TECHNICAL SPECIFICATIONS

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SECTION 01 01 10 - SUMMARY OF WORK

PART 1 - GENERAL

101.01 GENERAL

A. The WORK to be performed under this Contract shall consist of furnishing all plant, tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, WORK, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents.

101.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The WORK of this Contract includes work in the SERWTP influent vault and filter gallery in accordance with the drawings and these specifications. Work includes but is not limited to:

1. Replacing 3 valves in the influent vault.

2. Replacing motor actuators on two of the vault valves.

3. Removing the vault lid panels and constructing a new vault lid.

4. Disinfection of the new installation in accordance with AWWA C651 and as approved by the Engineer.

5. Paint all existing and new piping in vault.

6. Replacing 10 valves and actuators in the filter gallery.

101.03 CONTRACT METHOD

A. The WORK, hereunder, will be constructed based on lump sum prices.

101.04 WORK BY OTHERS

A. INTERFERENCE WITH WORK ON UTILITIES:

The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the WORK, and shall schedule the WORK so as to minimize interference with said relocation, altering, or other rearranging of facilities.

101.05 WORK SEQUENCE

A. WORK under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption of water service. The maximum allowable down time of water service to treatment plant is 28 days. Plant shutdown cannot occur during peak flow season (April 15 to October 1)

B. The CONTRACTOR shall have all of his materials necessary for work present at the site of WORK prior to interrupting water service.

C. The CONTRACTOR shall give notice to the OWNER of intent to disrupt water service at least two weeks (14 days) prior to disrupting water service. The OWNER will then notify the affected parties and assist by turning off any necessary valves. The CONTRACTOR shall not operate any of the OWNER's valves.

101.06 **CONTRACTOR USE OF PROJECT SITE**

A. The CONTRACTOR's use of the project site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities, and field offices.

B. The CONTRACTOR shall limit construction operations to areas within the public right-of-way and shall maintain public access to driveways.

101.07 **OWNER USE OF THE PROJECT SITE**

A. When the CONTRACTOR's WORK involved rehabilitation of or extension to the existing facilities, the OWNER may utilize all or part of the existing site and existing facilities during the entire period of construction for the conduct of the OWNER's normal operations. The CONTRACTOR shall cooperate with the OWNER to minimize interference with the CONTRACTOR's operations and to facilitate the OWNER's operations. In any event, the OWNER shall be allowed access to the project site during the period of construction.

101.08 **PROJECT MEETINGS**

A. PRECONSTRUCTION CONFERENCE:

Prior to the commencement of WORK at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by the CONTRACTOR, its superintendent, and its subcontractors as appropriate. Other attendees will include OWNER Representative and designated project representative, representatives of other utilities affected by the WORK, others as requested by CONTRACTOR or OWNER.

B. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and

procedures for handling such matters established. This agenda will include the following:

1. CONTRACTOR'S tentative schedules.

2. Transmittal, review, and distribution of CONTRACTOR's submittals.

3. Processing applications for payment.

4. Maintaining record documents.

5. Critical Work sequencing.

6. Field decisions and Change Orders.

7. CONTRACTOR's assignments for safety and first aid.

C. The OWNER will conduct the preconstruction conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

D. PROGRESS MEETINGS:

The CONTRACTOR shall schedule and hold regular on-site progress meetings as required by progress of the WORK. The CONTRACTOR and OWNER shall be represented at each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers, and subcontractors.

E. The CONTRACTOR shall conduct the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL PROCEDURES

A. General

1. This Section outlines the general terms that CONTRACTOR must follow for preparing and providing Submittals to ENGINEER for review.
2. CONTRACTOR shall anticipate resubmitting Submittals for major equipment or complex systems.
3. If CONTRACTOR has questions about submittal requirements, CONTRACTOR is encouraged to communicate with ENGINEER to discuss requirements prior to submitting the Submittal.
4. Substitutions shall be clearly identified on the Submittal transmittal form and shall include all the information required for review.

B. Wherever Submittals are required by the Contract Documents, transmit a single electronic PDF file to ENGINEER with a Submittal transmittal form which is acceptable to ENGINEER.

C. Sequentially number transmittal forms. Mark revised Submittals with original number and sequential alphabetic or numeric suffix, i.e., Submittal 1, Submittal 1.A, Submittal 1.1, etc.

D. Identify Project, Contractor, subcontractor and/or supplier, pertinent drawing and detail number, and Specification section number, appropriate to Submittal.

E. Each Submittal shall contain material pertaining to no more than one equipment or material item.

F. Each Submittal shall have the Specification section and applicable paragraph number clearly identified on the front of the Submittal transmittal form. A copy of the Specification section and applicable paragraph shall be included with the Submittal and items included shall be clearly mark as either in compliance or not in compliance. For items not in compliance a description shall be provided explaining the reason for non-compliance.

G. CONTRACTOR shall review Submittals prior to submission to ENGINEER. Apply Contractor's stamp, signed and dated, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents. Identify any deviations from the Contract Documents on the Submittal transmittal form.

H. Schedule Submittals to expedite Project and deliver to ENGINEER at their business address. Coordinate submission of related items.

I. Submittals shall be submitted sufficiently in advance to allow ENGINEER not less than ten regular working days for examining the drawings. These drawings shall be accurate, distinct, and complete and shall contain all required information, including satisfactory

identification of items and unit assemblies in relation to the Contract Drawings and/or specifications.

J. Identify variations from Contract Documents and product or system limitations which may adversely affect successful performance of completed Work.

K. If a Submittal is returned to CONTRACTOR marked “APPROVED”, or similar notification, formal revision and resubmission will not be required.

L. If a Submittal is returned marked “APPROVED – MAKE CORRECTIONS NOTED”, or similar notification, CONTRACTOR shall make the corrections on the Submittal, however, formal revision and resubmission will not be required.

M. Resubmittals

1. If a Submittal is returned marked “AMEND AND RESUBMIT”, or similar notification, CONTRACTOR shall revise the Submittal and resubmit the required number of copies.
2. Identify changes made since the previous submission.

N. Rejected Submittals

1. If a Submittal is returned marked “REJECTED – RESUBMIT”, or similar notification, it shall mean either that the proposed material or product does not satisfy the specification, or the Submittal is so incomplete that is cannot be reviewed.
2. CONTRACTOR shall prepare a new Submittal or submit a substitution request.

O. Distribute copies of reviewed Submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

P. Submittals not requested will not be recognized or processed.

Q. Unless noted otherwise, corrections indicated on Submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the Contract requirements.

R. Fabrication or purchase of an item may only commence after ENGINEER has reviewed the pertinent Submittals and returned copies to CONTRACTOR marked either “APPROVED” or “APPROVED – MAKE CORRECTIONS NOTED”.

S. ENGINEER's review of CONTRACTOR Submittals shall not relieve CONTRACTOR of the entire responsibility for the corrections of details and dimensions. CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR Submittals. CONTRACTOR shall be responsible for dimensions and quantities, coordinating with all trades, the design of adequate connections and details, and satisfactory and safe performance of the work.

1.2 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedules within 15 days after date of Owner-Contractor Agreement. After review comments on the initial schedule are received from ENGINEER and OWNER, CONTRACTOR shall resubmit required revised data within ten days.

B. Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

D. Submit computer generated horizontal bar chart with separate line for each major portion of Work or operation, identifying first workday of each week.

E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

F. Indicate estimated percentage of completion for each item of Work at each submission.

G. Submit separate schedule of submittal dates for shop drawings, product data, and samples.

1.3 PRODUCT DATA

A. Product Data: Submit to ENGINEER for review for limited purpose of checking for conformance with information given and design concept expressed in 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.

C. After review, produce copies and distribute to OWNER.

1.4 SHOP DRAWINGS

A. Shop Drawings: Submit to ENGINEER for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Fabrication of an item may be commenced only after ENGINEER has reviewed the pertinent submittals and returned copies to CONTRACTOR marked either "APPROVED", or "APPROVED - MAKE CORRECTIONS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.

C. When required by individual specification sections, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.

1. Include signed and sealed calculations to support design.
2. Submit 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. After review, produce copies and distribute to all ENGINEER, CONTRACTOR, AND OWNER.

1.5 SAMPLES

A. Whenever indicated in the Specifications or requested by ENGINEER, CONTRACTOR shall submit at least 1 sample of each item or material to ENGINEER for acceptance at no additional cost to OWNER.

B. Samples, as required herein, shall be submitted for acceptance prior to ordering such material for delivery to the jobsite, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delay in the Work.

C. Unless otherwise specified, all colors and textures of specified items will be selected by ENGINEER from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.6 CERTIFICATES

A. When specified in individual Specification sections, 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.

1.7 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual Specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to ENGINEER for delivery to OWNER in quantities specified for Product Data.

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

1.8 MANUFACTURER'S FIELD REPORTS

A. When required in individual sections, have Manufacturer or Supplier provide qualified representative to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable and to make written report of observations and recommendations to ENGINEER.

1.9 OPERATIONS AND MAINTENANCE MANUAL SUBMITTAL

A. NOT USED

B. CONTRACTOR shall also furnish ENGINEER one copy of the Operations and Maintenance Manuals in PDF electronic format.

C. CONTRACTOR shall include in the Operations and Maintenance manuals full details for care and maintenance for all visible surfaces as well as the following for each item of mechanical, electrical, and instrumentation equipment (except for equipment furnished by OWNER):

1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
2. Preventative maintenance procedures and schedules
3. A description of proper maintenance activities
4. Complete parts lists, by generic title, identification number, and catalog number, complete with exploded views of each assembly.
5. Disassembly and reassembly instruction
6. Name and location of nearest supplier and spare parts warehouse
7. Name and location of manufacturer
8. Recommended troubleshooting and start-up procedures
9. Prints of the record drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications.

D. All Operations and Maintenance manuals shall be submitted in final form to ENGINEER not later than the 75 percent of construction completion date. All discrepancies found by ENGINEER in the Operations and Maintenance manuals shall be corrected by CONTRACTOR prior to final acceptance of the project.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

SECTION 01 45 00
QUALITY CONTROL AND MATERIALS TESTING

PART 1 GENERAL

1.1 SUMMARY

A. This Section outlines responsibilities for controlling the quality of materials, products, and workmanship.

1.2 MATERIALS

A. All materials incorporated in the project shall be new and shall fully comply with the Specifications. Unless otherwise clearly provided in the Specifications, all workmanship, equipment, materials, and articles incorporated in the Work covered by the Contract are to be of the best available grade of their respective kinds. Whenever, in the specifications, any material, article, device, product, fixture, form, type of construction, or process indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired and shall be deemed to be followed by the words "or approved equal" and CONTRACTOR may in such case, upon receiving ENGINEER's approval, purchase and use any item, type, or process which shall be substantially equal in every respect to that indicated or specified.

B. Materials and equipment may be used in the Work based upon receipt of a Supplier's certificate of compliance. Certificate must be in possession of CONTRACTOR and reviewed by ENGINEER prior to use.

C. Quality Assurance Testing by OWNER and/or ENGINEER shall not relieve CONTRACTOR of responsibility to furnish materials and work in full compliance with Contract Documents.

1.3 MANUFACTURER'S INSTRUCTIONS

A. Should instructions conflict with Contract Documents, request clarification before proceeding.

B. When required in individual sections, submit manufacturer's instructions in the quantity required for product data, delivery, handling, storage, assembly, installation, start-up, adjusting, balancing, and finishing, as appropriate.

1.4 WORKMANSHIP

A. Maintain performance control and supervision over Subcontractors, Suppliers, manufacturers, products, services, workmanship, and site conditions, to produce work in accordance with Contract Documents.

B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

C. Provide suitable qualified personnel to produce specified quality.

D. Ensure finishes match approved samples.

1.5 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerance to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from ENGINEER before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 TESTING AND INSPECTION SERVICES

A. The testing agency and testing for quality control and material testing shall be furnished by CONTRACTOR as part of the project. Results of testing shall be reported to CONTRACTOR and ENGINEER on site. Reports of the testing shall be transmitted directly to ENGINEER.

B. Materials to be supplied under this contract will be tested and/or inspected either at their place of origin or at the site of the work by the testing agency. CONTRACTOR shall give ENGINEER written notification well in advance of actual readiness of materials to be tested and/or inspected at point of origin so ENGINEER may witness testing by the testing agency. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the material nor shall it preclude retesting or reinspection at the site of the work.

C. CONTRACTOR shall furnish such samples of materials as are requested by the ENGINEER, without charge. No material shall be used until reports from the testing agency have been reviewed and accepted by ENGINEER. See Section 01 33 00 - Submittal Procedures.

1.7 UNSATISFACTORY CONDITIONS

A. Examine areas and conditions under which materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

1.8 QUALITY CONTROL TESTING

A. ENGINEER’s failure to detect any defective Work or materials does not prevent later rejection when such defect is discovered nor does it obligate ENGINEER for acceptance.

B. CONTRACTOR shall provide 24-hours minimum notice to ENGINEER for all testing required by these specifications so ENGINEER may coordinate or be present during testing.

1.9 TESTING ACCEPTANCE AND FREQUENCY

A. Minimum Quality Control Testing Frequency: As defined in Table 01 45 00-1, CONTRACTOR shall be responsible to ensure that all testing is performed at the frequencies shown. CONTRACTOR shall uncover any work at no cost to OWNER to allow the testing agency to perform required testing at the frequency shown.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying the next material or substance.

B. Seal cracks or openings of substrate prior to applying the next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

TABLE 01 45 00-1: QUALITY CONTROL TESTING FREQUENCY

SYSTEM or MATERIAL	TESTS	MINIMUM REQUIRED FREQUENCY
PORTLAND CEMENT CONCRETE		
Section 3 30 00 Cast-in-Place Concrete	Slump	1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs and more frequently if batching appears inconsistent.
	Entrained air	1 test with slump test.
	Ambient and concrete temperatures	1 test with slump test.
	Water cement ratio.	to be verified and provided with batch tickets.
	Compressive strength	1 set of 5 cylinders (See Note 5). 1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs, and more frequently if batching appears inconsistent. (See Section 03 30 00-3.5.A.3 for additional requirements.) Each sample used to mold strength test specimens shall be tested for slump, air content, and temperature.

