
14. Hazardous materials
15. Hazardous communications program
16. Job hazard analysis
17. First aid/medical facilities
18. Personal protective equipment
19. Confined space entry plan
20. Shoring plan
21. Fall protection plan
22. Emergency Action Plan
23. Housekeeping
24. Safety training requirements and certification
25. Pedestrian access around work site during construction and after hours
26. Neighboring residences/community access and safety

B. If the project requires other health and safety issues to be addressed, they too shall be included in the Project Health and Safety Program. The Program shall subsequently be distributed to and implemented by the Contractor's personnel, as well as its Subcontractors and Suppliers, the Owner and Engineer. Contractor shall fully implement and comply with the Safety Program and shall submit to the Owner a letter signed by Contractor's owner/president affirming such implementation and compliance within 15 days after on-site work has started. Contractor shall notify the Owner and Engineer when safety meetings will be held so that Owner's and Engineer's personnel may attend. A copy of the Health and Safety Program must be maintained on-site at all times during the life of the Project.

2.10 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

A. Submit preliminary O&M materials for review by Engineer. The equipment manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:

1. Reviewed shop drawings and submittal data;

2. Model, type, size, and serial numbers of equipment furnished;

3. Equipment and driver nameplate data;

4. List of parts showing replacement numbers;

5. Recommended list of spare parts;

6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.;

7. Maintenance and repair requirements including frequency and detailed instructions; and

8. Name, address and phone numbers of local representative and authorized repair service.

B. Following review of the preliminary O&M materials by the Engineer and before acceptance of the Work, submit four copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information.

2.11 OTHER REQUIRED SUBMITTALS

A. Other required submittals include the items listed below. This list is provided for Contractor's convenience only and may not be complete in all respects. Contractor shall provide all submittals specified or required, whether or not listed here.

1. Contractor Emergency Contact List.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 45 00 - QUALITY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers quality control requirements supplementary to those of the General Conditions and Technical Specifications.

1.2 PROVISIONS

A. Contractor's Responsibility for Testing

The CONTRACTOR shall be responsible for the cost of all testing as specified in this section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.

B. OWNER's Right to Perform Additional Tests

The OWNER or ENGINEER reserves the right to complete additional testing. In such cases, the CONTRACTOR shall provide safe access for the OWNER or ENGINEER and their inspectors to adequately inspect the quality of work and the conformance with project specifications.

1.3 QUALITY ASSURANCE

A. Testing Requirements

An independently owned and operated laboratory approved by the ENGINEER shall perform all testing as specified herein.

B. Testing

1. General

a. All required testing of work and/or materials shall be conducted in the presence of the ENGINEER. The CONTRACTOR shall provide 48-hour notification to the OWNER and OWNER's REPRESENTATIVE prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the ENGINEER.

b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples of material to be tested shall be selected by such laboratory or agency or by the ENGINEER. The CONTRACTOR shall furnish such samples of all materials without charge to OWNER.

c. The results from any and all tests are made for the information of the OWNER. Regardless of any test results, the CONTRACTOR is solely responsible for the

quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.

2. Costs of Testing

   a. The CONTRACTOR shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.

   b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the CONTRACTOR with no reimbursement by the OWNER.

1.4 SPECIAL INSPECTIONS

Special inspections and testing as required by Chapter 17 of the IBC shall be conducted by OWNER-retained Special Inspectors and Testing Agencies as required and as indicated in the Contract Documents.

A. Special Inspectors and Testing Agencies Responsibilities

1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.

2. Promptly notify OWNER and CONTRACTOR of irregularities and deficiencies observed in the Work during performance of their services.

3. Submit certified written report of each test, inspection and similar quality control service to OWNER, CONTRACTOR and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.

5. Re-test and re-inspect corrected work.

B. CONTRACTOR'S Responsibilities

1. Provide quality requirements to all subcontractors and enforce all requirements.

2. Notify OWNER, ENGINEER, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.

3. Pay for any CONTRACTOR requested testing and inspecting not required by the Contract Documents.

4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. OWNER will deduct such costs from the Contract Price.

5. Submit copies of licenses, certifications, correspondence, records and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the OWNER, ENGINEER and Special Inspectors.

6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:

    a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

    b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.

7. Cooperate with Agencies performing required tests, special inspections, and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:

    a. Access to the Work, including providing an access tripod and safety personnel for the Agencies to access confined space.

    b. Incidental labor, equipment, and materials necessary to facilitate tests and special inspections.

    c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.

    d. Provide facilities for storage and field curing of test samples.

    e. Deliver samples to Testing Agencies.

8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.

9. Schedule times for tests, special inspections, obtaining samples, and similar activities. Distribute schedule to OWNER, ENGINEER, Special Inspectors, Testing Agencies, and each party involved in portions of the work where tests and special inspections are required.

1.5 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three copies of each report to the OWNER or OWNER's REPRESENTATIVE.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

A. The CONTRACTOR shall complete field testing in accordance with the following schedule. Additional source material testing shall be completed as necessary to establish the basis of field tests. The frequency of testing listed in this schedule lists the minimum number of tests per quantity of work completed by the CONTRACTOR. Testing locations to be determined by the ENGINEER.

Material to be Tested	Payment Responsibility	Minimum Testing Frequency
Concrete	OWNER	As required when placed. See detailed requirements in Article 3.14, Quality Control Testing During Construction of Section 03 11 00, Concrete Work.
Shotcrete	CONTRACTOR	As required when placed. See detailed requirements in Article 3.2, Field Quality Control of Section 03 64 23, Shotcrete.
Process Piping	CONTRACTOR	As required. See detailed requirements in Article 3.1, Leak Testing of Water Piping of Section 33 13 00, Testing and Disinfection of Water Utility Piping and Storage Tanks.
Reservoir – Disinfection	CONTRACTOR	As required. See Section 33 13 13, Disinfection of Water Utility Storage Tanks.

END OF SECTION

SECTION 03 11 00 - CONCRETE WORK

PART 1 GENERAL

1.1 SUMMARY

A. The extent of concrete work is shown on the Drawings.

B. Work includes providing formwork and shoring for cast-in-place concrete and installation into formwork of items such as reinforcing steel bar (rebar), anchor bolts, setting plates, bearing plates, anchorages, inserts, reveals, frames, nosings, sleeves and other items to be embedded in concrete.

C. Definitions

1. Batch: Used in this specification to define an overall class of concrete as delivered from a concrete batching plant or on-site batching operation. Batching operations can continue for hours or days and as long as the class of concrete is similar, the batch would be considered the same. Multiple mixer truck loads could be used to deliver a “batch” of concrete over the course of multiple hours or days.

2. Batched/Batching: The loading of concrete, as combined and mixed at a batching/ready-mix plant, into a concrete mixer truck for delivery to the job site.

3. Truckload: A standard concrete mixer truck size is assumed to have a concrete capacity of 8 cubic yards. A truckload is used to help define the frequency of testing which of occurs per concrete mixer truck.

4. Ready-Mix Concrete: Concrete that is manufactured in a batch plant, according to a set engineered mix design. This specification assumes ready-mix concrete will be delivered by mixer truck to the job site.

1.2 RELATED SECTIONS:

A. Section 03 21 00 - Reinforcing Steel.

1.3 QUALITY ASSURANCE

A. Codes and Standards

Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified here:

ACI 301 “Specifications for Structural Concrete for Buildings”

ACI 311 “Recommended Practice for Concrete Inspection”

ACI 318 "Building Code Requirements for Reinforced Concrete"

ACI 347 "Recommended Practice for Concrete Formwork"

ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"

Concrete Reinforcing Steel Institute, "Manual of Standard Practice"

Comply with building code requirements which are more stringent than the above and all Occupational Safety and Health Administration (OSHA) requirements.

B. ASTM International (ASTM)

1. C31, Making and Curing Concrete Test Specimens in the Field
2. C33, Specification for Concrete Aggregate
3. C39, Compressive Strength of Cylindrical Concrete Specimens
4. C40, Organic Impurities in Fine Aggregate for Concrete
5. C85, Cement Content of Hardened Portland Cement Concrete
6. C88, Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
7. C94, Standard Specifications for Ready-Mixed Concrete
8. C131, Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
9. C136, Method for Sieve Analysis to Fine and Coarse Aggregate
10. C143, Slump of Portland Cement Concrete
11. C150, Standard Specification for Portland Cement
12. C156, Water Retention by Concrete Curing Materials
13. C173, Air Content of Freshly Mixed Concrete by the Volumetric Method
14. C231, Air Content of Freshly Mixed Concrete by the Pressure Method
15. C233, Standard Method of Testing Air-Entraining Admixtures for Concrete
16. C260, Standard Specifications for Air-Entraining Admixtures for Concrete

17. C289, Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)

18. C441, Standard Test Method for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali-Aggregate Reaction

19. C457, Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete

20. C494, Standard Specifications for Chemical Admixtures for Concrete

21. C670, Preparing Precision Statements for Test Methods for Construction Materials

22. C803, Penetration Resistance of Hardened Concrete

C. Workmanship

The CONTRACTOR is responsible for correction of concrete work that does not conform to the specified requirements, including strength, tolerances, and finishes. Correct deficient concrete as directed by the ENGINEER. The CONTRACTOR shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

D. Concrete Testing Service

The OWNER or a representative of the OWNER will engage a special inspector/testing laboratory to perform material evaluation tests and to design concrete mixes. See detailed requirements in Part 3.14 “Quality Control Testing during Construction”. Per the OWNER or ENGINEER’s requirements the CONTRACTOR shall notify the designated representative to schedule the special inspections and materials testing required by the project documents.

E. Testing Requirements

Materials and installed work may require testing and retesting, as directed by the ENGINEER, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. Retesting of rejected materials and installed work shall be done at the CONTRACTOR’s expense.

F. Tests for Concrete Materials

1. Test aggregates by the methods of sampling and testing of ASTM C33.

2. For Portland cement, sample the cement and determine the properties by the methods of test of ASTM C150.

3. Submit written reports to the ENGINEER, for each material sampled and tested prior to the start of work. Provide the project identification name and number, date of report, name of CONTRACTOR, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.

4. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing. The materials producer and the CONTRACTOR must sign certificates of compliance.

G. Allowable Tolerances:

1. Construct formwork to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 347, and as follows:

   a. Variation from plumb in lines and surfaces of columns, piers, walls and rises; 1/4-inch per 10 feet, but not more than 1-inch. For exposed corner columns, control joint grooves, and other conspicuous lines, 1/4-inch in any bay or 20 feet maximum; 1/2-inch maximum in 40 feet or more.

   b. Variation from level or grade in slab soffits, ceilings, beam soffits, and rises 1/4-inch in 10 feet, 3/8-inch in any bay or 20 feet maximum, and 3/4-inch in 40 feet or more. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, 1/4-inch in any bay or 20 feet maximum and 1/2-inch in 40 feet or more.

   c. Variation from position of the linear lines and related columns, walls, and partitions, 1/2-inch in any bay or 20 feet maximum, and 1-inch in 40 feet or more.

   d. Variation in sizes and locations of sleeves, floor openings, and wall openings, 1/4-inch.

   e. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls, minus 1/4-inch and plus 1/2-inch.

   f. Variations in footing plan dimensions, minus 1/2-inch and plus 2 inches; misplacement or eccentricity, 2 percent of the footing width in direction of misplacement but not more than 2 inches; thickness reduction, minus 5 percent.

   g. Variation in steps - In a flight of stairs, 1/8-inch for rise and 1/4-inch for treads; in consecutive steps, 1/16-inch for rise and 1/8-inch for treads.

h. Circular structures shall be constructed in a true circular form, with maximum variation of 1/4-inch from the dimensions shown on the plans.

2. Before concrete placement check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.

3. During concrete placement check formwork and related supports to ensure that forms are not displaced, and that completed work will be within specified tolerances.

H. Quality Control Testing During Construction

See Section 3 - Execution.

1.4 SUBMITTALS

A. For information only, submit six copies of manufacturer's data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, water stops, joint systems, chemical floor hardeners, dry-shake finish materials, and others. Bind and submit in one submittal.

B. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with the ACE 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangements of concrete reinforcement. Include special reinforcement required at openings through concrete structures.

C. Submit shop drawings for fabrication and erection of specific finished concrete surfaces as shown or specified. Show the general construction of forms including jointing, special formed joints or reveals, location and pattern of form tie placement, and other items which affect the exposed concrete visually. Submit form drawings for building columns, walls, fascias, and intersections, and concrete pan and joist system. Submit for typical sections only. ENGINEER's review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is the CONTRACTOR's responsibility.

D. Submit six copies of laboratory test reports for concrete materials and mix design tests as specified.

E. Material Certificates may be provided in lieu of materials laboratory test reports. The material manufacturer and the CONTRACTOR, certifying that each material item complies with, or exceeds, the specified requirements shall sign material certificates.

1.5 CONCRETE MIX DESIGNS

A. All concrete materials shall be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

B. If the concrete mix designs specified herein have not been used previously by the ready-mix supplier or if directed by the ENGINEER, mix proportions and concrete strength curves for regular cylinder tests, based on the relationship of 7-, 14- and 28-day strengths versus slump values of 2, 4, and 6 inches, all conforming to these Specifications, shall be established by an approved ready-mix supplier or an independent testing laboratory. A laboratory, independent of the ready-mix supplier, shall be required to prepare and test all concrete cylinders. The costs for preparation of mix designs (if required by the OWNER to be performed by an independent testing laboratory) and testing of concrete and materials shall be borne by the OWNER, except when materials do not meet specified requirements, in which case such costs shall be borne by the CONTRACTOR.

C. The exact proportions by weight of all materials entering into the concrete delivered to the jobsite shall conform to the approved mix design unless specifically so directed by the ENGINEER or Laboratory for improved specified strength or desired density, uniformity and workability.

D. The proportions of such mix design shall be based on a full cubic yard of hardened concrete.

E. Ready-mix companies or jobsite batch plants shall furnish delivery tickets, signed by a Certified Weighmaster, on which each shall state the weight of aggregates, sand, cement, admixtures and water, and the number of cubic yards of concrete furnished, which will be compared against the approved mix design.

F. There shall be no variation in the weights and proportions of materials from the approved mix design.

G. There shall be no variation in the quality and source of materials once they have been approved for the specific mix design.

1.6 READY-MIXED CONCRETE

Ready-mixed concrete shall conform to the requirements of ACI 301 and ASTM C 94. In case of conflict, ACI 301 shall govern.

1.7 SAMPLE

Upon request by the OWNER or ENGINEER the CONTRACTOR shall pour and finish one 2-foot square exposed aggregate concrete sample for ENGINEER’s approval prior to construction if exposed aggregate is included on job.

1.8 JOB CONDITIONS

Maintain continuous traffic control and access for vehicular and pedestrian traffic as required for other construction activities as well as to adjoining facilities for regular operation. Utilize flagmen, barricades, warning signs and warning lights as required, to maintain a safe entrance and passage on all roads or drives abutting the project.

PART 2 PRODUCTS

2.1 FORMS FOR EXPOSED FINISH CONCRETE

Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Finish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Use overlaid plywood complying with U.S. Product Standard PS-1 “B-B High Density Overlaid Concrete Form”, Class I. Use flexible spring steel forms or laminated boards free of distortion and defects to form radius bends as required.

2.2 FORMS FOR UNEXPOSED FINISH CONCRETE

A. Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 FORM MATERIALS

A. Form Coatings

Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compound. Petroleum based coatings shall not be used for structures in creeks and waterways. Biodegradable coatings shall be used which will not contaminate the creeks/waterways or an alternate method for stripping the form shall be proposed.

B. Chamfers, Reveals, Drips

Provide preformed PVC or shaped wood or metal of size and profile as shown on drawings.

C. Inserts

Provide metal inserts for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work. Provide “Parabolt” by the Molly Company, “Phillips Red-Head”, or “Burke” products. The CONTRACTOR is responsible for insuring that all required anchorage not specified in the project documents is installed per current building code and applicable ICC report requirements.

2.4 REINFORCING MATERIALS

A. See Section 03 21 00 – Reinforcing Steel for additional information

B. Reinforcing Bar (rebar): ASTM A615 and as follows below>

Stirrups and Ties	Grade 60 (Grade 40 may be used for #3 and smaller)
All other Uses	Grade 60

C. Steel Wire: ASTM A82, plain, cold-drawn, steel.

D. Welded Wire Fabric (WWF): ASTM A185, welded steel wire fabric.

E. Supports for Reinforcement

Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars, and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise specified. Wood, brick, concrete blocks, and other devices will not be acceptable. For slabs-on-grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are hot-dip galvanized, after fabrication, or plastic protected or stainless steel protected.

F. Fiber Reinforcement – Collated polypropylene fiber, 3/4-inch, manufactured from 100 percent virgin homopolymer polypropylene, hydrophobic, in compliance with ASTM C116.

2.5 CONCRETE MATERIALS

A. Portland Cement

ASTM C150, Type II, unless otherwise acceptable to ENGINEER. Use only one brand of cement throughout the project, unless otherwise acceptable to the ENGINEER. The use of ground granulated blast furnace slag is not allowed.

B. Aggregates

ASTM C33 and as herein specified. Provide aggregates from a single source for all exposed concrete.

Local aggregates not complying with ASTM C33, but which have shown by special test or actual service to produce concrete of adequate strength and durability, may be used when acceptable to the ENGINEER.

1. Fine Aggregate - Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances. Dune sand, bank-run sand and manufactured sand are not acceptable.

2. Coarse Aggregate - Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:

    a. Crushed stone processed from natural rock or stone.

    b. Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted.

    c. Maximum Aggregate Size - Not larger than one-fifth of the narrowest dimensions between sides of forms, one-third of the depth of slabs, nor three-fourths of the minimum clear space between individual reinforcing bars or bundles of bars.

3. These limitations may be waived if, in the judgment of the ENGINEER, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.

4. In general, it is desired that normal commercial mixes using 1-1/2-inch or 3/4-inch maximum aggregate size be used.

5. Aggregate for exposed aggregate concrete shall consist of selected aggregate of washed clean river gravel in color range of medium to dark in browns and grays; material uniformly sized 5/8-inch to 3/4-inch.

C. Water: Clean, fresh, drinkable.

D. Air Entraining Admixture: ASTM C260.

E. Water-Reducing Admixture: ASTM C494, Type A.

F. Set-Control Admixtures: ASTM C494, as follows:

1. Type B, Retarding

2. Type C, Accelerating
3. Type D, Water-reducing and Retarding
4. Type E, Water-reducing and Accelerating

Calcium chloride will not be permitted in concrete, unless otherwise authorized in writing by the ENGINEER.

G. Waterproofing Admixture:

1. Crystalline waterproofing admixture to be added during batching.
2. Approved manufacturers: Xypex

2.6 RELATED MATERIALS

A. Waterstops

1. Provide flat, dumbbell type, or centerbulb type waterstops at construction joints and other joints as shown. Size to suit joints or as shown. Provide PVC waterstops complying with Corps of Engineer's CRD-C 572. Waterstops to be Greenstreak 701 or approved equal. Split face waterstops will not be acceptable under any circumstances.

2. Provide hydrophilic strip waterstops at construction joints and around pipe penetrations as shown in drawings. Cetco WATERSTOP-RX or approved equal.

B. Bituminous and Fiber Joint Filler

Provide resilient and non-extruding type pre-molded bituminous impregnated fiberboard units complying with ASTM D1751, FS HH-F-341, Type 1 and AASHTO M 213. Provide one of the following products:

1. Elastite; Philip Carey/Celotex
2. Flexcell; Celotex Corp.
3. Crane Fiber 1390; W.R. Grace & Co.
4. Fibre; W.R. Meadows, Inc.
5. Tex-Lite; J & P Petroleum Prod. Inc.
6. Sonoflex; Sonneborn/Contech, Inc.

C. Joint Sealing Compound: See Section 07 92 00, Sealants and Caulking

D. Moisture Barrier

Provide moisture barrier cover over all prepared base material. Use only materials that are resistant to decay when tested in accordance with ASTM E154. The moisture barrier consists of heavy Kraft papers laminated together with glass fiber

reinforcement and overcoated with black polyethylene on each side. Provide Moistop, St. Regis, or equal.

E. Form Ties (for forms other than wall forms)

Factory-fabricated, adjustable-length, removable or snap off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise shown, provide ties so portion remaining within concrete after removal is at least 1-1/2 inches inside concrete. Unless otherwise shown, provide form ties, which will not leave holes larger than 1-inch in diameter in concrete surface.

F. Concrete Curing Materials

Acrylic curing and sealing compound - Water emulsion acrylic curing and sealing compound formulated of acrylic polymers of water-based carrier. W.R. Meadows, Inc. VOCOMP-20 or approved equal.

G. Epoxy Adhesive

Provide Sikadur Hi-Mod (Sikastik 370) or Sikadur Hi-Mod Gel (Sikastix 390) for application to wire-brushed and prepared existing concrete to be mated to new concrete. Apply per manufacturer's recommendations.

H. Chemical-Hardener Finish: Provide Hornolith from Tamms Industries or approved equal.

I. Non-shrink Grout: See Section 03 60 00, Grouting.

2.7 PROPORTIONING NORMAL CONCRETE

A. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1. All measurements shall be by weight. All concrete admixtures will either be by the same supplier to insure compatibility. If different suppliers are used, a memorandum from EACH admixture supplier will be provided stating the compatibility of their product with the other supplier's products.

B. The slump shall be between 2 inches and 4 inches when tested in accordance with ASTM Specifications C 143. Variations in the slump range may be allowed by the ENGINEER if admixtures, such as water reducers or superplasticizers, are utilized in the concrete mix. Regardless of the measured slump, the maximum allowable water-cement ratios as specified here-in, shall be strictly adhered to.

C. Compressive Strength, Water and Cement Content

Notwithstanding what has been stated here-before, and unless shown otherwise on the Drawings, the concrete shall meet the following requirements. All concrete except as noted otherwise on the drawings shall have 4,000 pounds per square inch (psi) 28-day compressive strength and a maximum water/cement ratio of 0.45. Up to a maximum of 15 percent of cementitious material may be fly ash in accordance with ASTM C618. The use ground granulated blast furnace slag is not allowed.

D. Retarding Densifiers

1. All concrete (as defined in 2.9 below) used for wall construction shall also contain DARATARD-17, as manufactured by Grace Const. Products, Cambridge, MA or MBL-82, as manufactured by Master Builders, Cleveland, OH in the amounts recommended by the additive manufacturer whenever the air temperature during the pour exceeds 85 degrees Fahrenheit (F).

2. To be considered as equal, any alternate product offered for consideration shall contain no calcium chloride and shall be compatible with air-entrained cements and air-entraining admixtures conforming to the applicable ASTM, AASHTO, ANSI and Federal specifications.

3. CONTRACTOR shall certify that admixtures do not contain calcium chlorides or other corrosive materials.

E. Air-Entraining Agents

1. All concrete that that is specified to be air entrained or that may be exposed to freeze/thaw action either during construction or the service life of the structure must be air entrained. Sufficient air-entraining agent shall be used to provide total air content of 5 percent, +/- 1 percent.

2. Air-entraining agents shall meet ASTM C 260, ASTM C 233 and ASTM C 457.

3. The total volumetric air content of the concrete before placement shall be 6 percent plus or minus 1.5 percent as determined by ASTM C 173 or ASTM 231 for mixes using a ¾" nominal aggregate size

4. Subject to these Specifications, consideration will be given to the following products: PROTEX "AES," GRACE "DAREX AEA," MASTER BUILDERS "MB-AE10," or SIKA CHEMICAL "AER."

F. Water Reducing Admixtures

1. In addition to air-entrainment, approved water reducing additives, which do not affect the ultimate performance of any steel in any way, may be added to maintain

the maximum water content below that specified herein. Water reducing additives shall conform to ASTM C 494, Type A or D.

2. The use of water reducing additives shall not permit a reduction in the minimum specified cement content or in the specified amount of air-entrainment.

3. Admixtures shall contain no calcium chloride, tri-ethanolamine or fly ash. All admixtures shall be from the same manufacturer.

4. Superplasticizers, if allowed by the ENGINEER, shall conform to ASTM C 494, Type F or G, batch plant added using second or third generation only.

5. Set control admixtures if allowed by the ENGINEER, shall conform to ASTM C 494, Type B (retarding) or Type C (accelerating).

G. Fiber reinforcement admixture shall be included in the ready-mix concrete design used for filling and channeling the wet well chambers. Fibers shall be used in strict accordance with the manufacturer's directions.

2.8 CONCRETE MIXING

Ready-Mix Concrete - Comply with the requirements of ASTM C94, and as herein specified. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When the air temperature is between 85 degrees F and 90 degrees F, reduce the mixing and delivery time from 1-1/2 hours to 75 minutes, and when the air temperature is above 90 degrees F, reduce the mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 FORMS

A. Design, erect, support, brace, and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formworks so concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Design formworks to be readily removable without impact shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts,

and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

E. Erect falsework and support; brace and maintain it to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place concrete structures.

Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances.

F. Forms for Exposed Concrete

Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes. Do not use metal cover plates for patching holes or defects in forms. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material, which will produce bow. Assemble forms so they may be readily removed without damage to exposed concrete surfaces. Form molding shapes, recesses and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

Corner Treatment - Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise indicated.

G. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings of forms at inconspicuous locations.

H. Chamfer exposed corners and edges, reveals and drips as shown using wood, metal, PVC or rubber strips fabricated to produce uniform smooth lines and tight edge joints.

I. Provisions for Other Trades - Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such ties. Accurately place and securely support items built into forms.

J. Cleaning and Tightening - Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate mortar leaks.

3.2 PLACING REINFORCEMENT

Detail and place according to ACI Manual SP-66. Unless otherwise noted, minimum cover shall be 1-1/2 inches for No. 5 and smaller bars, 2 inches for No. 6 and larger bars and 3 inches when poured against earth. Unless otherwise noted, bend all horizontals reinforcing a minimum of 2 feet at corners and wall intersections.

A. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.

B. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

C. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Do not place reinforcing bars more than 2 inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

D. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus 2 inches, and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS

A. Construction Joints - Locate and install construction joints, which are not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the ENGINEER.

B. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints. Unless otherwise specified, reinforcement shall be lapped in accordance with ACI Standards.

C. Waterstops - Provide waterstops in construction joints as shown on the drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to

support and protect waterstops during the progress of the work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any joint.

D. Isolation Joints in Slabs-on-Ground - Construct isolation joints in slabs-on-ground at all points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

E. Control Joints in Slabs-on-Ground - Construct control joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4-inch wide by one-fifth to one-fourth of the slab depth, unless otherwise shown.

1. Form control joints by inserting a pre-molded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the slab surface. After the concrete has cured, remove inserts and clean groove of loose debris.

2. Joint sealant material shall be as specified above.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General - Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs - Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screed strips by the use of strike-off templates or accepted compacting type screeds.

C. Cast in Place Reglets - Place in straight and continuous lines as detailed to enable flashing to be applied continuously without deviation at reglet joints more than 1/8-inch. Miter corners for continuous reglet joint where outside corners occur. At inside corners extend one section 1-inch past corner. Adequately anchor or secure reglets per manufacturer's instructions prior to pouring and during construction to insure dimensional tolerances and alignment. Vibrate concrete to insure concrete cover adjacent to and around reglet. Visually inspect after pour and patch as required.

3.5 PREPARATION OF FORM SURFACES

Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed. Thin formcoating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Use dissipating-type form oil at surfaces to receive cement plaster finish. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.6 CONCRETE PLACEMENT

A. Pre-Placement Inspection

1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work as required. Notify ENGINEER in time for inspection prior to pouring.

2. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.

3. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

4. Concrete Curbs and Paving - Do not place concrete until subbase is completed and approved by the ENGINEER as required to provide uniform dampened condition at the time concrete is placed. Moisten subbase as required to provide uniform dampened condition at the time concrete is placed.

B. Place concrete in compliance with the practices and recommendations of ACI 304 and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to re-handling or flowing. Do not subject concrete to any procedure, which will cause segregation.

2. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

3. Do not use concrete which becomes non-plastic and unworkable or does not meet the required quality control limits or which has been contaminated by foreign materials. Do not use re-tempered concrete. Remove rejected concrete from the project site and dispose of in an acceptable location. Do not use concrete whose allowable mixing time has been exceeded.

C. Concrete Conveying

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practicable by methods, which will prevent segregation and loss of concrete mix materials.

2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice and other deleterious materials.

3. The CONTRACTOR shall provide traffic control on the narrow access roads to the work sites.

4. The CONTRACTOR shall not wash concrete trucks/chutes/equipment off at the project site unless plastic tarps and hay bales are employed to contain the concrete. The CONTRACTOR will be required to haul off-site all concrete contaminated soil.

D. Placing Concrete into Forms

1. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

2. Do not interrupt successive placement; do not permit cold joints to occur.

3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.

4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcing will not be permitted.

5. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

6. Do not place concrete in supporting elements until the concrete previously placed in columns and walls is no longer plastic.

E. Placing Concrete Slabs

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

2. Consolidate concrete during placing operations using mechanical vibrating equipment so the concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground, as specified for formed concrete structures. Consolidate concrete in the remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other acceptable methods. Limit the time of vibrating consolidation to prevent bringing an excess of fine aggregate to the surface.

4. Bring slab surfaces to the correct level with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

5. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

F. Bonding

1. Roughen surfaces of set concrete at all joints except where bonding is obtained by use of concrete bonding agent, and clean surfaces of laitance, coatings, loose particles and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and not to leave laitance, loose particles of aggregate or damaged concrete at the surface.

2. Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:

   a. At joints between footings and walls or columns, and between walls or columns and beams or slabs they support, and elsewhere unless otherwise specified herein, dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete.

   b. At joints in exposed work; at vertical joints in walls; at joints in girders, beams, supported slabs and other structural members; and at joints designed to contain liquids; dampen, but do not saturate the roughened and cleaned surface of set concrete and apply a liberal coating of neat cement grout.

c. Use neat cement grout consisting of equal parts Portland cement and fine aggregate by weight and not more than 6 gallons of water per sack of cement. Apply with a stiff broom or brush to a minimum thickness of 1/16-inch. Deposit fresh concrete before cement grout has attained its initial set.

d. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instructions of the bonding material manufacturer.

3. Prepare for bonding of fresh concrete to fully cured hardened concrete or existing concrete by using an epoxy-resin-bonding agent as follows:

a. Handle and store epoxy-resin adhesive binder in compliance with the manufacturer's printed instructions, including safety precautions.

b. Mix the epoxy-resin adhesive binder in the proportions recommended by the manufacturer, carefully following directions for safety of personnel.

c. Before depositing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy-resin grout not less than 1/16-inch thick. Place fresh concrete while the epoxy-resin material is still tacky, without removing the in-place grout coat, and as directed by the epoxy-resin manufacturer.

G. Cold Weather Placing

1. Protect all concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.

2. When the air temperature has fallen to or is expected to fall below 40 degrees F, provide adequate means to maintain the temperature in the area where concrete is being placed at either 70 degrees F for 3 days or 50 degrees F for 5 days after placing. Provide temporary housing or coverings including tarpaulins or plastic film. Keep protections in place and intact at least 24 hours after artificial heat is discontinued. Keep concrete moist. Avoid rapid dry-out of concrete due to over-heating and avoid thermal shock due to sudden cooling or heating.

3. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50 degrees F, and not more than 80 degrees F, at point of placement.

4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms,

reinforcing steel and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.

5. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot Weather Placing

1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.

3. Cover reinforcing steel with water soaked burlap if it becomes too hot so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

4. Wet forms thoroughly before placing concrete.

5. Do not use retarding admixtures unless otherwise accepted in mix designs.

3.7 FINISH OF FORMED SURFACES

A. Rough Form Finish

For formed concrete surfaces not exposed to view in the finish work or covered by other construction, unless otherwise shown or specified. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.