NOTES:

1 Additional tests shall be conducted when variations occur due to CONTRACTOR's operations, weather conditions, site conditions, etc.

2 Classification, moisture content, Atterberg limits and specific gravity tests shall be conducted for each compaction test, if applicable.

3 Tests can substitute for same tests required under "Aggregates" (from bins or source), although gradations will be required when blending aggregates.

4 Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for water/cement calculations.

5 Strength tests shall be the average of the strengths of at least two (2) 6-inch diameter by 12- inch high cylinders. If 4-inch diameter cylinders are used, collect an additional cylinder (6 total) and the strength test shall be the average of the strengths of at least three (3) 4-inch by 8-inch high cylinders.

- END OF SECTION –

SECTION 01 45 23
TESTING AGENCY SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. OWNER shall be responsible for providing Construction Quality Control Testing of all soils, concrete, etc. as required by the various sections of these Specifications. This section includes the following:

1. Use of independent testing agency
2. Control testing report submittal requirements
3. Responsibilities of testing agency

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures

1.3 REFERENCES

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM D 3740 Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
2. ASTM D 4561 Standard Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials
3. ASTM E 329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.4 DEFINITIONS

A. Independent Testing Agency: A testing agency NOT owned by CONTRACTOR or OWNER, and an agency that does not have any preferential affiliation or association with CONTRACTOR or OWNER, or any of CONTRACTOR's or OWNER's Subcontractors and Suppliers other than entering into a contract with OWNER to perform the duties defined in these Specifications.

B. Professional Engineer: An engineer who complies with Utah licensing law and is acceptable to the authority having jurisdiction.

1.5 QUALITY ASSURANCE

A. CONTRACTOR shall employ and pay for services of an independent testing agency which complies with ASTM D 3740, ASTM D 4561, and ASTM E 329 to test materials for contract compliance.

1.6 CONTRACTOR SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures

B. If CONTRACTOR is employing and paying for an independent testing agency, prior to start of Work, submit testing agency's name, address, telephone number and the following:

1. Concrete Technician: Approved by ENGINEER or ACI certified.
2. Person charged with engineering managerial responsibility
3. Professional engineer on staff to review services
4. Level of certification of technicians

1.7 TESTING AGENCY SUBMITTALS

A. Field Test Report: Submit report no later than the end of the current day.

B. Laboratory Test Report: Submit original report within 48 hours after test results are determined.

C. Final Summary Report: Submit prior to final payment

D. On all reports include:

1. Project title, number and date of the report
2. Date, time and location of test
3. Name and address of material Supplier
4. Identification of product being tested and type of test performed
5. Identify whether test is initial test or retest
6. Results of testing and interpretation of results
7. Name of technician who performed the testing

1.8 RESPONSIBILITIES OF TESTING AGENCY

A. Calibrate testing equipment at least annually with devices with an accuracy traceable to either National Bureau of Standards or acceptable values of natural physical constraints.

B. Provide sufficient personnel at site and cooperate with CONTRACTOR, ENGINEER and OWNER's Representative in performance of testing service.

C. Secure samples using procedures specified in the applicable testing code.

D. Perform testing of products in accordance with applicable sections of the Contract Documents.

E. Immediately report any compliance or noncompliance of materials and mixes to CONTRACTOR, ENGINEER, and OWNER's Representative.

F. When an out-of-tolerance condition exists, perform additional inspections and testing until the specified tolerance is attained, and identify retesting on test reports.

1.9 LIMITS ON TESTING AGENCY AUTHORITY

A. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Agency may not suspend Work.

C. Agency has no authority to accept Work for OWNER.

1.10 SPECIAL INSPECTOR

A. Special Inspections as required by for modifications to the existing Vault shall be paid for by the OWNER. CONTRACTOR shall be responsible for coordinating all special inspections including inspections, observations, tests, and sampling CONTRACTOR shall provide a minimum of 48 hours notice prior to any required special inspections.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

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SECTION 01 50 00 - CONSTRUCTION FACILITIES AND ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

101.01 GENERAL

A. The Contractor shall provide and maintain adequate construction facilities and perform the necessary work to minimize the impact and inconvenience of the construction activities.

101.02 SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures in accordance with Part 1926 of the OSHA Standards for Construction.

101.03 BARRIERS AND ENCLOSURES

A. Provide as required to prevent public entry to construction areas, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades as required by governing authorities for public rights-of-way and for public access to existing building.

C. Provide barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, and puddling or continuous running water.

101.04 PROTECTION OF INSTALLED WORK

A. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage. Repair or replace at OWNER's option any installed work damaged by traffic, the public, or Work operations.

101.05 DUST, WATER AND NOISE CONTROL

A. Surface Water, Erosion and Sediment Control:

1. Surface water shall be controlled so that the construction area is not allowed to become wet from runoff from adjacent areas.

B. DUST CONTROL:

1. All work shall be in compliance with the Federal, State, and local air pollution standards, and not cause a hazard or nuisance to personnel and the public in the vicinity of the work.

2. Execute work by methods to minimize raising dust from construction operations.

C. NOISE CONTROL:

1. Execute construction between the hours as allowed unless otherwise approved by OWNER.

101.06 **CONSTRUCTION CLEANING**

A. All public and private areas used as haul roads shall be continuously maintained and cleaned of all construction caused debris such as mud, sand, gravel, soils, pavement fragments, sod, etc. Care shall be taken to prevent spillage on haul routes. Any such spillage shall be removed immediately, and the area cleaned.

B. Public roads shall be maintained in accordance with applicable ordinances and regulations.

C. Through all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work site clean and shall remove daily all refuse, dirt, damaged materials, unusable materials, and all other trash or debris that he has created from his construction activities.

D. Materials and equipment shall be removed from the site as soon as they are no longer necessary; and upon completion of the work and before final inspection, the entire work site shall be cleared of equipment, unused materials, and rubbish so as to present a satisfactory clean and neat appearance. All cleanup costs shall be included in the Contractor's Bid.

101.07 **REMOVAL**

A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities. Remove underground installations to a depth of two feet; grade site as indicated. Restore existing facilities used during construction to specified, or to original, condition.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 60 00 - MATERIAL AND EQUIPMENT

PART 1 - GENERAL

101.01 GENERAL

A. It is the responsibility of the Contractor to provide products as specified in the Contract Documents free from manufacturer defects or damage from shipping.

101.02 PRODUCTS

A. Products include all material, equipment, and systems.

B. Components required to be supplied in quantity within a specification section shall be the same and shall be interchangeable.

C. Do not use products removed from an existing structure, pipeline, etc., except as specifically required, or allowed, by Contract Documents.

101.03 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition.

B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

101.04 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer's instructions. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

C. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

101.05 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only; Any product meeting those standards.

B. Products Specified by Naming One or More Manufacturers with a Provision of Substitutions: Submit a request for substitution for any manufacturer not specifically named.

C. Product Specified by Naming Several Manufacturers: Products of named manufacturers meeting specifications: no options, or substitutions allowed.

D. Products Specified by Naming Only One Manufacturer: No options, no substitutions allowed.

101.06 **PRODUCTS LISTS**

A. Within 10 days after date of Owner-Contractor Agreement, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number (if applicable) of each product.