B. Smooth Form Finish

Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view. Or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, damp proofing, painting or other similar system.

Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.

C. Grout Cleaned Finish (Sacked)

Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment, and to all exposed to view interior and exterior building surfaces, typical.

Combine one part Portland cement to 1-1/2 parts fine sand by volume, and mix with water to the consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.

Thoroughly wet concrete surfaces and apply grout immediately to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

D. Related Unformed Surfaces

At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.8 MONOLITHIC SLAB FINISHES

A. Float Finish

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing or sand bed terrazzo, and as otherwise shown on drawings or in schedules.

2. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float, or both. Consolidate the surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding 1/4-inch in 10 feet when tested with a 10-foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill at low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

B. Trowel Finish

1. Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring, paint, or other thin-film finish coating system.

2. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.

3. Consolidate the concrete surface by the final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

C. Broom Finish (Non-Slip)

1. Apply non-slip, broom finish to exterior concrete platforms, steps and ramps and elsewhere as shown on the drawings or in schedules.

2. Immediately after trowel finish, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route or in the direction of water flow. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the ENGINEER before application.

D. Chemical-Hardener Finish

1. Apply chemical curing-hardening compound or chemical-hardener to all interior concrete floors which will not receive applied finish materials. Mask adjacent work and surfaces to avoid over spray. Apply liquid chemical-hardener after complete curing and drying of the concrete surface.

2. Dilute the liquid hardener with water and apply in accordance with the manufacturer's printed directions. Evenly apply each coat and allow for drying between coats in accordance with manufacturer's printed directions.

3. After the final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.9 SCHEDULE OF CONCRETE SURFACE FINISHES

Also see Section 09 90 00, Painting and Coating for protective coating requirements.

	Surface Description	Type	Finish Requirement
A.	Interior Horizontal Slabs	Slab	Trowel Finish
B.	Interior Vertical Surfaces (including Wet Well)	Formed	Smooth Form

3.10 CONCRETE CURING AND PROTECTION

A. General

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

2. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.

3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods

Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing, or by combinations thereof, as herein specified. Provide the curing methods indicated as follows:

1. For concrete floor slabs provide moisture curing, moisture cover curing, or liquid membrane/chemical curing-hardening curing. If liquid membrane curing is used, it must be compatible with concrete hardening compounds to be applied later.

2. For other concrete work, provide moisture curing or moisture cover curing. Do not use liquid membrane or chemical curing-hardening curing on any concrete work to receive any applied finishes.

3. For curing, use only water that is free of impurities, which could etch or discolor exposed, natural concrete surfaces.

4. Provide moisture curing by any of the following methods:

    a. Keeping the surface of the concrete continuously wet by covering with water.

    b. Continuous water-fog spray.

    c. Covering the concrete surface with the specified absorptive cover thoroughly saturated with water and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges with a 4-inch lap over adjacent absorptive covers.

5. Provide moisture-cover curing as follows - Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete placed in the widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

6. Provide liquid membrane curing as follows:

    a. Apply the specified membrane-forming curing compound to damp concrete surfaces as soon as the water film has disappeared. Apply uniformly in a coat continuous operation by power spray equipment in accordance with the manufacturer's directions. Recoat areas, which are subjected to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period.

    b. Do not use membrane-curing compounds on surfaces, which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete. Such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the ENGINEER.

7. Curing Formed Surfaces - Cure formed concrete surfaces, including the undersides of girders, beams, supported slabs, and other similar surfaces by moist curing with the forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

8. Curing Unformed Surfaces

    a. Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing, whenever possible.

    b. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.

    c. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise acceptable to the ENGINEER.

9. Provide liquid curing-hardening compound as follows:

    a. Apply to horizontal surfaces when concrete is dry to touch by means of power spray, hand spray or hair broom in accordance with manufacturer's directions.

C. Temperature of Concrete during Curing

1. When the atmospheric temperature is 40 degrees F and below, maintain the concrete temperature between 50 degrees F and 70 degrees F continuously throughout the curing period. When necessary, make arrangements before concrete placing for heating, covering, insulation, or housing as required to maintain the specified temperature and moisture conditions continuously for the concrete curing period. Provide cold weather protections complying with the requirements of ACI 306.

2. When the atmospheric temperature is 80 degrees F, and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protections complying with the requirements of ACI 305.

3. Maintain concrete temperature as uniformly as possible and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete, which exceed 5 degrees F in any 1-hour and 50 degrees Ft in any 24-hour period.

D. Protection from Mechanical Injury - During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In - Fill-in holes and openings in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.

B. Curbs - Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations - Provide machine and equipment bases and foundations as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

3.12 REMOVAL OF SHORES AND FORMS

A. Remove shores and re-shore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate re-shoring to safely support the work without excessive stress or deflection.

Keep re-shores in place a minimum of 15 days after placing upper tier, and longer if required, until the concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

B. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulative curing at not less than 50 degrees F for 24 hours after placing concrete. Providing the concrete is sufficiently hard to not be damaged by form removal operations and provided curing and protection operations are maintained.

C. Formwork supporting weight of concrete, such as beam soffits, joints, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in place concrete by testing field-cured specimens representative of concrete location or members.

D. Form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

E. Re-Use of Forms

Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use “patched” forms for exposed concrete surfaces, except as acceptable to the Architect.

No forming material will be allowed to be built permanently into exposed visible surfaces.

3.13 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas

1. Repair and patch defective areas with cement mortar immediately after removal of forms but only when directed by the ENGINEER.

2. Cut out honeycomb, rock pockets, voids over 1/2-inch diameter, and holes left by tie rods and bolts down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the ENGINEER.

3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

4. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.

B. Repair of Formed Surfaces

1. Repair exposed-to-view formed concrete surfaces that contain defects, which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the ENGINEER. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolt; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.

2. Repair concealed formed concrete surfaces that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects, as such, include cracks in excess of 0.01-inch wide, cracks or any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corners.

C. Repair of Unformed Surfaces

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.

2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.

3. Repair finished unformed surfaces that contain defects, which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, pop outs, honeycomb, rock pockets, and other objectionable conditions.

4. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so those repairs can be made without damage to adjacent areas.

5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the ENGINEER.

6. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with a neat cement grout coating, or use concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same material to provide concrete of the same type or class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

7. Repair isolated random cracks and single holes not over 1-inch in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

8. For repair of existing unformed surfaces, mechanically remove all lose concrete as required to expose sound aggregate. Clean concrete surfaces to achieve a contaminate free, open textured surface. Square cut or undercut perimeter to minimum depth as specified by the repair mortar manufacturer. Remove all loose concrete around the exposed steel and hand tool or blast clean all portions of rebar with visible rust to near white metal finish. If half of the diameter of the reinforcing steel is exposed, chip out behind the reinforcing to a 1/2-inch minimum depth. Splice new reinforcing steel to existing where corrosion has depleted the cross-section area by 25 percent. Apply a corrosion inhibitor/primer/bonding agent to all exposed rebar and other steel components and to concrete surfaces to be repaired per manufacturer's requirements, such as Sika Armatec 110 . Apply a polymer-modified, cement-based, repair mortar, trowel applied as specified by the manufacturer, such as Sika MonoTop 615.

9. Repair methods not specified above may be used subject to the acceptance of the ENGINEER.

3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The OWNER or a representative of the OWNER will engage a special inspector/testing laboratory to perform all tests and to submit test reports to the ENGINEER and the CONTRACTOR.

B. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:

1. Sampling Fresh Concrete - ASTM C172, except modified for slump to comply with ASTM C94.

2. Slump - ASTM 143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.

3. Air Content - ASTM C231, pressure method; one for each set of compressive strength test specimens.

4. Compression Test Specimen - ASTM C31; one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

5. Concrete Temperature - Test hourly when air temperature is 40 degrees F and below, and when 80 degrees F and above; and each time a set of compression test specimens is made.

6. Compressive Strength Tests - ASTM C39; one set for each 100 cubic yards or fraction thereof, of each concrete class placed in any 1 day or for each 5,000 square

feet of surface area placed; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

a. When the total quantity of a given class of concrete is less than 50 cubic yards, the strength tests may be waived by the ENGINEER if, in his judgment, adequate evidence of satisfactory strength is provided.

b. If required by the building official, perform strength tests of cylinders cured under field conditions. Field cured cylinders shall be taken and molded at the same time and from the same samples as the laboratory cured test cylinders. When the strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

C. Report test results in writing to the ENGINEER and the CONTRACTOR on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of CONTRACTOR, name of concrete supplier and truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength and type of break for both 7-day tests and 28-day tests.

D. Additional tests - The testing service will make additional tests of in-place concrete when test results indicate the specified concrete strengths and other characteristics have not been attained in the structure, as directed by the ENGINEER. The testing service shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. CONTRACTOR shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

SECTION 03 21 00 - REINFORCING STEEL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes all the work necessary to furnish, install, and complete the reinforcing steel.

B. Section includes:

1. Reinforcing steel

1.2 RELATED SECTIONS

A. Section 03 11 00 – Concrete Work
B. Section 03 37 13 - Shotcrete

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Submit shop drawings of detailed placing and bending lists for the ENGINEER's approval before the reinforcement is fabricated.

C. Mill Certificates: Mill test certificates shall be submitted to the ENGINEER to certify that the reinforcing steel meets the specified requirements. Mill test certificates shall be furnished and paid for by the CONTRACTOR.

1.4 QUALITY CONTROL

A. The ENGINEER may require that test samples be taken, and test certificates be furnished by a reputable material testing laboratory at the OWNER's expense.

PART 2 PRODUCTS

2.1 DEFORMED REINFORCING BARS

A. Unless otherwise specified, reinforcing steel shall be Grade 60 billet steel conforming to ASTM A615.

B. Varying grades shall not be used interchangeably in structures.

C. All such reinforcing shall be deformed steel bars with deformations conforming to the requirements set forth in ASTM Specification A615.

D. Steel bending processes shall conform to the requirements of ACI 318.

E. Bending or straightening shall be accomplished so that the steel will not be damaged.

F. Kinked bars shall not be used.

G. Spiral reinforcement and steel wire shall be cold-drawn steel wire conforming to the requirements of ASTM A82 unless shown otherwise on the Drawings.

2.2 SUPPORTS

A. Bar supports shall conform to ACI 315.

B. Bar supports shall consist of approved high density "adobes", stainless steel chairs, plastic spacers or plastic shim plates.

1. Brick, broken concrete masonry units, spalls, rocks or similar materials shall not be used for support of reinforcing steel.

2. Steel chairs shall be furnished with plastic tips when incorporated into concrete exposed to view, such as in the roof slab.

3. Plastic spacers shall be PRECO BARSPAN WHEELS, as manufactured by the PRECO CORPORATION or equal.

4. Plastic shim plates may be used to support the plastic spacers and shall be used to support the vertical reinforcing in the corewall, unless shown otherwise on the Drawings.

C. Hot-dipped Galvanized Reinforcing Bars

When reinforcing bars are indicated on the Drawings to be hot-dipped galvanized, they shall be galvanized in accordance with ASTM A767 and ASTM A143. The grade of reinforcing bars shall be as specified under Section 03210-2.1. The bars shall be galvanized in conformance with a Class 1 coating and shall be galvanized after fabrication and shearing.

D. Welded Wire Fabric Reinforcement

If specified on the Drawings, welded wire fabric shall be manufactured in accordance with ASTM A185. It shall be of new stock and free from rust when placed in the work.

E. Steel Tie Wire: Annealed steel tie wire shall be used to fasten the reinforcing steel in place.

PART 3 EXECUTION

3.1 REINFORCING BARS

Comply with the specified codes and standards and Concrete Reinforcing Steel Institutes recommended practice for "placing reinforcing bars," for details and methods of reinforcement placement and supports, and as herein specified.

A. General

1. Mild steel reinforcing bars shall be furnished, cut, bent, and placed as indicated on the Drawings.

2. At the time of placing concrete, all reinforcement shall be free from loose mill scale, rust, grease or other coating which might destroy or reduce its bond with concrete.

3. Steel reinforcement which is to be placed in the work shall be stored under cover to prevent rusting, and shall be placed on blocking such that no steel touches any ground surface.

4. All reinforcing steel placed in the work shall be tied together and supported in such a manner that displacement during placing of concrete and shotcrete will not occur.

5. When there is a delay in depositing concrete, reinforcement shall be re-inspected and cleaned when necessary.

B. Cutting and Bending

1. Steel reinforcement shall be cut and bent in accordance with ACI 318 and with approved practices and machine methods, either at the shop or in the field.

2. Reinforcement shall be accurately formed to the dimensions indicated on the Drawings and on the bending schedule.

3. Bends for hooks on bars shall be made around a pin having a diameter not less than six times the minimum thickness of the bar.

4. All bars shall be bent cold.

C. Minimum Bar Spacing

The clear distance between parallel bars shall not be less than one and one-half times the diameter of the bars and, unless specifically authorized, shall in no case be less than 1-inch, nor less than the maximum size of coarse aggregate specified.

D. Concrete Cover (Minimum)

1. On all formed surfaces which will be exposed to water, ground, or the elements, there shall be a nominal cover over the steel of 2 inches for bars number 6 through number 18 and 1-1/2 inches for bars number 5 and smaller, with an installation tolerance of + 1/4-inch. When crossing bars of different diameter are encountered in one face, one shall consider the bar size and location that will provide the largest cover over the nearest steel to the outside surface.

2. Unless otherwise specified in these specifications or shown on the Drawings, all reinforcing steel facing subgrades in footing and floors for concrete construction of the tank shall be given a nominal protective cover of 3.0-inch minimum. The largest cover shall be used when different size bars are encountered in one face.

3. The minimum cover over reinforcing steel for concrete construction of other facilities shall be as shown on the Drawings.

4. No "bury" or "carrier" bars will be allowed unless specifically approved by the ENGINEER.

E. Splicing

1. Except as shown or specified on the Drawings, reinforcing steel shall not be spliced at any location without specific approval by the ENGINEER. Splices in adjacent bars shall be staggered.

2. Where permitted or required, splices in reinforcing steel shall have sufficient lap to transfer full strength of the bar by bond and shear. Unless specified or shown otherwise on the Drawings, the bars at a lap splice shall be in contact with each other. In no event shall the lap be less than 40 diameters of the spliced bars.

3. Unless specified or shown otherwise on the Drawings, bars shall be lap spliced in accordance with ACI 318 and shall be fastened together with steel tie wire.

4. Unless shown otherwise on the Drawings, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated on the Drawings. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

F. Supports

1. All reinforcement shall be retained in place, true to indicated lines and grades, by the use of approved bar supports. The CONTRACTOR shall submit for ENGINEER's

approval, samples of all bar supports he proposes to use along with a written description of where each bar support will be used.

2. The supports shall be of sufficient quantity, strength and stability to maintain the reinforcement in place throughout the concreting operations. Bar supports shall be placed no further than 4 feet apart in each direction. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete. The CONTRACTOR shall be held responsible for providing the appropriate quantity and type of bar supports.

3. Do not place reinforcing bars more than 2 inches beyond the last leg on continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

G. Bar Tying

1. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (this shall not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity).

2. Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

	Slab Bars (inches)	Wall Bars (inches)
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 through No. 11	120	96

H. Reinforcement Around Openings -- Where reinforcing steel has to be cut to permit passage of pipe or to create openings, and should no detail be shown for extra reinforcing in such areas, the area of steel removed by the creation of the opening must be replaced by placing at least double the area of steel removed by the opening equally around the openings. The steel shall be placed such that it extends 5 feet beyond the opening on each side to provide for sufficient bond.

END OF SECTION

SECTION 03 37 13 - SHOTCRETE

PART 1 GENERAL

1.1 SCOPE

A. This work includes batching, mixing, transporting, applying, finishing, and testing of shotcrete, installation of drainage and clean-up. Provide all labor, materials, and equipment necessary to perform and complete the work in accordance with requirements of the specifications, and in reasonably close conformity with lines and dimensions shown on the plans and as accepted by the ENGINEER.

B. Shotcrete shall be applied by the wet mix process and may be applied with an automated system acceptable to the ENGINEER.