101.07 **SUBSTITUTIONS**

A. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

B. Request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.

2. Will provide the same warranty for substitution as for specified product.

3. Will coordinate installation and make other changes which may be required for WORK to complete in all respects.

4. Waives claims for additional costs which may subsequently become apparent.

C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of Contract Documents.

D. OWNER will determine acceptability of proposed substitution and will notify Contractor of acceptance or rejection in writing within a reasonable time.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 70 00 - CONTRACT CLOSEOUT

PART 1 - GENERAL

101.01 CLOSEOUT PROCEDURES

A. When Contractor considers WORK has been reached final completion, submit written certification that Contract Documents have been reviewed, WORK has been inspected, and that WORK is complete in accordance with Contract Documents and ready for OWNER's review.

B. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

C. OWNER will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

101.02 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean and flush drainage systems.

C. Clean site; sweep paved areas, rake clean other surfaces.

D. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site.

101.03 PROJECT RECORD DOCUMENTS

A. Provide completed record drawings and other required closeout documents prior to requesting final payment.

B. Store record documents separate from those used for construction.

C. Keep documents current; do not permanently conceal any WORK until required information has been recorded.

D. At Contract closeout, submit documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

101.01 MAINTENANCE AND GUARANTEE

A. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the Contractor fails to make such repairs or

replacements promptly, the OWNER reserves the right to do the WORK and the Contractor and his surety shall be liable to the OWNER for the cost thereof.

B. Comply with ordinances of local jurisdictions having authority.

C. Make periodic inspections during guarantee period and correct defective work or correct defective work as directed by the OWNER or appropriate governing authority.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 70 20 - RECORD DRAWINGS

PART 1 - GENERAL

101.01 RECORD DRAWINGS

A. The CONTRACTOR shall keep and maintain, at the job site, one record set of drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. These master record drawings of the CONTRACTOR's representation of as-built conditions, including all revisions made necessary by addenda, change orders, and the like shall be maintained up-to-date during the progress of the WORK.

B. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.

C. Record drawings shall be accessible to the OWNER at all times during the construction period and shall be delivered to the OWNER upon completion of the WORK.

D. Final payment will not be approved until the CONTRACTOR-prepared record drawings have been delivered to the OWNER. Said up-to-date, record drawings may be in the form of a set of prints with carefully plotted information overlaid in pencil.

E. Upon substantial completion of the WORK and prior to final acceptance, the CONTRACTOR shall complete and deliver a complete set of record drawings to the OWNER, conforming to the construction records of the CONTRACTOR. This set of drawings shall consist of corrected plans showing the reported location of the WORK. The information submitted by the CONTRACTOR and incorporated by the OWNER into the Record Drawings will be assumed to be reliable, and the OWNER will not be responsible for the accuracy of such information, nor for any error or omissions which may appear on the Record Drawings as a result.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 02 10 00 - SITE PREPARATION

PART 1 - GENERAL

101.01 **DESCRIPTION**

This section specifies site preparation which consists of clearing, grubbing and demolition.

101.02 **JOB CONDITIONS**

A. EXISTING CONDITIONS:

The Contractor shall determine the actual condition of the site as it affects this portion of WORK. Contractor shall coordinate site preparation with OWNER's administration and operation staff.

B. PROTECTION:

Site preparation shall not damage structures, landscaping, or vegetation adjacent to the site. The Contractor shall repair or replace any damaged property.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

303.01 GENERAL

The Contractor shall notify the Project Representative when site preparation is complete.

303.02 PERFORMANCE

A. DEMOLITION AND REMOVAL:

1. Piping:

Piping shall be removed where indicated on the drawings and disposed of as directed by the Owner.

- END OF SECTION -

SECTION 02 50 90 - PROTECTION AND RESTORATION OF EXISTING IMPROVEMENTS

PART 1 - GENERAL

101.01 GENERAL

A. The WORK of this section includes the restoration of all existing improvements damaged or altered by the construction of the project.

B. Existing improvements shall include but are not limited to permanent surfacing, curbs, gutters, sidewalks, planted areas, ditches, driveways, culverts, fences, walls, signs, mailboxes, and sprinkling appurtenances. All improvements shall be reconstructed to equal or better, in all respects, the existing improvements removed. Said existing improvements shall be reconstructed in accordance with the notes and details shown on the drawings and/or the applicable provision of these Specifications.

101.02 **QUALITY ASSURANCE**

A. Use adequate numbers of skilled workmen who are trained and experienced in the type of construction required.

B. The quality of the finished restored improvement, as determined by the OWNER, shall be of equal or better quality than was said improvement prior to being damaged or removed.

101.01 **REFERENCES**

A. State of Utah Standard Specifications for Road and Bridge Construction, latest edition including all addendums.

PART 2 - PRODUCTS

202.01 MATERIALS - GENERAL

A. As required to complete the restoration of existing improvements and shall be at least equal to original improvement at the time of damage or removal, as determined by the OWNER of said improvement, and shall match original construction in finish and dimension.

B. Shall be in accordance with requirements of local jurisdiction having authority. Obtain approval of all materials from local jurisdiction having authority prior to ordering or delivering.

PART 3 - EXECUTION

SECTION 02 50 90 - PROTECTION AND RESTORATION OF EXISTING IMPROVEMENTS

303.01 PREPARATION

A. Obtain all permits necessary for the restoration of existing surface improvements.

B. Protect all public and private property adjacent to the WORK. Exercise due caution to avoid damage to such property.

303.02 GENERAL RESTORATION REQUIREMENTS

A. All improvements damaged or removed shall be restored in accordance with local jurisdiction having authority. In case of conflict between these specifications and local authority specifications, the local authority shall govern.

B. Repair or replace all existing surface improvements, which were damaged or removed as a result of operations of WORK under this contract. Restoration shall be of at least equal quality and identical in dimension to original improvement unless specifically specified otherwise.

303.08 NOTIFICATION BY THE CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipeline; all buried electric power, communications or television cables; all traffic signal and street lighting facilities; and all roadway and state highway right-of-way the Contractor shall notify the respective authorities representing the OWNERS or agencies responsible for such facilities not less than three working days nor more than five working days prior to excavation so that a representative of said OWNERS or agencies can be present during such work if they so desire.

- END OF SECTION -

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers the work necessary to furnish, install, and complete, the concrete formwork.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. American Concrete Institute (ACI) -ACI 347R- Guide to Formwork for Concrete
2. American Hardboard Association (AHA) -AHA A135.4- Basic Hardboard
3. Department of Commerce (DOC) -DOC PS 1- Structural Plywood
4. ACI 350R-01 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
5. NSF International (NSF) 61 - Drinking Water System Components - Health Effects

1.4 DESIGN

A. Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the finish specified in Section 03 30 00 Cast- in-Place Concrete. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. The following shall be submitted:

1. Drawings showing details of forming, shoring and bracing for footings, walls, and floors shall be submitted to ENGINEER at least 3 weeks prior to their use. Drawings showing details of formwork shall include joints, supports, studding and shoring, and sequence of form and shoring removal.
2. If requested by ENGINEER, design analysis and calculations shall be submitted for form design and methodology used in the design. The analysis and calculations shall verify the selection of form ties, horizontal and vertical stiff-backs or braces for wall panels, forming and form openings, or any other part of forming, shoring or bracing which may be considered critical by ENGINEER.

3. Manufacturer's data including literature describing form materials, accessories, and form releasing agents.
4. Manufacturer's recommendation on method and rate of application of form releasing agent.

C. ENGINEER's review will not relieve CONTRACTOR from any responsibility as to the adequacy of the forming, shoring and bracing design. Any formwork installed by CONTRACTOR shall be solely at CONTRACTOR's risk. ENGINEER's review will not lessen or diminish CONTRACTOR's liability.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Form surfaces shall be in "new and undamaged" condition and may be plywood, hard plastic finished plywood, overlaid waterproof particle board, and steel of sufficient strength and surface smoothness to produce the specified finish. CONTRACTOR shall verify that his types of form surfaces and panel sizes satisfy all requirements of these specifications.

B. The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

2.2 FORM TIES

A. Form ties on exposed surfaces shall be located in a uniform pattern. Snap ties shall not be broken until the concrete has reached the design concrete strength. The use of tie wires as form ties will not be permitted. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. Form ties shall be **Plastic Cone Snap Tie by Dayton-Superior, Wrench Head Snap Tie by MASCO Mason Supply,** or approved equal.

B. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Taper ties shall be **Taper Tie by Dayton-Superior, Taper-Tie by MASCO Mason Supply**, or approved equal.

2.3 FORM RELEASING AGENTS

A. Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

B. Any agents used inside of the weir house shall consist of products which are certified by laboratories approved by ANSI and shall comply with be NSF Standard 61 for approved use in potable water systems.

PART 3 EXECUTION

3.1 INSTALLATION

A. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03 30 00 Cast-in-Place Concrete. Forms shall be used, whenever necessary, to confine the concrete, to shape the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating. The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar.

B. The surfaces of all forms in contact with the concrete shall be clean, rigid, tight and smooth. All dirt, chips, sawdust, mud, water and other foreign matter shall be removed from within the forms or within the excavated areas, before any concrete is deposited therein.

C. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be thoroughly cleaned of mortar from previous concreting and of all other dirt and foreign matter before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

D. Bulkheads to form vertical wall joints shall be strong enough to withstand concrete pressures during pouring and vibrating, and shall be properly placed between the forms to avoid mortar seepage. Holes shall be provided in the bulkheads to permit passage of horizontal mild steel reinforcing where required by the Contract Drawings. Unless these are specifically called for on the Contract Drawings, no chamfer strips shall be placed in the corners of vertical construction joints.

3.2 COATING

A. Form inside surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.3 ALIGNMENT AND TOLERANCES

Forms shall be properly aligned and adequately supported to produce concrete surfaces conforming to construction tolerance given in Table 03 10 00-1 - Tolerances for Formed Surfaces.

TABLE 03 10 00-1
TOLERANCES FOR FORMED SURFACES

Condition	Measurement	Tolerance
1. Variations from the plumb:	In any 10 feet of length	1/4-inch
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length	1-inch
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 20 feet of length Maximum for entire length	1/4-inch 1/2-inch
2. Variation from the level or from the grades indicated on the drawings	In any 10 feet of length In any bay or in any 20 feet of length	1/4-inch 3/8-inch
3. Variation of the linear building lines from established position in plan	In any 20 feet Maximum	1/2-inch 1-inch
4. Variation of distance between walls, columns, partitions	1/4-inch per 10 feet of distance, but not more than 1/2-inch in any one bay, and not more than 1-inch total variation	
5. Variation in the thickness of slabs and walls	Minus Plus	1/4-inch 1/2-inch

3.4 FORM REMOVAL

A. Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Forms shall not be removed until approval is given by ENGINEER. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement.

B. CONTRACTOR shall remove all wood splinters on concrete surfaces after stripping of wood forms.

- END OF SECTION -

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers the steel reinforcement bars, wire fabric mats, rod mats, and couplers for use in reinforced cast-in-place concrete.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 301	Specifications for Structural Concrete
2. ACI 315	Details and Detailing of Concrete Reinforcement
3. ACI 318	Building Code Requirements for Structural Concrete and Commentary
4. ACI 350R	Code Requirements for Environmental Engineering Concrete Structures and Commentary

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
2. ASTM A 615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
3. ASTM A 767	Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
4. ASTM A 775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
5. ASTM A 1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

D. CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

1. CRSI (DA4)	Manual of Standard Practice (MSP-1)

E. Wire Reinforcement Institute (WRI)

1. Manual of Standard Practice for Welded Wire Reinforcement

1.4 SUBMITTALS

A. CONTRACTOR shall submit the following in accordance with Section 01 33 00 - Submittal Procedures:

1. Drawings of Concrete Reinforcement System with details showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.
2. Reinforcing Steel with certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.
3. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, manufacturer's literature shall be submitted which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

1.5 DELIVERY AND STORAGE

A. Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

A. Dowels shall conform to ASTM A 615, Grade 60.

2.2 FABRICATED BAR MATS

A. Fabricated bar mats shall conform to ASTM A 184.

2.3 REINFORCING STEEL

A. Reinforcing steel shall be deformed bars conforming to ASTM A 615 grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 1064. When no grade is indicated use 60 ksi grade steel. Special coated bars (epoxy and zinc) may be specified for use in a highly corrosive atmosphere where concrete cover is not considered sufficient, in which case reference to ASTM A 767 and A 775 will be included.

2.4 WELDED WIRE FABRIC

A. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 1064. Welded wire fabric with longitudinal wire of W4 size and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.

2.5 WIRE TIES

A. Wire ties shall be 16-gauge or heavier black annealed steel wire.

2.6 MECHANICAL COUPLERS

A. Mechanical couplers shall only be provided where shown on the Contract Drawings. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.

C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

D. Mechanical Couplers shall be **Lenton Form Saver by Erico Products, D51A DBR by Dayton Superior**, or approved equal.

2.7 SUPPORTS

A. Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI (DA4) MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete.

B. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2-inch of concrete surface shall be plastic protected or shall be stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

C. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

D. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

2.8 EPOXY ANCHOR GROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy anchor grout shall meet the requirements of Section 03 60 00 – Grout.

PART 3 EXECUTION

3.1 GENERAL

A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the requirements specified herein.

3.2 REINFORCEMENT

A. Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete.

B. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.

C. Placement:

1. Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete.
2. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.
3. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks.
4. For concrete over formwork, the CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
5. Limitations on the use of bar support materials shall be as follows.
    a. Concrete Dobies: permitted at all locations except where architectural finish is required.
    b. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
    c. Plastic Bar Supports: permitted at all locations except on grade.
6. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
7. Bars additional to those shown which may be found necessary or desirable by CONTRACTOR for the purpose of securing reinforcement in position shall be provided by CONTRACTOR at no additional cost to OWNER.

8. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.
9. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Specially coated bar supports shall be used. CONTRACTOR shall repair all chips or cracks in the epoxy coating with a compatible epoxy repair material prior to placing concrete.
10. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

D. Splicing:

1. Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.3 WELDED-WIRE FABRIC

A. Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned using supports.