C. The CONTRACTOR shall inform the ENGINEER at least 24 hours in advance of the times and places at which he intends to place shotcrete.

D. All submittals of data shall be in accordance with the submittals section, except as noted, herein. The CONTRACTOR shall submit specifications and data for review on equipment proposed for the project including compressed air equipment, proposed arrangements, and capacities.

E. Shotcrete shall comply with ACI 506R, “Guide to Shotcrete,” and the requirements of ACI 506.2 “Specification for Materials, Proportioning, and Applications of Shotcrete,” published by the American Concrete Institute, Detroit, Michigan, except as otherwise specified.

1.2 RELATED SECTIONS:

A. Section 03 21 00 - Reinforcing Steel

B. Section 03 11 00 – Concrete Work

1.3 DEFINITIONS

Shotcrete - Pneumatically applied mixture of Portland cement, aggregate, water, and steel fibers conveyed through a hose and projected at high velocity onto a surface. The mixture contains admixtures to provide quick set, high early strength, and satisfactory adhesion. Condensed silica fume may be utilized, subject to the approval of the ENGINEER.

The wet-mix process consists of thoroughly mixing all the ingredients except accelerating admixtures but including the mixing water, introducing the mixture into the delivery equipment and delivering it by positive displacement or compressed air to the nozzle. The mixed shotcrete shall then be air jetted from the nozzle at high velocity onto the surface.

The accelerator admixture shall be added to the shotcrete mixture at the nozzle in a manner which allows proper regulation and uniform dispersion throughout the placed shotcrete.

Defective Shotcrete - Shotcrete which, in the opinion of the ENGINEER, lacks uniformity; exhibits segregation, honeycombing, or lamination; has suffered excessive cracking; was not prepared or applied in strict compliance with these specifications; or fails to meet the strength and toughness requirements specified herein.

1.4 SUBMITTALS

Provide submittals for the following:

A. Qualifications – As a condition of the award of the Contract, submit written documentation as supporting evidence of the qualifications of personnel.

B. Shop Drawings – Submit Shop Drawings listed below.

C. Shotcrete Materials, Preparation, and Application -- Provide all information necessary to verify compliance with ACI 506.2, including the following:

1. Proposed method of application of shotcrete.
2. Description of proposed equipment for mixing and applying shotcrete.
3. Proposed shotcrete mix design including pigment, steel fibers and all admixtures.

D. Reports and Records

1. Shotcrete Testing Reports - Submit certified results of all testing of shotcrete samples to the ENGINEER. Submit certified preconstruction testing reports as specified herein at least 2 weeks prior to the actual application of shotcrete to any surface forming a part of the work. Submit field quality control testing reports within two working days of performing the tests. Include in the reports:

a. Sample identification, including mix design, and test panel number and orientation.

b. Date and time of sample preparation, including curing conditions and sample dimensions.

c. Date, time, and type of test.

d. Complete test results, including load and deformation data during testing, sketch of sample prior to and after testing, and any unusual occurrences observed.

e. Name and signature of person performing the test.

2. Shotcrete Production and Application Reports - Prepare and submit summary of shotcrete production and application for each shift to the ENGINEER on the following work day. Include in the report:

    a. Quantity and location of shotcrete applied, including sketches.

    b. Observations during production and application.

    c. Description of placement equipment.

    d. Batch number(s), if applicable.

    e. Locations of soil nail covered by shotcrete, and verification that the nut soil nail element was checked for tightness and retightened as necessary.

    f. Name and signature of nozzle person.

3. Product Data and Samples:

    a. Applicable manufacturers' instructions, recommendations, literature, and performance and test data for materials, and mixing and application equipment.

    b. Representative samples of shotcrete materials.

1.5 CERTIFICATIONS:

A. Certification of the testing laboratory that will perform shotcrete testing.
B. Certification of specified shotcrete materials to the required standards.

C. ACI Certification of nozzlemen

D. All materials in contact with potable water shall have a current National Science Foundation (NSF) Standard 61 certification.

1.6 REFERENCES:

A. American Concrete Institute (ACI):

1. ACI 506.2 Specifications for Materials, Proportioning, and Application of Shotcrete.
2. ACI 506R Guide to Shotcrete.

B. American Society for Testing and Materials (ASTM):

1. ASTM C31 Practice for Making and Curing Concrete Test Specimens in the Field.

2. ASTM C42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

3. ASTM C494 Specification for Chemical Admixtures for Concrete.

4. ASTM C1018 Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete.

5. ASTM C1140 Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels

6. ASTM C1436 Standard Specifications for Materials for Shotcrete

7. ASMT C1436 Standard Specification for Materials for Shotcrete

8. ASTM E329 Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.7 QUALITY ASSURANCE

A. Workers, including foremen, nozzlemen, and delivery equipment operators, shall be fully qualified to perform the work. All nozzlemen on this project shall have an least 1 year of continuous experience in similar shotcrete application work and shall demonstrate ability to satisfactorily place the material in accordance with the recommendations of ACI 506.3R "Guide to Certification of Shotcrete Nozzlemen," local codes, and the specifications. Each nozzleman will be required, by the ENGINEER, to place shotcrete only after successfully completing one test panel for each shooting position to be encountered, and the results of the 7-day strength tests are known. No shotcrete shall be placed by personnel without this specific qualification.

B. The CONTRACTOR shall notify the ENGINEER no less than 2 days prior to the shooting of a qualification panel.

C. Qualification shall be based on a visual inspection of the shotcrete density and void structure and a 7-day compressive strength of 2,500 psi determined from the average test results from two cores extracted from each panel.

PART 2 PRODUCTS

2.1 MATERIALS

All materials for shotcrete shall conform to the following requirements. All admixtures in contact with potable water must have current, valid NSF 61 approval certificate.

Cement	ASTM C 150, Type I or II.

Fine Aggregate	Clean natural sand, ASTM C 33. Artificial or manufactured sand will not be acceptable.
Coarse Aggregate	Crushed rock, washed gravel, or other inert granular materials conforming to ASTM C 33, except that clay and shale particles shall not exceed 1%.
Water	Clean, potable, and free from deleterious substances.
Admixtures	
Accelerator	Fluid type. To be applied at nozzle.
Water-reducer	ASTM C 494, Type A.
Air-Entraining Agent	ASTM C 260.
Crystalline Waterproofing	ASTM E 329
Welded Wire Fabric	ASTM A 185 or A 497.
Cement Coloring, Integral	

2.2 MIX DESIGN

A. Shotcrete shall be proportioned to produce a mix capable of attaining 4,000 psi compressive strength at 28 days. The shotcrete mix design and method of placement proposed for use at the job site shall be submitted to the ENGINEER by the CONTRACTOR at least 14 calendar days prior to beginning shotcrete placement. The CONTRACTOR shall also include evidence within this submittal that the proposed shotcrete mix design and method of placement will produce the required compressive strength at 28 days. No shotcrete shall be placed without written authorization from the ENGINEER accepting the proposed mix design and method of placement.

B. The minimum cement content shall be 658 pounds (seven sacks) per cubic yard. The sand-cement ratio shall not be more than 4.5 to 1 by weight.

C. Air entrainment shall be at least 7.5%.

D. No admixture shall be used without the ENGINEER's approval. Admixtures used to entrain air, to reduce water-cement ratio, to retard or accelerate setting time, or to accelerate the development of strength, shall be thoroughly mixed at the rate specified by the manufacturer and approved by the ENGINEER.

2.3 FIELD QUALITY CONTROL

A. Field control tests shall be performed by qualified personnel in the presence of the ENGINEER. The CONTRACTOR shall provide equipment, supplies, and the services of one or more employees as necessary to assist in the field control testing.

B. Tests required during the progress of the work will be made at the expense of the Owner.

C. The frequency specified for each field control test is approximate. If additional field control tests are necessary, in the opinion of the ENGINEER, all such tests shall be made.

D. A clearly defined pattern of continuous horizontal or vertical ridges or depressions at the reinforcing elements, after they are covered, will be an indication of insufficient cover or poor application and probable void. In this case, the application of shotcrete shall be immediately suspended and the work carefully inspected by the ENGINEER. Corrective measures, if any, shall be implemented and completed prior to resuming the shotcrete operations.

E. The shotcrete application procedure may be corrected by adjusting the nozzle distance and orientation perpendicular to the surface or water content of the shotcrete mix. All overspray shall be removed from the surface. The shotcreted surface shall be broomed and roughened if needed to ensure proper bond.

F. Slump shall be determined in accordance with ASTM C 143 and total air content shall be determined in accordance with ASTM C 173 or C 231.

G. Before starting shotcrete work, at least one test panel for each proposed mix shall be made by each shotcreting crew, using the 36-in. square panel method and shooting against a solid backboard in a vertical position. The maximum anticipated reinforcing congestion shall be included in a portion of each test panel. Specimens shall be cured under conditions that simulate site curing of applied shotcrete. A minimum of three cubes or cores, no less than 4 in. in diameter and having L/D ratio of at least one, shall be made from each test panel in accordance with ASTM C 42 and tested at 7 days.

H. Test reports which indicate unsatisfactory compressive strengths shall result in suspension of the crew responsible for the rejected specimens until they have demonstrated that they are capable of producing acceptable work, or until additional specimens have been submitted, tested, and proven satisfactory. Panels shall be discarded by and at the expense of the CONTRACTOR.

I. Test reports shall be prepared in four copies and shall be distributed by the testing laboratory directly to the ENGINEER and CONTRACTOR.

2.4 ALIGNMENT CONTROL

Non-corroding alignment wires and thickness control pins shall be provided to establish thickness and plane surface. Alignment wires shall be installed at corners and offsets not established by formwork. The CONTRACTOR shall ensure that the alignment wires are tight, true to line, and placed to allow further tightening.

PART 3 EXECUTION

3.1 SHOTCRETE APPLICATION

A. Prior to shotcrete application, loose materials and loose dried shotcrete from previous placement operations shall be removed from the surfaces by methods acceptable to the ENGINEER. The removal shall be accomplished in such a manner as not to loosen, crack, or shatter the surfaces to receive the shotcrete. Any surface material which, in the opinion of the ENGINEER, is so loosened or damaged, shall be removed to a sufficient depth to provide a base which is sufficiently substantial to receive the shotcrete. Material that loosens as the shotcrete is applied shall be removed.

B. A clean, dry supply of compressed air sufficient for maintaining adequate nozzle velocity for all parts of the work and for simultaneous operation of a blow pipe for cleaning away rebound shall be maintained at all times. Thickness, methods of support, air pressure, and rate of placement of shotcrete shall be controlled to prevent sagging or sloughing of freshly applied shotcrete.

C. The shotcrete shall be applied from the lower part of the area upwards to prevent accumulation of rebound on uncovered surfaces. Surfaces to receive shotcrete shall be damp but not have free-standing water. No shotcrete shall be placed on dry, dusty, or frozen surfaces. The nozzles shall be held at a distance and at an angle approximately perpendicular to the working face so that rebound will be minimal and compaction will be maximized. Shotcrete shall emerge from the nozzle in a steady uninterrupted flow. When, for any reason, the flow becomes intermittent, the nozzle shall be diverted from the work until steady flow resumes.

D. Shotcreter shall take every possible precaution to protect adjacent surfaces, equipment, conduits, piping, etc., from being damaged by overshooting shotcrete. Overshot shotcrete and rebound materials shall be removed before it adheres to adjacent surfaces.

E. Unless otherwise noted on the Drawings, minimum cover over reinforcing and other embedments shall be 1.5-inches.

F. Finish

1. Final wall surfaces shall receive a steel trowel finish. Surface shall be uniform in texture and appearance and maintain a +/- 1/16" smoothness to the surface plane.

3.2 PLUMBNESS OF WALL NOT TO EXCEED ¼" IN 10' WHEN TESTED WITH A 10' STRAIGHTEDGE. DEFECTIVE SHOTCRETE

A. Surface defects shall be repaired as soon as possible after initial placement of the shotcrete. All shotcrete which lacks uniformity, which exhibits segregation, honeycombing, or lamination, or which contains any dry patches, slugs, voids, or sand pockets shall be removed and replaced with fresh shotcrete by the CONTRACTOR to the satisfaction of the ENGINEER at no additional costs to the Owner. Shotcrete repair work shall conform with ACI 506.2.

B. Core holes shall be repaired in accordance with Chapter 9 of ACI 301. Core holes shall not be filled with shotcrete.

C. If newly placed shotcrete is subjected to rain that washes out cement or otherwise makes the shotcrete unacceptable to the ENGINEER, the shotcrete layer in question shall be removed and replaced.

3.3 CONSTRUCTION JOINTS

Construction joints shall be uniformly tapered over a minimum distance of twice the thickness of the shotcrete layer. The surface of the joints shall be rough, clean, sound, and damp. The hardened surface shall be cleaned of all laitance, foreign substances, washed with clean water, and wetted thoroughly preceding placement of fresh shotcrete.

3.4 CURING

The shotcrete shall be cured by applying a clear curing compound. The curing compound shall be applied immediately after gunning. The air in contract with shotcrete surfaces shall be maintained at temperatures above freezing for a minimum of 7 days. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitous finishing materials are to be bonded unless positive measures, such as sandblasting, are taken to completely remove curing compounds prior to the applications of such additional materials.

3.5 COLD-WEATHER SHOTCRETE

Shotcrete shall not be placed in cold weather when the ambient temperature is below 40°F and falling, and when the shotcrete is likely to be subjected to freezing temperatures before gaining sufficient strength to avoid damage. Materials shall be heated in order that the temperature of the shotcrete, when deposited, shall be not less than 50°F or more than 70°F. The temperature of the shotcrete shall be maintained in accordance with ACI 301 and

ACI 306R. Shotcrete shall be protected in accordance with the recommendations of ACI 306R.

END OF SECTION

SECTION 03 60 00 - GROUTING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes all work necessary to form, mix, place, cure, repair, finish, and do all other work as required to produce finished grout, in accordance with the requirements of the Contract Documents.

B. Work covered in this Section includes:

1. Grouting
2. Removal of loose and spalling grout and concrete
3. Anchoring, patching, grouting, and sealing

1.2 RELATED SECTIONS

A. Section 03 11 00 – Concrete Work

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specifications, codes, and standards shall be as specified in Section 03 11 00, Concrete Work and as referred to herein.

B. Commercial Standards:

1. CRD-C 621, Corps of Engineers Specification for Non-Shrink Grout

2. ASTM C109, “Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)”

3. ASTM C531, “Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes”

4. ASTM C579, “Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes”

5. ASTM C827, “Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures”

1.4 SUBMITTALS

A. Manufacturer Technical Data and Strength Test Results: For sack-mix grouts used on minor-structure/systems provide datasheet information verifying the compressive strength, shrinkage, and expansion requirements specified herein for grout used.

B. Manufacturer's Literature: Containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout used in the work.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not place grout when temperature or humidity will affect the performance or appearance of the grout.

B. Do not place grout on dirty, wet, or frozen substrates

PART 2 PRODUCTS

2.1 PREPACKAGED GROUTS

A. Non-shrink grout: This type of grout is to be used wherever grout is required in the Contract Documents, unless another type is specifically referenced.

B. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation of each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

C. Class A non-shrink grouts shall have minimum 28-day compressive strength of 5,000 pounds per square inch (psi); shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRDC 621.

D. Class B non-shrink grouts shall have minimum 28-day compressive strength of 5,000 psi and shall meet the requirements of CRD C621.

E. Application

1. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B

non-shrink grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

2. Class B non-shrink grout shall be used or the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

2.2 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where “dry pack” is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.3 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers approved by the ENGINEER. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as specified by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.

B. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the ENGINEER.

3.2 GROUTING PROCEDURES

Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution of prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

END OF SECTION

See Addendum #2 for changes to this page.

SECTION 03 64 23 - EPOXY ADHESIVE INJECTION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes all work necessary to furnish all materials, tools, equipment, appliances, transportation, labor and supervision required to repair cracks by the injection of an epoxy resin adhesive.