3.4 DOWELS

A. Dowels shall be installed in slabs on grade at locations indicated and at right angles to the joint being doweled. Dowels shall be accurately aligned parallel to the finished concrete surface and rigidly supported during concrete placement. A PVC sleeve shall cover one end of dowels up to the joint location at the center of the bar. Grease to be placed at the back of the sleeve prior inserting dowel so that the grease will flow out, around, and fully encase the inserted bar. Grease the bar before insertion. Grease shall be semi-solid, inert lubricant, such as lithium grease.

3.5 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Dowel Epoxy Installation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be

no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.

2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or damaging any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole to guarantee full wetting of the bar surface with epoxy. CONTRACTOR shall insert the bar slowly enough to avoid developing air pockets.

3.6 CLEANING AND PROTECTION

A. CONTRACTOR shall protect reinforcement steel from conditions conducive to corrosion until concrete is placed.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is a delay in placing concrete, reinforcement shall be reinspected and if necessary, recleaned.

- END OF SECTION -

SECTION 03 25 00
EXPANSION JOINTS, CONSTRUCTION JOINTS AND WATERSTOPS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers the work necessary to furnish, install and complete expansion and construction joints, including waterstops.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 33 00 Cast-in-Place Concrete

1.3 REFERENCES

A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 318 Building Code Requirements for Reinforced Concrete

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
3. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
4. ASTM D 570 Standard Test Method for Water Absorption of Plastics
5. ASTM D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
6. ASTM D 638 Standard Test Method for Tensile Properties of Plastics
7. ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
8. ASTM D 747 Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
9. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
10. ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
11. ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

12. ASTM D 2240 Standard Test Method for Rubber Property-Durometer Hardness

D. FEDERAL SPECIFICATIONS (FS)

1. FS-TT-S-00227E Sealing Compound: Elastomeric Type, Multi-Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

1.4 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures:

1. Submit certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified. ENGINEER, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by OWNER. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by CONTRACTOR.
2. Samples of factory fabricated waterstop joints representing in all respects the material and workmanship of the material that will be furnished under this contract. Samples will be submitted and approved by ENGINEER prior to use of the factory joints in the field.
3. Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

1.5 OBSTRUCTIONS

A. CONTRACTOR shall pay particular attention to removing all obstructions such as concrete, nails, etc., from joints when movements of floor or wall sections can be expected under temperature and other conditions.

1.6 QUALITY ASSURANCE

A. Waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

1.7 DELIVERY AND STORAGE

A. Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 HORIZONTAL JOINT SEALANT

A. Horizontal joints not requiring waterstops or when so indicated on the Contract Drawings, shall be sealed using **Sikaflex-1A**, or approved equal, and shall meet the requirements of ASTM C-920, Type S, Grade NS, Class 35 and TT-S-002230C, Type II, Class A.

2.2 VERTICAL JOINT SEALANT

A. Vertical joints not requiring waterstops or when so indicated on the Contract Drawings, shall be sealed using **Sikaflex-1A**, or approved equal, and shall meet the requirements of ASTM C-920, Type S, Grade NS, Class 35 and TT-S-002230C, Type II, Class A.

2.3 JOINT PRIMER

A. Not required.

2.4 EXPANSION JOINTS

A. Not required.

2.5 PVC WATERSTOPS

A. Not required

2.6 HYDROPHILIC WATERSTOP

A. Non-bentonite rubber hydrophilic waterstop shall only be used where shown on the Contract Drawings or when approved by ENGINEER. Size shall be as indicated on the Contract Drawings.

B. The hydrophilic waterstop shall meet the following physical properties:

Physical Property	Test Method	Result
Tensile Strength (Minimum)	ASTM D412	350 psi
Elongation (minimum)	ASTM D412	600 %
Hardness	ASTM D2240	52 +/-5 Shore A
Tear Resistance	ASTM D624	50 lb/in
Specific Gravity	ASTM D792	1.35 +/-5

C. Manufacturer, or approved equal:

1. 2. Sika Swellstop II

PART 3 EXECUTION

3.1 WATERSTOPS

A. Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. The waterstop shall be correctly positioned in the forms so that the center of the waterstop is centered on the joint. Waterstop shall be held in place in the forms by use of a split form or other approved method that will positively hold the waterstop in the correct position and to the correct alignment. Vibrate concrete to obtain impervious concrete in the vicinity of all joints. In horizontal joints, ensure that the areas below the water stop are completely filled with concrete.

B Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. All waterstops shall be properly spliced and joints shall be checked for strength and pinholes after splicing. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop and shall be watertight. Splices in waterstop shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross-sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.

C. Install hydrophilic waterstop in accordance with the manufacturer's written instructions. Adhesives used on hydrophilic waterstop shall be NSF 61 certified. Adhesives shall meet the requirements of ASTM C 920 and shall be **Manus Bond 75-AM Lot NSF61**, **DAP Premium Polyurethane Construction Adhesive**, or approved equal.

3.2 JOINTS

A. Joints shall be installed at locations indicated and as authorized. Joints shall be constructed to produce straight joints, and shall be vertical or horizontal, except where walls intersect sloping floors.

B. Construction Joints

1. Prior to placing the abutting concrete for all construction joints, the contact surface shall be cleaned by approved means to remove all laitance and expose the aggregate. The exposed portion of the reinforcing steel shall be cleaned of all concrete. The cleaning method shall be conducted to not damage the waterstop, if waterstop is present.

C. Expansion Joints

1. Not used

D. Joint Sealant

1. The joint cavity shall be cleaned by sandblasting or power wire brushing and shall be blown clean of dust and sand with compressed air before the joint sealant may be applied. Joints must be frost-free, free of oils, grease, curing compound residues, and any other foreign matter that might prevent bond. A bond breaker tape shall be installed over the joint per manufacturer's instructions. After the joints have been prepared as described above, the joints shall be primed, and the sealant shall be applied in accordance with the manufacturer's recommendations.

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

GENERAL

SUMMARY

This Section covers cast-in-place concrete mix design and placement.

CONTRACTOR shall provide cast-in-place concrete as indicated in the Specifications and the Contract Drawings.

RELATED WORK

Related Work specified in other Sections includes, but is not limited to:

Section 03 10 00 Concrete Forming and Accessories
Section 03 20 00 Concrete Reinforcement
Section 03 25 00 Expansion Joints, Construction Joints, and Waterstops
Section 31 23 23 Excavation and Backfill for Structures

REFERENCES

Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301 Structural Concrete for Buildings
ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R Hot Weather Concreting
ACI 306R Cold Weather Concreting
ACI 318 Building Code Requirements for Structural Concrete and Commentary
ACI 350R Code Requirements for Environmental Engineering Concrete Structures and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33 Standard Specification for Concrete Aggregates
ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)

6. ASTM C 94 Standard Specification for Ready-Mixed Concrete
7. ASTM C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
8. ASTM C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete
9. ASTM C 150 Standard Specification for Portland Cement
10. ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete
11. ASTM C 172 Standard Specification for Sampling Freshly Mixed Concrete
12. ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
13. ASTM C 192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
14. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
15. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
16. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
17. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
18. ASTM C 595 Standard Specification for Blended Hydraulic Cements
19. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
20. ASTM C 1157 Standard Performance Specification for Hydraulic Cement

D. NSF INTERNATIONAL (NSF)

1. NSF/ANSI 61 Drinking Water System Components - Health Effects.

1.4 DEFINITIONS

A. Average Strength (f_{cr}): The required average strength for 30 consecutive strength tests which statistically assures not more than the permissible proportions of tests will fall below Specified Strength.

B. Specified Strength (f_c'): The indicated strength.

1.5 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Provide catalog information for all products to be used as part of the submitted mix design.

C. The results of trial mix designs along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory. Indicate whether mixes have been designed for pumping. Include in the report the following information:

1. Water-cement ratio.
2. Air entrainment.
3. Proportion of materials in the mix.
4. Source and type of cement.
5. Analysis of water to be used unless potable.
6. Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times and strengths.
7. Slump, air content and temperature of samples.
8. Unit weight of fresh and dry light weight concrete.
9. Strength test data showing mix meets indicated strength requirements per ACI-301.

D. Preapproved Mix Design Data: If supplier has on record, an OWNER approved mix design, submit name and address of supplier for each mix design 1 day prior to using concrete mix.

E. Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials. Test reports shall meet the following requirements:

1. Date of mix design: No older than 365 days from the date of submission.
2. Physical properties of the aggregate: Test results shall not be older than 455 days from the date of submission. A new report will be required if the aggregate source is changed.

F. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.

G. Submit catalog information on the curing compound and the proposed location(s) to be used.

1.6 QUALITY ASSURANCE

A. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures, or aggregate without ENGINEER'S approval.

B. In proportioning materials for mixing, use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.

C. Do not change the quantity of cement per cubic yard for approved mix design without written approval of ENGINEER.

D. Use of admixtures will not relax hot or cold weather placement requirements.

E. Ready-mixed concrete to be in accordance with Alternate No. 3 of ASTM C-94 and the requirements in this Section.

F. Tolerances for concrete construction and materials shall be in accordance with ACI 117.

1.7 PRODUCT STORAGE AND HANDLING

A. Store bagged and bulk cement in weatherproof enclosures to exclude moisture and contaminants.

B. Stockpile aggregate to avoid segregation and prevent contamination.

C. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

PART 2 PRODUCTS

2.1 ADMIXTURES

A. Admixtures shall be approved by ENGINEER prior to use. Any admixtures to be used shall be included in proposed concrete mix designs.

B. Air Entrainment: ASTM C 260.

C. Later Reducing and Set Retarding Agents: ASTM C494.

1. Type A: Set water reducing.
2. Type B: Set retarding.
3. Type C: Set accelerating.
4. Type D: Water reducing and set retarding.
5. Type E: Water reducing and set accelerating.
6. Type F: High range water reducing (super plasticizer).*
7. Type G: High range water reducing and set retarding.*

* The relative durability factor of water reducing admixtures shall not be less than 80 and the chlorides content (as Cl^-) expressed as a percent of the cement shall not exceed 0.1 percent by weight.

D. Calcium Chloride: None allowed.

E. Pozzolan: Pozzolan conforming to the requirements of ASTM C 618, Class F, is allowed as a Portland cement replacing agent under the following conditions:

1. The maximum percentage of Portland cement replacement is:
   a. 15 percent, for concrete exposed to weather.
   b. 20 percent, for interior concrete.
2. Pozzolan should not exceed 25% by weight of the cement plus pozzolans.
3. The minimum cement content shall be used in the design formulas before replacement is made.
4. Loss of ignition of pozzolan is less than 3 percent and the water requirement does not exceed 100 percent.
5. All other requirements of this section still apply.
6. Mix designs including trial batches are required for each aggregate source and for each concrete class.

F. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of

the specification under which it is furnished, for cement and pozzolan.

2.2 CEMENTITIOUS MATERIALS

A. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall conform to one of the following:

1. Cement: Use Portland cement, ASTM C 150, Type II, Type IIA, or Type V, low alkali, or ASTM C595 and ASTM C 1157 IL(10)-HS,unless noted otherwise.

B. Only one brand of cement from one manufacturing plant may be used.

2.3 AGGREGATES

A. Aggregates shall be natural aggregates, free from deleterious coatings, and shall conform to the requirements of ASTM C 33, except as modified herein. Aggregates shall not be potentially reactive as defined in Appendix XI of ASTM C 33. CONTRACTOR shall import nonreactive aggregates if local aggregates are reactive.

B. Fine Aggregates

1. Fine aggregate shall consist of clean, sharp, natural sand and shall conform to the requirements of ASTM C 33. Fine aggregate shall be graded as follows:

FINE AGGREGATES	
Sieve Size	Percent Passing by Weight
3/8 inch	100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#50	10-30
#100	2-10

2. Fine aggregates shall have no more than two percent by weight passing #200 sieve.

C. Coarse Aggregate

1. Coarse aggregate shall be washed gravel or crushed stone, or a combination of these materials, consisting of hard, tough, durable particles free from adherent coatings. It shall contain no more than 15 percent flat or elongated particles. A thin, flat or elongated particle is defined as a particle having a maximum dimension in excess of five times its minimum dimension. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered in the work under consideration shall not be used. Coarse aggregate shall be graded as follows (ASTM C 33):

COARSE AGGREGATES	
Sieve Size	Percent Passing by Weight
1-1/2 inch	100
1 inch	95-100
½ inch	25-60
#4	0-10
#8	0-5

2. Coarse aggregates shall have no more than 1.75 percent by weight passing #200 sieve. Proof of gradation will be provided to ENGINEER by CONTRACTOR.

2.4 ACI MIX DESIGN

A. The amount by which the average strength (f_{cr}) of a concrete mix exceeds the specified compressive strength (f'_c) shall be based upon no more than 1 in 100 random individual strength tests falling more than 500 psi below the specific strength.

B. Proportion the materials in accordance with ACI 211.1, 211.2 or 211.3 as applicable to produce concrete having the properties or limitations of Table No. 03 30 00-A.

2.5 HAND MIXING

A. Do not hand mix batches exceeding 0.5 cubic yards.

B. Hand mix only on watertight platform. Mix cement and aggregate prior to adding water.

C. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency.

2.6 HEATING, WATER AND AGGREGATE

A. Do not allow products of fuel combustion to contact the aggregate.

B. Heat mixing water to maximum temperature of 150 degrees F. Heat aggregates uniformly.

C. Do not mix cement with water and aggregate at a mix temperature greater than 100 degrees F.

2.7 WATER

A. Water shall be potable, except that non-potable water may be used if it produces cylinders having 7- and 28-day strengths at least 90 percent of the strength of similar specimens made with water from a municipal supply. The strength comparison shall be made on cylinders, identical except for mixing water, prepared and tested in accordance with ASTM C 109. Water for curing shall not contain any substance injurious to concrete, or which causes staining.