B. Section includes:

1. Epoxy resin adhesive for injection.
2. Surfacing sealing.
3. Equipment for epoxy injecting.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on materials to be used.

1.3 QUALIFICATIONS

A. Epoxy injection shall be performed by a certified applicator.

B. CONTRACTOR'S/SUBCONTRACTOR'S OPERATOR engaged in the epoxy injection process shall have satisfactory operator experience in the methods of restoring concrete structures utilizing the specific epoxy injection process indicated. OPERATOR'S experience shall include previous repairs of cracked or damaged concrete structures, the technical knowledge of correct material selection and use, and the operation, maintenance and troubleshooting of equipment.

PART 2 MATERIALS & EQUIPMENT

2.1 EPOXY RESIN ADHESIVE FOR INJECTION

Epoxy adhesive grout shall be a 100% solids 2-part water insensitive low-viscosity epoxy resin system. Epoxy shall be suitable for grouting both dry and damp cracks. Epoxy shall develop a minimum tensile strength (ASTM D695) of 6,000 psi and a minimum compressive strength of 8,000 psi. Epoxy shall be SELECT BOND GP-4440, as manufactured by SPC, or equivalent.

2.2 SURFACE SEAL

A. The surface seal material is that material used to confine the injection adhesive in the fissure during injection and cure.

B. The surface seal material shall have adequate strength to hold injection fittings firmly in place and to resist injection pressures adequately to prevent leakage during injection.

2.3 EQUIPMENT FOR INJECTION

A. The equipment used to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack shall be portable, positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in-line metering and mixing.

B. The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 psi plus or minus 5 psi and shall be equipped with a manual pressure control override.

C. The injection equipment shall have the capability of maintaining the volume ratio for the injection adhesive prescribed by the manufacturer of the adhesive within a tolerance of plus or minus 5 percent by volume at any discharge pressure up to 200 psi.

PART 3 EXECUTION

3.1 PREPARATION

A. Surface adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil, efflorescence or other foreign matter which may be detrimental to the integrity of the bond between the epoxy and the injection surface. Acids and corrosives shall not be permitted.

B. Entry ports shall be provided along the crack at intervals of not less than the thickness of the concrete at that location.

C. Surface seal material shall be applied to the face of the crack between the entry ports. For through cracks, surface seal shall be applied to both faces.

D. Enough time for the surface seal material to gain adequate strength shall pass before proceeding with the injection.

3.2 EPOXY INJECTION

A. Injection of epoxy adhesive shall begin at lower entry port and continue until there is an appearance of epoxy adhesive at the next entry port adjacent to the entry port being pumped.

B. When epoxy adhesive travel is indicated by appearance at the next adjacent port, injection shall be discontinued on the entry port being pumped, and epoxy injection shall be transferred to the next adjacent port where epoxy adhesive has appeared.

C. Epoxy adhesive injection shall be performed continuously until cracks are completely filled.

D. If port to port travel of epoxy adhesive is not indicated, the work shall immediately be stopped and the ENGINEER notified.

3.3 FINISHING

A. When cracks are completely filled, epoxy adhesive shall be cured to sufficient time to allow removal of surface seal without any draining or runback of epoxy material from cracks.

B. Surface seal material and injection adhesive runs or spills shall be removed from concrete surfaces.

C. The face of the crack shall be finished flush to the adjacent concrete showing no indentations or protrusions caused by the placement of entry ports.

3.4 PRESSURE TEST

A. The mixing head of the injection equipment shall be connected and the equipment run until clear uniformly mixed material flows into the purge pail. The OPERATOR shall engage the equipment shut-off nozzle valve and subsequently bump the on-off switch while monitoring pressure on psi gauge until the pressure reaches 200 psi. Pressure gauge shall be monitored for one minute. If pressure is maintained between 190-200 psi, check valves shall be considered to be functioning properly and the injection may proceed. If pressure drops below 190 psi, CONTRACTOR shall be required to have new seals installed on the check valves and the equipment shall be subsequently retested.

B. The pressure test shall be run for each injection unit at the beginning and after meal break of every shift that the unit is used in the work of crack repair.

C. The adequacy and accuracy of the equipment shall be solely the responsibility of the CONTRACTOR.

3.5 RATIO TEST

A. The epoxy mixture ratio shall be monitored continuously while injecting by placing a strip of masking tape on the sides of the A & B reservoirs full height. After filling reservoirs, the A & B levels shall be marked and monitored while running injection machine into purge pail for a period of one minute.

B. The ratio test shall be run for each injection unit at the beginning and after meal break of every shift that the unit is used in the work of crack repair.

3.6 PROOF OF RATIO AND PRESSURE TEST

A. At all times during the course of the work the CONTRACTOR shall keep complete and accurate records available to the ENGINEER of the pressure and ratio tests specified above.

B. In addition, the ENGINEER at any time without prior notification of the CONTRACTOR, may request the CONTRACTOR to conduct the tests specified above in the presence of the ENGINEER.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. The extent of metal fabrications work is shown on the Drawings and includes items fabricated from iron, steel, stainless steel and aluminum shapes, plates, bars, sheets, strips, tubes, pipes, and castings which are not a part of structural steel or other metal systems in other sections of these specifications.

B. Section Includes:

1. Shop-fabricated metal items
2. Loose steel lintels
3. Hoist beams and divider beams
4. Bollards
5. Ladders
6. Window security grilles
7. Anchor bolts
8. Stairs
9. Handrails and railings
10. Gratings
11. Roof access hatches
12. Fasteners
13. Miscellaneous fabricated architectural details

1.2 RELATED SECTIONS

A. Section 03 30 00, Cast-In-Place Concrete
B. Section 09 90 00, Painting and Coating
C. Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes
D. Section 33 16 10, Prestressed Concrete Water Utility Storage Reservoir

1.3 REFERENCE STANDARDS

A. Aluminum Association (AA):

1. AA DAF-45 - Designation System for Aluminum Finishes

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum

2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

C. American National Standards Institute (ANSI):

1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements

D. American Welding Society (AWS):

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination

2. AWS D1.1 - Structural Welding Code - Steel

3. AWS D1.6 - Structural Welding Code - Stainless Steel

E. ASTM International (ASTM):

1. ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

2. ASTM A36 - Standard Specification for Carbon Structural Steel

3. ASTM A47, grade as selected - Malleable Iron Castings

4. ASTM A48, Class 30 - Gray Iron Castings

5. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

6. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

7. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

8. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

9. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

10. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

11. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

12. ASTM A283, Grade C - Steel Plates to be Bent or Cold Formed

13. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

14. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

15. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

16. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

17. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

18. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

19. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

20. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing

21. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts

22. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

23. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

24. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

25. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

26. ASTM A992 - Standard Specification for Structural Steel Shapes

27. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings

28. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings

29. ASTM B177 - Standard Guide for Engineering Chromium Electroplating

30. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

31. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

32. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire

33. ASTM B 308, Alloy 6061-T6, Anodic Coating Class I, AA-C22-A41, anodized after fabrication - Structural Aluminum Shapes and Plates

34. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

35. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

36. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings

37. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

38. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength

39. ASTM F436 - Standard Specification for Hardened Steel Washers

40. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use

41. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength

F. Builders Hardware Manufacturers Association (BHMA):

1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps

G. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. NOMMA Guideline 1 - Joint Finishes

H. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual
2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer
3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic)
4. SSPC SP 1 - Solvent Cleaning
5. SSPC SP-7 Brush-off Blast Cleaning
6. SSPC SP 10 - Near-White Blast Cleaning

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for Submittals.

B. Manufacturer's Data: For information only, submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal work, including paint products.

C. Shop Drawings:

1. General: Submit copies of shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work which are not completely shown by the manufacturer's data sheets.

a. Include plans, elevations, and details of sections and connections and fabricators proposed shop coat paint or galvanizing specifications.

b. Show anchorage and accessory items.

c. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction.

d. Indicate welded connections using standard AWS A2.4 welding symbols.

e. Indicate net weld lengths.

2. Stairs, Handrails, and Railings:

a. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

3. Gratings:

    a. Indicate details of gratings, plates, component supports, anchorages, openings, perimeter construction details, and tolerances.

D. Samples:

1. Submit two sets of representative samples of materials, illustrating factory finishes as may be requested by the Engineer.

2. Engineer's review will be for color, texture, style and finish only.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

F. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings from a registered, licensed professional engineer within the State of Oregon.

2. Include design calculations and assumptions for the following:

    a. None required.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statement:

1. Submit qualifications for licensed professional to perform Delegated Design Submittals as noted above.

1.5 MOCKUPS

C. Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Transporting, handling, storing, and protecting products shall be in accordance with manufacturer's requirements.

B. Inspection: Accept metal fabrications on-site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.7 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to preparation of Shop Drawings and fabrication. Indicate field measurements on Shop Drawings.

1. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication.

PART 2 PRODUCTS

2.1 GENERAL

A. For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, roughness and defects which impair strength, durability and appearance. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating and application of surface finishes including zinc coatings.

2.2 LINTELS

A. Not used.

2.3 HOIST BEAMS AND DIVIDER BEAMS

A. Hoist and Divider Beams:

1. Steel, wide-flange sections

2. Shape and Size: As required to support applied loads with maximum deflection of 1/240 of the span.

3. Shop Finish: Prime paint, one coat

2.4 BOLLARDS

A. Not used.

2.5 LADDERS

A. 316 Stainless steel Ladder:

1. ANSI 316.

2. TIG welded construction.

3. Siderails:

    a. Size: 1/2 by 2 inches
    b. Spacing: 20 inches on center

4. Rungs:

    a. Solid rod. Hex rod or gnarled rebar
    b. Size: 1-inch diameter
    c. Spacing: 12 inches on center

5. Mounting:

    a. Space rungs as shown on Drawings, a minimum of 7 inches from wall surface.

    b. Provide steel mounting brackets and attachments per Drawings.

6. Shop Finish: Satin polish No. 4.

B. Ladder Safety Cage: Not used.

C. Ladder Security Enclosure: Not used.

D. Ladder Safety Post: Bilco LadderUP® Model No. LU-3 or approved equal.

2.6 WINDOW SECURITY GRILLES - NOT USED

2.7 FABRICATED ARCHITECTURAL TRIM - NOT USED

2.8 ANCHORS

A. All anchors shall be epoxy anchors or expansion anchors as shown in the Drawings.

B. Materials:

1. As shown in the Drawings.

2. For direct bury:

    a. Malleable iron complying with ASTM A47
    b. Cast steel complying with ASTM A27
    c. Iron and steel galvanized in compliance with ASTM A153

3. For wetted atmospheric conditions

    a. Type 316 stainless steel

4. Threaded rod, nuts, bolts, and washers:

a. Material matching anchor insert type

C. Types:

1. Threaded-type Concrete Inserts:

a. Internally threaded to receive machine bolts
b. Malleable iron, ASTM A47
c. Cast steel, ASTM A27
d. Stainless steel, type 304, ASTM A320

2. Wedge-type Concrete Inserts:

a. Box-type ferrous castings designed to accept bolts having special wedge-shaped heads.

3. Slotted-type Concrete Inserts:

a. Box-type welded construction with slot designed to receive square head bolt and with knockout cover.

D. Manufacturers:

1. Hilti, Inc.
2. Simpson Strong-Tie Co., Inc.
3. Proprietary products as named in the Drawings.

2.9 STAIRS - NOT USED.

2.10 HANDRAILS AND RAILINGS

A. Maximum spacing between members shall be as directed by local code and OSHA requirements unless otherwise noted on the Drawings.

B. Railing assembly, wall rails, and attachments to resist lateral force of 200 pounds at any point without damage or permanent set. Test according to ASTM E935.

C. Construction:

1. Height: 3 foot, 6-inch high.

2. Outside diameter:

a. 2-inch for top and vertical segments.
b. 1-1/2-inch all others.

3. Top corners of handrail are to be bent to the smallest radius possible without causing grain separation or otherwise impairing the work.

4. Radius Sections -- Roll to radii shown on Drawings.

5. Vertical segments of handrail are to be set plumb and mount as shown on Drawings or as otherwise specified.

6. Spacing between vertical segments will be according to Drawings.

D. Welded Connections:

1. Cope intersections of rails and posts, weld joints of tailings or use welding connectors, at fabricator's option.

   a. Other methods of welding may be used when acceptable to the Engineer.

2. Weld corners and seams continuously and in accordance with the recommendations of AWS.

3. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.

4. Discoloration of finished surfaces and sharp edges will not be acceptable.

E. Materials: As shown on the Drawings.

2.11 GRATINGS - NOT USED.

2.12 ACCESS HATCHES

A. See Specification Section 08 31 00

2.13 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting systems. Acceptable manufacturers are Simpson or approved equal.

B. Manufacture or fabricate items of sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere furnish galvanized steel washers.

2.14 MISCELLANEOUS FABRICATIONS, FRAMING, AND SUPPORTS

A. Provide miscellaneous steel framing and supports required to complete the Work.

B. Fabricate miscellaneous units to the sizes, shapes and profiles shown in the Drawings or, if not shown, of the required dimensions to receive adjacent grating, plates doors, or other work to be retained by the framing.

C. Except as otherwise shown, fabricate from structural steel shapes and plate and steel bars, all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection.

D. Cut, drill, and tap units to receive hardware and similar items to be anchored to the work.

E. Equip units with integrally welded anchors for casting into concrete, bolting to structural steel or building into masonry. Furnish inserts if units must be installed after concrete is placed.

F. Galvanize all miscellaneous fabrications unless otherwise noted.

2.15 NON-SHRINK GROUT

A. Where required for anchoring, patching, or sealing, grouting and sealing compounds shall conform to the requirements of Section 03 60 00, Grouting.

2.16 MATERIALS

A. Materials listed below shall be provided unless otherwise noted in the Drawings or other sections of these specification.

B. Steel:

1. Structural W Shapes: ASTM A992

2. Structural Shapes: ASTM A36

3. Channels and Angles: ASTM A36

4. Steel Plate: ASTM A36

    a. Steel Plate to be Bent or Cold Formed: ASTM A283, Grade C

5. Hollow Structural Sections: ASTM A500, Grade B

6. Structural Pipe: ASTM A53, Grade B, Schedule 40 unless shown otherwise in Drawings

7. Bar: ASTM A36

    a. Cold-Finished Steel Bar: ASTM A108, grade as selected by fabricator

8. Sheet Steel: ASTM A653, Grade 33 Structural Quality

9. Tubing: ASTM A513, Type 5, minimum 50 kilopounds per square inch (ksi) yield strength

10. Standard Bolts: ASTM A307; Grade A

    a. Washers: ASTM F844

11. High Strength Bolts: ASTM A325

    a. Washers: ASTM F436; Type 1

12. Nuts: ASTM A563; heavy-hex type

13. Welding Materials: AWS D1.1; type required for materials being welded

C. Stainless Steel:

1. Bars and Shapes: ASTM A276; Type 316

2. Tubing: ASTM A269; Type 316

3. Pipe: ASTM A312, seamless; Type 316

4. Plate, Sheet, and Strip: ASTM A666; Type 316

5. Bolts, Nuts, and Washers: ASTM A354; Type 316

6. Welding Materials: AWS D1.6; type required for materials being welded

D. Aluminum:

1. Structural Aluminum Shapes and Plates: ASTM B308, Alloy 6061, Temper T66, Anodic Coating Class I, anodized after fabrication

2. Aluminum-Alloy-Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6

3. Aluminum-Alloy Bars: ASTM B211 Alloy 6063, Temper T6

4. Bolts, Nuts, and Washers: Stainless steel or Steel, galvanized

5. Welding Materials: AWS D1.1; type required for materials being welded

E. Bolts, Nuts, and Washers for Equipment and Piping:

1. Select fasteners for the type, grade, and class required for the installation of miscellaneous metal items.

2. Carbon Steel:

    a. General: Zinc-coated, ASTM A153

    b. Structural Connections: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized

    c. Anchor Bolts: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized

    d. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7

    e. High Strength Bolts: ASTM F3125, Heavy Hex Head

3. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts

    a. Where stainless steel bolts are in contact with dissimilar metals, glass epoxy insulating sleeves and washers shall be used to electrically isolate the bolts.

2.17 FABRICATION

A. Workmanship:

1. Use materials of the size and thicknesses shown in the Drawings or, if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use as approved by the Engineer.

2. Work to the dimensions shown in the Drawings or accepted on Shop Drawings, using proven details of fabrication and support.

3. Use the type of materials shown in the Drawings or specified for the various components of work.

4. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

5. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise shown in the Drawings.

6. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.

B. Fit and shop-assemble items in largest practical sections for delivery to Site.

C. Fabricate items with joints tightly fitted and secured.

D. Continuously seal join members by means of continuous welds in accordance with the recommendations of AWS, unless otherwise noted or approved.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Loose Bearing and Leveling Plates:

1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.

2. Drill plates to receive anchor bolts and for grouting as required.

3. Galvanize after fabrication.

I. Miscellaneous Steel Trim:

1. Provide shapes and sizes for profiles shown in the Drawings.

2. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.

3. Use concealed field splices wherever possible.

4. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.

J. Fabrication Tolerances:

1. Squareness: 1/8-inch maximum difference in diagonal measurements.

2. Maximum Offset between Faces: 1/16-inch.

3. Maximum Misalignment of Adjacent Members: 1/16-inch.

4. Maximum Bow: 1/8-inch in 48 inches.

5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

2.18 FINISHES

A. Steel:

1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

2. Do not prime surfaces in direct contact with concrete or where field welding is required.

3. Prime-paint items with one coat, except where galvanizing is specified.

4. Coatings as specified per Section 09 90 00, Painting and Coating.

   a. Primer paint selected must be compatible with the required finish coats of paint.

   b. At locations in contact with potable water, use only primer approved for potable water use.

5. Galvanizing for Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123; hot-dip galvanize after fabrication

6. Galvanizing for Fasteners, Connectors, and Anchors:

   a. Hot-Dip Galvanizing: ASTM A153
   b. Mechanical Galvanizing: ASTM B695; Class 50 minimum

7. Chrome Plating: ASTM B177, nickel-chromium alloy

8. Sheet Steel: Galvanized

9. Bolts: Hot-dip galvanized

10. Nuts: Hot-dip galvanized

11. Washers: Hot-dip galvanized

12. Touchup Primer for Galvanized Surfaces: ASTM A780 (A780M), A1. Repair Using Zinc-Based Alloys (Heat and Stick Method)

B. Stainless Steel:

1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.

2. Mirror-Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed.

C. Aluminum:

1. Protection of All Aluminum:

   a. Aluminum surfaces in contact with cementitious, masonry or dissimilar materials, apply the following coating system:

      1) One (1) coat of epoxy primer, 1 to 2 mils dry film (D.F.).
      2) Followed by two (2) coats of Bitumastic, 6 to 8 mils D.F.
      3) Followed by two (2) coats of tarset material, 6 to 8 mils D.F.

D. Shop Painting

1. Shop painting of metal fabrications shall be allowed only at the sole discretion of the Engineer.

2. Shop paint miscellaneous metal work in accordance with Section 09 90 00, Painting and Coating, with the following exceptions:

   a. Those members or portions of members to be embedded in concrete or masonry.

   b. Surfaces and edges to be field welded.

   c. Galvanized surfaces.

3. Remove scale, rust, and other deleterious materials before the shop coat of paint is applied.

   a. Clean off heavy rust and loose mill scale in accordance with SSPC SP-7, Brush-off Blast Cleaning.

   b. Remove oil, grease, and similar contaminates in accordance with SSPC SP-1, Solvent Cleaning.

4. Immediately following surface preparation, brush or spray on metal primer paint, applied in accordance with the manufacturer's instructions or as specified below.

5. Apply one shop coat of metal primer paint to fabricated metal items, except apply two coats of paint to surfaces which will be inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

E. Touch-up Painting, Pre-painted Items:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting.

2. Apply touch-up coatings by brush or spray to provide a minimum dry film thickness of the original coating thickness.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal and aluminum where Site welding is required.

B. Furnish setting drawings, diagrams, templates, instructions, and directions for the installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections. Coordinate delivery of such items to the project Site.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, and free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

D. Fit exposed connections accurately together to form tight hairline joints.

E. Grind joints smooth and touch-up shop paint coat.

F. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

G. Field-weld components indicated on Drawings and Shop Drawings.

H. Perform field welding according to AWS D1.1 with regards to procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.

I. Obtain approval of Engineer prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

A. Maximum Variation from Plumb: 1/4-inch per story or for every 12 feet in height, whichever is greater, non-cumulative.

B. Maximum Variation from Level: 1/16-inch in 3 feet and 1/4-inch in 10 feet.

C. Maximum Offset from Alignment: 1/4-inch.

D. Maximum Out-of-Position: 1/4-inch.

3.5 FIELD QUALITY CONTROL

A. Welding: Inspect welds according to AWS D1.1.

B. Replace damaged or improperly functioning hardware.

C. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

D. Touch up factory-applied finishes according to manufacturer-recommended procedures.

3.6 ADJUSTING

A. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION

SECTION 07 92 00 - SEALANTS AND CAULKING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the work necessary to furnish and install sealing or caulking joints between dissimilar materials for watertight seal.

B. Section includes:

1. Sealants
2. Filler gaskets
3. Primers and bond breakers

1.2 DEFINITIONS

A. Sealants: Where the words “sealants” or “caulking” are used in this text, they shall be considered to be synonymous and shall mean sealant or caulking compounds as specified under Part 2 of this specification.

1.3 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Product data and materials list of items proposed to be provided under this Section.

C. Sufficient technical data to demonstrate compliance with the specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Type A Sealant

1. Application: General building sealant.

2. Material: One component polyurethane sealant.

a. Vulkem 116, as manufactured by Tremco.
b. Sonolastic NP1, as manufactured by BASF.

B. Type B Sealant

1. Application - General building sealant for wide joints.

2. Materials - Self leveling one component polyurethane.

    a. Vulkem 45, as manufactured by Tremco

C. Type C Sealant

1. Application: General building sealant for appurtenances in contact with drinking water.

2. Material - One component polyurethane sealant.

    a. Sikaflex – 221, as manufactured by Sika

3. Certifications:

    a. ASTM C 920
    b. NSF/ANSI standard 61 for portable water
    c. UL listed for potable water

D. Filler Gasket (Backer Rod) Cord Strip

1. Ethafoam, as manufactured by Dow Chemical
2. Sonolastic Closed-cell Backer Rod, as manufactured by Sonneborn
3. Equal, as approved by ENGINEER

PART 3 EXECUTION

3.1 PREPARATION

A. Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings, including lacquers, form coatings, clear sealers, etc.

B. Brush out all foreign matter and loose particles.

C. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 INSTALLATION

A. Primers and Bond Breakers

1. Apply to surfaces as required; verify with manufacturer.

2. In general, prime all concrete and Portland cement-based plaster or grout surfaces.

3. Prime wood surfaces where specifically required.

4. Use proper type primers and bond breakers, apply per sealant manufacturer's printed instructions.

B. Sealants

1. Provide watertight caulked joints at all building exterior locations where possible water penetration through joint may occur.

2. If caulking systems for such joints are not shown, provide as specifically approved.

C. Gaskets or Fillers

1. Compress all gaskets to tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to 3/8-inch).

2. Install gun grade material with gun nozzle of similar size as joint width as shown. Tool all beads, after application to assume full firm contact. Strike off excess material.

3. Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per manufacturer's printed instructions.

4. Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate from caulking with gasket filler.

5. Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.3 CORRECTIONS AND CLEANUP

A. Remove all damaged, defective or improperly installed sealant and/or caulking and replace.

B. Clean and remove all sealant and caulking from adjacent surfaces.

C. Upon completion of the work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

SECTION 08 31 00 – ACCESS DOOR SPECIFICATION

PART 1 GENERAL

1.1 1.01 SUMMARY

A. This Section Furnishing and installing factory fabricated vault access doors

B. Section Includes:

1. Clear Well Access Door

1.2 REFERENCES

A. ASTM A 36: Standard Specification for Structural Steel

B. ASTM A 276: Standard Specification for Stainless Steel Bars and Shapes

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for all materials in this specification.

B. Shop Drawings: Show profiles, accessories, location, and dimensions.

C. Samples: Manufacturer to provide upon request; sized to represent material adequately.

D. Contract Closeout: Vault access door manufacturer shall provide the manufacturer's Warranty prior to the contract closeout.

1.4 PRODUCT HANDLING

A. All materials shall be delivered in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping immediately after installation.

1.5 SUBSTITUTIONS

A. Proposals for substitution products shall be accepted only from bidding contractors and not less than (10) working days before bid due date. Contractor guarantees that

proposed substitution shall meet the performance and quality standards of this specification.

1.6 JOB CONDITIONS

A. Verify that other trades with related work are complete before installing vault access door(s).

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

D. Observe all appropriate OSHA safety guidelines for this work.

1.7 WARRANTY/GUARANTEE

A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of (5) Five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. U.S.F. Fabrication, Inc. 3200 W. 84 ST, Hialeah, FL 33018 – Toll Free: 800.258.6873 Fax: 305.882.1577

E-mail: service@usffab.com Website: www.usffab.com

B. Approved equal.

2.2 ACCESS DOOR

A. Furnish and install where indicated on plans access door U.S.F. Fabrication FPS type, Size as shown on drawings. The access door shall be single leaf design. The entire assembly shall be manufactured and assembled in the USA.

B. Performance characteristics:

1. Cover: Shall be reinforced to support 300 PSF live load and capable of holding up to 10 ft. head of water.

2. The cover shall be opened using the flush lifting handle to ensure controlled operation throughout the entire arc of opening and closing.

C. Cover:

1. Shall be 1/4” (6.3 mm) stainless steel plate reinforced to support 300 PSF pedestrian loads.

2. The cover shall be fitted with 316 stainless steel pressure locks to hold the cover securely on a U-shaped neoprene gasket riveted to the frame to minimize water intrusion.

D. Frame: Angle frame shall be minimum 1/4” (6.3mm) stainless steel with a horizontal anchor flange to allow bolting to the top slab.

E. Hinges: Shall be through bolted to the cover with tamperproof type 316 stainless steel bolts and locknuts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

F. A flush lifting handle shall be provided

G. Lifting mechanisms: (OPTIONAL) Manufacturer shall provide the proper amount of stainless steel lift assist mechanisms to insure that the cover can be opened by one person with no more than 35 lbs of force required. Torsion type lift assist will not be acceptable.

H. Hardware:

1. Hinges Type 316 stainless steel hinges shall be provided.

2. Hold-open arm: Doors shall be equipped with a 316 stainless steel hold-open arm with a secondary latch that insures that the hold-open arm properly engages when the door is brought to its full up right and locked position. Two piece hold-open devices, or those that require the manual insertion of pins as a means of engagement will not be allowed.

3. A staple for a padlock shall be provided

4. Hardware: Shall be Type 316 stainless steel throughout.

I. Finishes:

1. Factory finish shall be mill finish

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that the vault access door installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.2 INSTALLATION

A. Submit product design drawings for review and approval to the architect or specifier before fabrication.

B. The installer shall check as-built conditions and verify the manufacturer's vault access door details for accuracy to fit the application prior to fabrication. The installer shall comply with the vault access door manufacturer's installation instructions. Installer shall insure that the entire unit is installed level and square to insure proper performance.

C. The installer shall furnish mechanical fasteners consistent with the vault access door manufacturer's instructions.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 THE REQUIREMENT

A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.

B. This specification is applicable to coated pipe, steel, concrete, and other surfaces listed in the coating schedule at the end of this section. Reservoir painting, pipe corrosion protection systems, galvanizing, and anodizing are specified elsewhere within the contract documents.

C. The Coating System Schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

D. Related Work Specified in Other Sections -- Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other divisions. Some items with factory finishes, or corrosion resistant finishes may be scheduled or directed to be painted by the ENGINEER to unify a wall finish or color scheme, at the ENGINEER's discretion.

E. Exclusions -- Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze, and other corrosion-resistant material (except for valve bodies and piping); Electrical switch-gear and motor control centers having factory finish; Fencing; Multiple coated factory finished baked enamel or porcelain products; Concealed areas such as ducts, piping, conduits, and items specified elsewhere for special linings and coatings.

F. Damaged Factory Finish -- If directed by the ENGINEER, refinish the entire exposed surfaces of equipment chipped, scratched, or otherwise damaged in shipment or installation.

G. All coating coming in contact with potable water shall be NSF approved.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.

1. "Architectural Specification Manual" by the Painting and Decorating Contractors of America (PDCA), 333 Taylor Avenue North, Seattle, Washington 98109.

2. "Systems and Specifications" - Volume 2 of Steel Structures Painting Council (SSPC).

3. NSF International (NSF) Standard No. 61.

B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 986, Katy, TX 77450.

C. Pipe Coating Commercial Standards

ANSI/AWWA C105	Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
ANSI/AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger - Shop Applied
ANSI/AWWA C209	Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Pipelines.
ANSI/AWWA C210	Liquid Epoxy Coating for Exterior and Interior of Steel Pipe.
ANSI/AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
ANSI/AWWA C214	Tape Coating systems for the Exterior of Steel Water Pipelines.

D. Federal Specifications

DOD-P-23236A(SH)	Military Specification, Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast.

1.3 CONTRACTOR SUBMITTALS

A. Coating Materials List -- The CONTRACTOR shall provide a coating materials list which indicates the manufacturer and the coating number, keyed to the coating systems

herein. The amount of copies to submit shall be as specified within Section 01 10 00, Summary of Work.

B. Coating Manufacturer's and Applicator Information -- For each coating system to be used the CONTRACTOR shall submit, the following listed data.

1. Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.

2. Manufacturer's instructions and recommendations on surface preparation and application.

3. Colors available for each product and each coat.

4. Compatibility of shop and field applied coatings (where applicable).

5. Material safety data sheet (MSDS) for each product used.

6. The manufacturer’s recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.

7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.

8. Certificate -- Submit manufacturer's certificate of compliance with the specifications and standards signed by a representative in the manufacturer's employ.

9. Samples -- Provide painted surface areas at the job for approval of main color selections, or submit sample on 12-inch sample of substrate using required finish system at ENGINEER’s discretion.

1.4 QUALITY ASSURANCE

A. Painter Qualifications -- The Painting/Coating CONTRACTOR must be capable of performing the various items of work as specified. The Painting/Coating CONTRACTOR shall furnish a statement covering experience on similar work, a list of machinery, plant and other equipment available for the proposed work, and a financial statement, including a complete statement of the Painter/Coating CONTRACTOR’s financial ability and experience in performing similar painting and coating work. The Painting/Coating CONTRACTOR shall have a minimum of 5 years practical experience and a successful history in the application of the specified products to concrete/steel surfaces. Upon request, the Painting/Coating CONTRACTOR shall substantiate this requirement by furnishing a list of references, which shall include jobs of similar nature.

B. The CONTRACTOR shall give the ENGINEER a minimum of 3 days advance notice of the start of any field surface preparation work of coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

C. All such work shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such work in its absence.

D. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.

E. Surface Preparation -- Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.

F. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be provided by the CONTRACTOR to cover all areas to be inspected.

G. Paint Products -- No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the CONTRACTOR and ENGINEER may agree upon in order that dust-free and neat work be obtained. All painting shall be in strict accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the ENGINEER.

H. Manufacturer's Representative -- Require coating manufacturer's representative to be at job site when the first day's coating application is in progress and periodically during progress of the work.

I. Labels -- Deliver to the job site in the original sealed containers with manufacturer's name, product name, type of product, manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.

J. Colors -- Colors will be selected from manufacturer's standard colors as reviewed by ENGINEER and approved by the OWNER. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of manufacturer's standard colors, provided that the manufacturer's product line represents a color range comparable to similar products of other manufacturers.

K. Flame Spread -- Provide paint materials which will result in a Class II finish for all coated surfaces in exit corridors, and a Class III finish for all other interior rooms or areas.

L. Film Thickness Testing -- On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model

111/1EZ, or approved equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using wet film gage readings and destructive film thickness tests.

M. Inspection Device -- The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the ENGINEER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.

N. Holiday Testing -- The CONTRACTOR shall holiday test all coated ferrous surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.

1. Coatings With Thickness Exceeding 20 Mils -- For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Coatings With Thickness of 20 Mils or Less -- For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or approved equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Deliver in labeled containers as specified above and store in a locked room accessible for inspection. Comply with fire and health regulations.

B. Provide adequate heat and forced mechanical ventilation for health, safety, and drying requirements. Use explosion proof equipment. Provide face masks.

C. Protect adjacent surfaces with suitable masking and drop cloths as required. Remove cloths or waste from the project daily.

D. Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Do not apply coating in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet

surfaces, unless otherwise permitted by the coating manufacturer's printed instructions. Coating application may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

1.6 PROTECTION

A. Follow all safety recommendations of manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable O.S.H.A. and other regulations.

B. Protect surface adjacent to work being coated from overspray, drips or other damage.

1.7 EXTRA STOCK

Provide one gallon of each type and color, fully labeled, at completion of job.

PART 2 PRODUCTS

2.1 GENERAL

A. Definitions -- The terms "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.

B. General -- Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.

C. The CONTRACTOR shall use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.

D. Compatibility -- In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the ENGINEER, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

E. Colors -- All colors and shades of colors of all coatings shall be as selected or specified by the ENGINEER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the

manufacturer's standard color samples by the ENGINEER. Color pigments shall be lead free.

F. Protective Coating Materials -- Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirement.

G. Substitute or "Or-Equal" Submittals -- Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The CONTRACTOR shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.

H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the ENGINEER shall be paid by the CONTRACTOR. If the proposed substitution requires changes in the contract work, the CONTRACTOR shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 INDUSTRIAL COATING SYSTEMS

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these specifications and as directed by the ENGINEER. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows

1. Coating System 100

a. Location -- Exposed, unprimed, non-galvanized, nonsubmerged metal surfaces, both interior and exterior including piping, and structural steel.

b. Surface Preparation -- As specified herein.

c. Coating System -- Apply prime coat and topcoat, 4.0-6.0 mils each coat of Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.

2. Coating System 101

   a. Location -- Exposed metal surfaces, shop primed, both interior and exterior including piping, railings, ladders, steel doors, and any other metal items not otherwise specified.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Apply shop prime coat 3.0 mils DFT Tnemec Series 90-97 Tneme-Zinc, one coat 4.0 - 6.0 mils DFT Tnemec Series 66 Hi-Build Epoxoline, and 3.0 - 4.0 mils DFT of Tnemec Series 175 Endura Shield, or approved equal. Color as selected by Owner.

3. Coating System 102

   a. Location -- Unprimed or non-galvanized, continuously or intermittently submerged metal items, both interior and exterior including piping, structural steel, and all other metal items not otherwise specified.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 20 Pota-Pox, or approved equal. Color as selected by Owner.

4. Coating System 103

   a. Location -- Vertical concrete walls, exterior, below finish grade, not exposed to view.

   b. Surface Preparation -- As specified herein.

   c. Paint System -- Apply two coats 9.0-10.0 mils each, Carboline Bitumastic 50, or approved equal.

5. Coating System 104

   a. Location – Non-submerged, exposed to view, PVC piping.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Apply one coat, 4.0-6.0 mils Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.

2.3 SPECIAL PIPE AND SEVERE SERVICE COATING SYSTEMS

A. General

The following coatings are for buried pipe and surfaces used in severe service conditions. The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated within the paragraph entitled " 'Or-Equal' Clause" in Section 01 10 00, Summary of Work.

B. Special pipe and severe service coating systems shall be as follows

1. Coating System 200 -- Cement Mortar Coating

   a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

   b. Surface Preparation - As specified herein.

   c. Coating System -- A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than 1-part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309-81, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped by at least 6 inches. At the ENGINEER's discretion, the hot applied coal tar epoxy coating may be used as the curing membrane for the mortar coating.

2. Coating System 201 -- Hot Applied Coal Tar Epoxy Coating

   a. Location -- Exterior surface of concrete pipe and cement-mortar coated pipe and fittings.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- The hot applied coal tar epoxy shall be a solvent free 100 percent solids coal tar epoxy chemically compatible with hydrating cement and suitable for application on moist surfaces of freshly placed cement mortar or concrete and properly prepared cured surfaces. The coal tar epoxy coating material shall be Amercoat 1972B or approved equal. The finish coal tar epoxy coating shall have a minimum DFT of 26 mils.

See Addendum #2 for changes to this page.

3. Coating System 202 -- Coal-Tar Epoxy Coating System

   a. Location -- Exterior surface of buried steel pipe, fittings, and other ferrous surfaces.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- High build, two-component amine or polyamide cured coal-tar epoxy shall have a solids content of at least 68 percent by volume, suitable as a long term coating of buried surfaces, and conforming to AWWA C210. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field. The coal-tar epoxy coating system shall include:

      1) Prime coat (DFT = 1-1/2 mils), Amercoat 83HS, Tnemec P66, or equal.

      2) Finish coats (Two or more, DFT = 18 mils), Amercoat 78 HB, Tnemec 46 H-413, or equal.

      3) Total system DFT = 19-1/2 mils.

4. Coating System 202A – Epoxy for Potable Water Contact

   a. Location – Steel or concrete emersion and non-emersion service

   b. Surface Preparation – As specified herein.

   c. Coating System – 100% solids, high-build epoxy for the protection of steel and concrete. Coating shall be certified by NSF International in accordance with NSF/ANSI/CAN Std. 61 for potable water contact.

      1) Coating (DFT 16 to 40), Tnemec Epoxoline 22, or equal.

5. Coating System 203 -- Fusion Bonded Epoxy

   a. Location -- Ferrous surfaces of sleeve couplings, steel pipe, and fittings.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". The coating shall be applied using the fluidized bed process.

      1) Liquid Epoxy -- For field repairs, the use of a liquid epoxy will be permitted, applied in not less than three coats to provide a DFT 16 mils. The liquid

epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.

2) Coating (DFT = 16 mils), Scotchkote 203, or equal.

3) Total system DFT = 16 mils.

6. Coating System 204 -- Hot, Coal-Tar Enamel

   a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

   b. Surface Preparation - As specified herein

   c. Coating System -- Coal-Tar Enamel materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a primer layer, coal-tar enamel layer, coal-tar saturated non-asbestos felt outerwrap, and a finish coat. Total system DFT = 188 mils.

7. Coating System 205 -- Hot Applied Tape

   a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a cold-applied liquid primer and heated coal-tar base tape. Total system DFT = 50 mils.

8. Coating System 206 -- Cold Applied Tape

   a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. Prefabricated tape shall be Type II. The system shall consists of a primer layer, inner layer tape of 35 mils, and an outer layer tape of 35 mils. Total system DFT = 70 mils.

9. Coating System 207 -- PVC Tape

   a. Location -- Small galvanized steel pipe and fittings.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Prior to wrapping pipe with PVC tape, the pipe and fittings shall be primed using a primer recommended by the PVC tape manufacturer.

After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half lapped for a total thickness of 40 mils.

10. Coating System 208 -- Mastic

    a. Location -- Pipe and fitting joints, and general buried surface coating repair and touch up.

    b. Surface Preparation - As specified herein.

    c. Coating System -- Mastic shall be a one-part solvent drying heavy bodied thixotropic synthetic elastomeric coating with chemically inert resins and fillers and an average viscosity of 650,000 CPS at 77 degrees Fahrenheit (F), thereby requiring generous applications by hand or trowel. Total coat thickness shall be 30 mils, minimum. Mastic shall be Protecto Wrap 160 H or approved equal and be fully compatible with pipeline coating systems.

11. Coating System 209 -- Polyethylene Encasement

    a. Location -- Ductile iron, steel and concrete cylinder pipe and fittings

    b. Surface Preparation -- None required.

    c. Coating System -- Except as otherwise specified, application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

2.4 ARCHITECTURAL COATING SYSTEMS

A. General

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or topcoat.

Fungus Control: Submit evidence for all paints attesting the passing of Federal Test Method Standard No. 141, Method 6271.1 showing no fungus growth or other approved test results.

Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Acrylics require 60 degrees F and above temperature and below 50 percent relative humidity. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F and 90 degrees F unless otherwise permitted by the paint manufacturer's printed instructions.

B. Architectural coating systems shall be as follows

1. Coating System 300

   a. Location -- Vertical, exterior concrete masonry unit walls exposed to view.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Apply prime, intermediate and topcoat, 75 square foot per gallon (ft^2/gal), 100 ft^2/gal and 100 ft^2/gal respectively for each coat of Tnemec Series 156 Envirocrete or approved equal. Color as selected by Owner.

2. Paint System 301

   a. Location -- Vertical concrete exterior walls and flat concrete exterior roofs and slabs exposed to view.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Apply two coats 6.0-9.0 mils (100 ft^2/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by Owner.

3. Paint System 302

   a. Location -- Interior concrete masonry unit walls and interior and exterior wood walls, ceilings, and other wood surfaces not otherwise specified, exposed to view.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Prime as specified by coating manufacturer. Apply two coats 6.0 - 9.0 mils (100 ft^2/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by Owner.

4. Paint System 303

   a. Location -- Wood surfaces not otherwise specified, exposed to view.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Apply an alkyd primer as recommended by the manufacturer, 2 mils. Apply finish coats (two or more coats 6 mils total) of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Total DFT = 8 mils. Color as selected by Owner.

5. Paint System 304

    a. Location -- Interior drywall surfaces not otherwise specified, exposed to view.

    b. Surface Preparation - As specified herein.

    c. Coating System -- Apply two coats 2.0 - 3.0 mils each coat of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Color as selected by Owner.

6. Paint System 305

    a. Location -- Exterior brick surfaces not otherwise specified, exposed to view.

    b. Surface Preparation -- Surfaces shall be cleaned with a manufacturers approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils, paint, and other contaminants before the coating system is applied. Coating system shall be applied according to the manufacturers published recommendations. A manufacturer's representative shall be present during application of the coating system, if required by the manufacturer's warranty.

    c. Coating System -- Apply two coats of masonry water retardant material. The system shall be clear, non-staining, silane-modified-siloxane, Fabrishield 161, Rainstopper 1500, or equal. The selected coating system shall provide a minimum of a 5-year manufacturer's warranty.

PART 3 EXECUTION

3.1 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Manufacturer's Recommendations -- Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.

B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and Mixing -- Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification.

1. Solvent Cleaning (SSPC-SP1) -- Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC-SP2) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC-SP3) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC-SP5) -- Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products, and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC-SP6) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC-SP7) -- Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC-SP10) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

8. High- and Ultra High- Pressure Water Jetting (SSPC-SP12): Water jetting at high- or ultra-high-pressure to prepare a surface for recoating using pressure above 10,000 pounds per square inch (psi).

9. Surface Preparation of Concrete (SSPC-SP-13) - Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.

10. Industrial Blast Cleaning (SSPC-SP14): Blast cleaning to remove all visible oil, grease, dust and dirt, when viewed without magnification

3.3 CORRECTIONS AND CLEANUP

At completion any damaged, de-laminated or defaced coated surfaces shall be touched up, restored, and left in first class condition. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage, spatter spots or other misplaced coating material shall be removed in a manner which will not damage surfaces. Perform required patching, repair, and cleaning to the satisfaction of the ENGINEER. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.4 SURFACE PREPARATION

A. General

Prepare all surfaces scheduled to receive new coating systems, as required to provide for adequate bonding of the specified coating system to the substrate material. Request review of prepared surfaces by the ENGINEER prior to proceeding. For existing coated surfaces, hand wash with cleaner or product recommended by coating manufacturer to properly prepare existing surface and provide for bonding of coating specified to follow. Remove any loose, peeling or flaking coating, or mildewed areas. Surface preparation minimums shall be as follows:

1. Exposed metal items, non-submerged, unprimed, non-galvanized both interior and exterior, including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP6, "Commercial Blast Cleaning".

2. Exposed metal items, shop primed, both interior and exterior including: piping, steel doors, steel ladders to be painted, and railings, and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning"; SSPC-SP2, "Hand Tool Cleaning"; and SSPC-SP3, "Power Tool Cleaning" as may be required to remove grease, loose, or peeling or chipped paint.

3. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including: piping, structural steel, and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".

4. Stainless Steel – Non-submerged and submerged, exposed piping and fittings, both interior and exterior shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning".

5. Polyvinyl Chloride (PVC) – Non-submerged, both interior and exterior, process piping and plumbing, shall be lightly sanded prior to application of the specified coating system to follow.

6. Non-submerged Concrete - Clean all concrete surfaces of dust, form oil, curing compounds, or other incompatible matter. Etch and prime if required by manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.

7. Submerged Concrete – Prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Abrasive blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers and other contaminants and too provide a minimum ICRI-CSP 5 surface profile. Fill large cracks, voids and other surface imperfections with a compatible recommended filler or surfacer.

8. Concrete Masonry Units -- Repair all breaks, cracks and holes with concrete grout. The surface must be free of dirt, dust, loose sand and other foreign matter. Brush clean. Allow minimum 28-day cure of concrete joint mortar and repair grout prior to application of coatings system.

9. Wood -- Wood surfaces shall be thoroughly cleaned and free of all foreign matter with cracks, nail holes, and other defects properly filled, smoothed, and sandpapered to fine finish. Wipe clean of dust.

10. Preparation of All Existing Coated Surfaces -- Removed rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces, to be painted, with benzine or mineral spirits or Rodda's Gresof before coating, or as recommended by manufacturer. For walls, patch existing nicks and gouges, sand to match wall finish.

3.5 PRIME COATING

A. Exposed Steel -- Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.

B. Galvanized Metal -- After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with manufacturer before application the compatibility with coatings specified to follow.

C. Shop Primed Metal -- Where indicated on the plans or coating schedule and following the surface preparation procedures specified in paragraph 3.4.A.2 above, the CONTRACTOR shall apply intermediate and topcoats of the specified paint system to

shop primed metal. The CONTRACTOR shall verify with the manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.

D. Non-Shop Primed Metal and Piping -- Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above. Prime paint in accordance with SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.

E. Cast-In-Place Reinforced Concrete -- After surface preparation specified above, prime coat concrete as specified in the coating schedule found elsewhere in the specifications.

F. Concrete Masonry Units -- After surface preparation specified above, prime coat as specified in the coating schedule found elsewhere in the specifications.

G. Wood Surfaces -- Following surface preparation specified above, prime coat exterior exposed wood surfaces with appropriate coating system as specified in the painting schedule.

3.6 FIELD PRIME

Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and re-priming, at the ENGINEER’s discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.7 APPLICATION

A. Thickness -- Apply coatings in strict conformance with the manufacturer's application instructions. Apply each coat at the rate specified by the manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.

B. Porous Surfaces -- Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe coating for these areas.

F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Ventilation -- Adequately ventilate enclosed rooms and spaces during painting and drying periods.

H. Drying Time -- Do not apply next coat of coat until each coat is dry. Test non-metallic surfaces with moisture meter. The manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.8 COATING SCHEDULE

Coating Schedule

Item	Location	Material	Coating System
Concrete – Ceiling and column surfaces submerged and unsubmerged	Inside Clear Well	Concrete	Coating System 202A
Miscellaneous Metals – In contact with potable water	Inside Clear Well	Steel	Coating System 202A

END OF SECTION

SECTION 33 13 00 - TESTING AND DISINFECTION OF WATER UTILITY PIPING AND STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes leak testing, disinfection, and purity testing of potable water systems piping, fittings, valves, and domestic water services.

B. Section Includes:

1. Leak testing and disinfection of potable water piping systems and appurtenances.

2. Testing and reporting of results.

C. Related Requirements:

1. Section 33 13 13 – Disinfection of Water Utility Storage Tanks

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites
2. AWWA B301 - Liquid Chlorine
3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
4. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings
5. AWWA C651 - Disinfecting Water Mains
6. AWWA C655 - Field Dechlorination

1.3 SUBMITTALS

A. Section 01 33 00 –Submittals Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Pipeline Testing and Disinfection Plan: To be submitted for review and approval by the Engineer a minimum of 1 month before testing is to start. As a minimum, the plan shall include the following:

1. Testing schedule.

2. Disinfection Plan:

    a. Narrative of the proposed process.

    b. Proposed chemicals and equipment (including list of all pumps and meters) to be used.

    c. Calculations for the amount of chlorine required to achieve required chlorine residual levels.

    d. Proposed method of mixing, injecting, and distributing of chlorine solution throughout all portions of the new water system facilities.

    e. Proposed plan for testing chlorine levels throughout the length of pipeline.

3. Proposed testing locations.

4. Proposed plan for water conveyance, including flow rates.

5. Proposed plan for water control.

6. Proposed plan for water disposal, including flow rates. Include proposed plan for dechlorination of disinfection water, including discharge points.

7. Proposed measures to be incorporated in the project to minimize erosion while discharging water from the pipeline.

1.4 CLOSEOUT SUBMITTALS

A. Disinfection Report:

1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.

3. Test locations.

4. Name of person collecting samples.

5. Initial and 24-hour disinfectant residuals in treated water in parts-per million (ppm) for each outlet tested.

6. Date and time of flushing start and completion.

7. Disinfectant residual after flushing in ppm for each outlet tested.

1.5 QUALITY ASSURANCE

A. Perform Work according to AWWA C651.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future functions.

B. All temporary thrust restraint and equipment and facilities required for leak testing will be considered incidental.

C. As a minimum, furnish the following equipment and materials for the testing:

Amount	Description
2	Graduated containers approved by the Engineer.
1	Hydraulic pump approved by the Engineer with hoses, valves, and fittings as needed and required for the leak testing and disinfection of the facilities.
1	High range chlorine test kit, as approved by Engineer, with digital readout. Range of detection shall be between 5 and 200 ppm. Accuracy of 3 percent.
2	Pressure gauges with pressure range at least 120 percent greater than the required maximum test pressure with graduations in 2 pounds per square inch (psi) increments. Gauges shall have been calibrated with 90 days of pressure testing.

2.2 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.
2. Liquid chlorine: Comply with AWWA B301.

2.3 DECHLORINATION CHEMICALS

A. Chemicals:

1. Comply with AWWA C655.

PART 3 EXECUTION

3.1 LEAK TESTING OF WATER PIPING

A. Make all necessary provisions for conveying water to the points of use and for the disposal of test water.

B. Provide 72-hour notification to the Engineer and Owner prior to conducting leak testing.

1. Provide coordination and scheduling required for the Owner and Engineer to witness and provide necessary labor for operating Owner's existing system during leak testing and disinfecting procedures.

2. The Contractor shall not operate any part of the existing water systems.

C. Pipe Filling:

1. Fill pipes slowly from the lowest elevation to highest point along test section with potable water.

2. Take all required precautions to prevent entrapping air in the pipes.

3. Allow for natural absorption of water by the lining of the pipe to occur.

4. Apply specified test pressure by pumping.

D. Leak Testing:

1. General:

a. Visual leak tests shall be conducted under standard operating pressure for all process piping installed by Contractor.

b. The visual test will be conducted for a 2-hour period.

2. Defects, Leakage, Failure:

a. If the test reveals any defects, leakage, or failure, furnish all labor, equipment, and materials required to locate and make necessary repairs.

b. All leaks shall be repaired in a manner acceptable to the Engineer.

c. The testing of the line shall be repeated until a test satisfactory to the Engineer has been achieved.

3.2 STORAGE TANK CLEANING, INSPECTION, AND WATERPROOFING

A. After construction is completed, the interior of the reservoir shall be completely hosed out and cleaned of all dirt and loose material. The reservoir floor shall be power washed for clear detection of possible cracks.

B. CONTRACTOR shall notify ENGINEER at least 48 hours before interior of reservoir is clean and ready for inspection by the ENGINEER.

C. Floor, wall, footing, column, and roof cracks, which may have developed from drying shrinkage, shall not be taped or chipped out and caulked. All cracks shall be pumped and sealed with a two-part water insensitive epoxy by a qualified and certified technician or subcontractor per specification Section 03 64 23 Epoxy Adhesive Injection. No repair shall be performed until ENGINEER has completed inspection of the interior of the reservoir. Any repairs performed by the CONTRACTOR prior to inspection by the ENGINEER will be required to be removed as per the ENGINEER by the CONTRACTOR at no expense to the OWNER.

3.3 TESTING AND REPAIRING LEAKS

A. Testing

1. Leak testing shall be performed after all required concrete surface repair has been completed and accepted by the ENGINEER.

2. Leak test procedure per the current edition of AWWA D110.

3. CONTRACTOR shall notify ENGINEER and OWNER 72 hours before reservoir is ready for filling.

4. After filling the reservoir, the water level shall be held at the overflow for a period of 72 hours. The reservoir and the drain lines from the ring drain shall then be examined for evidence of leaks. All leaks shall be repaired to the satisfaction of the ENGINEER. Any areas that, in the opinion of the ENGINEER, are exposed to contamination during the repair work shall be re-chlorinated to the ENGINEER's satisfaction.

5. Testing shall be completed before the reservoir is backfilled.

B. Leak Detection Methods

1. Leaks in floor construction joints may be detected with the aid of a diver.

2. Mud or cement deposits on the floor, when stirred up, would flow to the leak and may so indicate where the leaks are.

3. Honeycomb and cracks around waterstops may be detected through tapping with a hammer along the joint.

4. Any of these procedures may be insisted upon by the ENGINEER when epoxy injection has not stopped the leaks.

5. Leakage through joints, which may have resulted from bent over waterstops or honeycomb under or around waterstops may require the removal of concrete around the waterstops in suspected areas.

6. Chipped out concrete areas shall be properly dry packed with a mix of one-part cement to two-part coarse sand, after coating the existing concrete surface with an approved epoxy.

C. Acceptance

1. The net liquid loss shall not exceed 0.05 of 1.0 percent of reservoir capacity per 24 hours after the reservoir has been filled.

2. There shall be no visible running leaks or water puddles.

3. Damp spots on the exterior wall surface shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and repaired per these Specifications.

4. Any cracks, voids, honeycomb or cold joints shall be repaired as per AWWA D110. Any cracks or crazing shall be observed by the ENGINEER prior to any repairs being made. If cracks are repaired prior to observation by ENGINEER, the repair will be required to be removed and the repair completed following observation. If requested by the Contractor to stop floor leakage and if allowed by the Owner, the floor may be covered with a minimum of 2 inches of water and pure cement shall then be spread evenly over the entire floor area at the rate of one sack of cement to every 1,000 square feet of floor area. The floor shall not be allowed to dry after the application of cement. If the reservoir has been cement-seeded and if the reservoir is drained during the warranty period, Contractor shall be given 14 days advance notice and Contractor shall promptly remove all cement residue from the reservoir floor and clean the reservoir to the Owners satisfaction. The Owner shall pay for the subsequent reservoir disinfection and chlorination.

5. The reservoir shall not be backfilled until and unless the ENGINEER has accepted the tests.

6. This Section shall be applicable during the entire specified warranty period of the reservoir.

3.4 DISINFECTING AND FILLING

A. Refer to Section 33 13 13, Disinfection of Water Utility Storage Tanks, for disinfection requirements.

B. The reservoir should only be filled during normal working hours, at the end of each day the reservoir and ring drain should be checked for any kind of visible leakage. If only damp spots and small puddles of water are noted, the filling can continue. If major leaks are noted, they should be thoroughly investigated prior to continuing to fill the reservoir.

C. The reservoir will be filled at a constant fill rate from an existing 4-inch fill line at a rate no greater than 8 feet per day (24 hours) or as otherwise approved by the engineer. The reservoir shall be filled over a period of no less than 3 days (72 hours). Contractor will coordinate operation of 4-inch fill line with City staff.

3.5 DISINFECTION OF WATER PIPING

A. Disinfection shall be in accordance with the latest version of AWWA C651 following Engineer's acceptance of hydrostatic testing.

B. Chlorination by means of tablets or powders (calcium hypochlorite) placed in each length of pipe during installation is specifically prohibited.

C. Flush all foreign matter from the pipeline, branches and services.

1. Provide at no additional cost to the Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.

2. Flushing velocities shall be at least 2.5 feet per second (fps).

3. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipe in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

D. Chlorine Application:

1. Fill the test section of main from the lowest elevation and maintain a steady flow rate while injecting the water main with chlorinated water.

2. Flow (bleed) a blow-off, standpipe or hydrant at the water main's high point(s) to allow air to escape and ensure all interior pipe surfaces are wetted.

E. Chlorine Residual:

1. Measure chlorine residual with a high-range chlorine test kit at a point near to the injection point while filling the main.

2. Adjust the dose rate as necessary to maintain the target dose rate.

F. Potable water piping shall be disinfected with a solution containing a minimum 25 ppm and a maximum 50 ppm chlorine.

1. Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 200 feet of main and once for each main branch, 2-inch service, or as directed by the Engineer.

2. The chlorine solution shall remain in the piping system for a period of 24 hours, after which time the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.

3. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained.

G. Flush piping, branches, and services with municipal potable water until the chlorine residual is below 1.5 ppm and approximately the same as the source water.

1. There is no minimum flushing velocity for this step.

H. Disposal of any water containing chlorine shall be performed in accordance with the latest edition of AWWA C651 and C655, and all state or local requirements.

1. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective system owners.

2. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge to levels acceptable by Oregon State Department of Environmental Quality (DEQ).

3.6 DISINFECTION AND TESTING OF WATER MAIN END CONNECTIONS AND TIE-INS

A. Disinfection of potable water piping and appurtenances at end connections and tie-ins to the existing system which are required to remain in service due to restrictions in allowable shutdown time shall be disinfected as described below.

B. Prior to connecting new potable water piping and appurtenances with existing piping and appurtenances, the interior of all new pipe, fittings, valves and appurtenances shall be swabbed or sprayed with a 1 percent to 5 percent calcium hypochlorite solution.

C. In accordance with AWWA C651, swabbing or spraying of connection piping is allowed only if the total length of piping is equal to or less than one pipe length (18 feet). All

runs of new piping over 18 feet in total length will require hydrostatic pressure testing, flushing and disinfection as detailed elsewhere in this Section.

D. Following the disinfection procedures described above, connection of the new piping and appurtenances to the existing water system shall be made.

1. During the system startup, the Engineer and Contractor shall visually inspect all new fittings, piping, valves and appurtenances for evidence of leakage.

2. Any leakage observed during this period shall be promptly repaired by the Contractor, at Contractor's expense, as required by the Engineer.

3.7 FIELD QUALITY CONTROL

A. Bacteriological Sampling and Testing:

1. The Owner will collect samples after the line is flushed in accordance with the latest edition of AWWA C651.

a. The locations for sample collection shall be at the sole discretion of the Owner and Engineer.

b. The chlorine residual must be below 1.5 ppm or restored to the level maintained in the Owner's distribution system, when the sample is taken.

2. Bacterial Testing: After completing the chlorination procedure, test the main according to the following:

a. Bacterial Sampling

1) Option A:

a) Take an initial set of samples using sampling site procedures outlined herein.

b) Resample after a minimum of 24 hours' time has elapsed using sampling site procedures outlined herein.

c) Both sets of successive samples must pass for the main to be approved for service.

2) Option B:

a) Allow main to sit for a minimum of 24 hours without any water use.

b) Using sampling site procedures outlined herein, collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running.

c) Both sets of samples must pass for the main to be approved for service.

3) Allow 24 hours for the test results for each sample set.

b. Sampling Locations

1) The Owner will take one bacteriological sample from the end of the main and on each branch.

2) For long runs of main, at least one sample will be taken for every 1,200 feet of new main and as directed.

c. Sample Testing

1) The Owner will test the sample set for coliform bacteria and publish the test results within 24 hours.

d. Evaluating the Test Results

1) If one or more of the sample set tests positive for coliforms (fails), repeat chlorination and sampling processes specified herein after correcting the cause of the failure and as directed by the Engineer.

2) When two consecutive sample sets test negative (passing)for coliform bacteria, the bacterial testing is complete.

e. Completion of Bacterial Testing

1) Upon completion of bacterial testing, notify the Owner shall notify the Engineer and Contractor in writing that the testing is complete and the main is ready for tie-in.

f. Multiple Positive (Failing) Test Results

1) If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.

3. Results of the bacteriological testing shall be satisfactory with the Oregon Health Authority and/or other appropriate regulatory agencies, or disinfection shall be repeated by the Contractor.

B. Optional Sampling and Testing

1. If a pipeline is not promptly returned to service, the situation will be evaluated by the Owner to determine if the water quality may have been impacted and if additional testing as specified herein is warranted.

END OF SECTION

SECTION 33 13 13 - DISINFECTION OF WATER UTILITY STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes methods of disinfecting water storage tanks for potable water.

B. Section includes:

1. Water storage tank disinfection.
2. Bacteriological testing.

1.2 RELATED SECTIONS

A. None.

1.3 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C652 - Disinfection of Water Storage Facilities

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Disinfection Procedure:

1. Submit description of procedure, including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration.

2. Comply with Sections 3 and 4 of AWWA C652.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Certify that disinfectants meet or exceed AWWA C652 requirements.

E. Test and Evaluation Reports: Indicate results of bacteriological and residual chlorine laboratory test reports.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 QUALITY ASSURANCE

A. Perform Work in compliance with AWWA C652.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store disinfectants according to manufacturer's recommendations and in a cool, dry place away from combustibles such as wood, rags, oils, and greases.

C. Handle disinfectants according to manufacturer's safety precautions.

PART 2 PRODUCTS

2.1 DISINFECTANTS

A. Chlorine Forms: According to AWWA C652, Section 4.

1. Liquid chlorine
2. Sodium hypochlorite
3. Calcium hypochlorite

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspection:

1. Conduct inspection of tank interior before beginning disinfection.

2. Verify tank is clean and free of polluting materials.

3. Verify tank piping and vent connections are properly made and clear of obstructions.

4. Verify all interior paint is thoroughly cured according to paint manufacturer's instructions.

3.2 PREPARATION

A. Furnish personnel working inside tank during disinfection with equipment to comply with Federal and State regulations for Work conducted in a hazardous atmosphere.

B. Coordinate with the Engineer and Owner for scheduling of disinfection activities.

1. The Owner may require up to 1 weeks' time following notice to supply water for filling of reservoir.

3.3 APPLICATION

A. Use Chlorination Method 2 for disinfecting tank in Section 4 of AWWA C652, generally detailed as followed:

1. Spray or brush a solution of 200 milligrams per liter (mg/L) available chlorine directly on the surfaces of all parts of the storage facility that will be in contact with water when the storage facility is full to the overflow elevation.

2. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water.

3. Disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 minutes.

4. Following the completion of the chlorination procedure, potable water shall be admitted, the drain piping purged of the 10 mg/L chlorinated water, and the storage facility filled to its overflow level.

B. A sample shall be taken by the Owner for microbiological analysis according to State Health Standards for potable water.

1. Contact the Engineer and/or Owner to arrange for samples to be taken for microbiological analysis.

2. Microbiological analysis must indicate that the water is free of coliform organisms before the facility can be put into service.

3. It will not be necessary to flush the reservoir or tank after the chlorine solution is applied by spraying or brushing provided passing microbiological and leakage tests are achieved.

C. When water samples fail to meet State Health Standards for potable water, perform corrective measures until water quality conforms to State Health Standards.

D. Any super-chlorinated water shall be discharged through an approved connection to the public sanitary sewer system or shall be dechlorinated to limits acceptable by the Oregon State Department of Environmental Quality (DEQ) for discharge into the existing storm drainage system. If super-chlorinated water is to be discharged into the public sanitary sewer system, notify the sewage treatment plant notifying the planned

time, location, and quantity of discharge. No super-chlorinated water shall be discharged into the storm drainage system or natural drainage way prior to approved dechlorination treatment.

END OF SECTION