2.8 PROPORTIONS OF MIX

A. Mixture Proportioning, Normal Weight Concrete: All concrete that must be watertight and resistant to freeze-thaw cycles and to naturally occurring or commonly used chemicals should be air entrained. All materials should be proportioned to produce a

well-graded mixture of high density and maximum workability with a minimum specified 28-day compressive strength of concrete classification. Trial batches shall contain materials proposed to be used in the project. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified. In the case where ground iron blast-furnace slag is used, the weight of the slag will be substituted in the equations for the term P which is used to denote the weight of pozzolan. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength. Maximum water-cement or water-cement plus pozzolan Ratio: 0.45.

B. Average Strength: In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

TABLE NO. 03 30 00-A

CONCRETE MIX PROPERTIES (e)			
CONCRETE PROPERTIES	CONCRETE CLASSIFICATION(S)		
	Class 5000	Class 4500	Class 4000
Specified Compressive Strength $f_{c'}$ at 28 days, min., psi	5,000	4,500	4,000
Compressive Strength at 7 days, min., psi (a)	3,350	3,015	2,680
Cement content (94 lb. sacks of cement per cubic yard of concrete), min. (b)	7.5	7.0	6.5
Entrained air content, (% by volume).	6±1	6±1	6±1
Slump Range, in. (c)	1 - 4 (f)	1 - 4 (f)	1 - 4 (f)
Maximum Water Cement Ratio	0.45	0.45	0.45

(a) Used for monitoring purposes only.
(b) May include pozzolan replacements if approved by ENGINEER.
(c) Not more than 8 inches after adding high range water reducing admixture at site.
(d) Not allowed if concrete is exposed to freezing and thawing temperatures. Use Class 4000 or higher compressive strength and 6±1.0 percent air entrainment.
(e) All mix designs must be approved by ENGINEER.
(f) 1-3" for footings, sub-structural walls and 1-4" for slabs, beams, reinforced walls and columns.

2.9 CURING MATERIALS

A. Normal Curing Compound

1. The curing compound shall be white pigmented and shall conform to ASTM C 309, Type 2 Class B.
2. Sodium silicate compounds cannot be used.
3. Manufacturer, or approved equal:
   a. 1200-White by W.R. Meadows
   b. White Resin Cure J10W by Dayton Superior
   c. Safe-Cure 2000 by ChemMasters
   d. Aqua Kure White by Lambert Corporation

B. Dissipating Curing Compound

1. When the curing compound must be removed for finishes or grouting, compounds shall be of a dissipating type, conforming to the requirements of ASTM C 309, Type 1 or Type 2, Class B
2. Manufacturer, or approved equal:
   a. 1100-Clear by W.R. Meadows
   b. Kurez DR VOX by Euclid Chemical Company
   c. Clear Cure VOC J7WB by Dayton Superior
   d. Safe-Cure Clear DR by ChemMasters

PART 3 EXECUTION

3.1 GENERAL

A. CONTRACTOR shall inform ENGINEER at least 72 hours in advance of time and places at which CONTRACTOR intends to place concrete. All preparation work for concrete placements shall be substantially completed at least 2 workdays prior to the scheduled start of concrete placement to allow for ENGINEER's review and any necessary corrections.

3.2 PREPARATION OF SURFACES

A. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance.

B. Foundations: Earthwork shall be as specified. Flowing water shall be diverted without washing over freshly deposited concrete. Rock foundations shall be cleaned by high velocity air-water jets, sandblasting, or other approved methods. Debris and loose, semi-detached or unsound fragments shall be removed. Rock surfaces shall be moist but

without free water when concrete is placed. Semi porous subgrades for foundations and footings shall be damp when concrete is placed. Pervious subgrades shall be sealed by blending impervious material with the top 6 inches of the in-place pervious material or by covering with an impervious membrane.

C. Preparation of Previously Placed Concrete: Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be moist but without free water when concrete is placed.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.

B. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations as indicated or shown on the Contract Drawings. Proper placement and locations shall be the responsibility of CONTRACTOR.

3.4 BATCHING, MIXING AND TRANSPORTING CONCRETE

A. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and non-agitating units shall comply with NRMCA TMMB-1. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA-QC 3.

B. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quantity and quality of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by ENGINEER.

C. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than 1 inch when the specified slump is 3 inches or less, or more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

D. Admixtures: Admixtures shall be batched within an accuracy of 3 percent. Where two or more admixtures are used in the same batch, they shall be batched separately and must be compatible. Retarding admixture shall be added within one minute after addition of water is complete or in the first quarter of the required mixing time, whichever is first. Superplasticizing admixtures shall be added at the project site, and the concrete with the admixture shall be mixed 4 to 5 minutes before placing as recommended by

manufacturer. Concrete that shows evidence of total collapse or segregation caused by the use of admixture shall be removed from the site.

E. Control of Mixing Water: No water from the truck system or elsewhere shall be added after the initial introduction of mixing water for the batch. No water shall be added at the jobsite without the approval of ENGINEER.

3.5 SAMPLING AND TESTING

A. Aggregates: Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C33.

B. Sampling of Concrete: Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C 172.

1. Air Content: Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test shall be conducted each time a slump test is made.
2. Slump: At least 1 slump test shall be made on randomly selected batches of each mixture of concrete for every 100 cubic yards of ready-mixed concrete delivered to the job site. Also note the time batched at the plant and the starting time when unloading began at the site. Tests shall be performed in accordance with ASTM C 143.
3. Temperature: Concrete and air temperatures shall be measured and recorded with each slump test or with each set of cylinders and the air temperature shall also be recorded when the air temperature at the site is 40 degrees F or below and/or 90 degrees F or above.

C. Evaluation and Acceptance of Concrete

1. Frequency of Testing: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 3,000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent. Each sample used to mold strength test specimens shall be tested for slump, air content, and temperature.
2. Testing Procedures: Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two (2) 6-inch diameter by 12-inch high cylinders made from the same sample of concrete and tested at 28 days or at another specified test age. If 4-inch diameter cylinders are used, the strength shall be the average of the strengths of three (3) 4-inch by 8-inch high cylinders.
3. Evaluation of Results: Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength

test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch.

4. Unless noted otherwise, make a minimum of five (5) 6-inch diameter by 12-inch high concrete cylinders or six (6) 4-inch diameter by 8-inch high cylinders each time a test is required. When concrete is being placed in suspended slabs, beams and retaining walls make two (2) extra cylinders which must be cured on site. The extra cylinders will be used to determine when to remove forms and/or when to backfill.

D. Investigation of Low-Strength Test Results: When any strength test of standard-cured test cylinder falls below the specified strength requirement by more than 500 pounds per square inch, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803 or ASTM C 805 may be permitted by ENGINEER to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in a place that is considered potentially deficient. The location of cores shall be determined by ENGINEER to least impair the strength of the structure. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C 42. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to or at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by ENGINEER in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to ENGINEER. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by ENGINEER, at the expense of CONTRACTOR.

3.6 CONVEYING CONCRETE

A. Concrete shall be conveyed from mixer to forms as rapidly as possible and within the time interval specified in paragraph 3.7 CONCRETE PLACEMENT by methods which will prevent segregation or loss of ingredients. Conveying concrete shall be in accordance with the requirements of ACI 304.

1. Chutes: When concrete can be placed directly from a truck mixer or other transporting equipment, chutes attached to this equipment may be used. Separate chutes will not be permitted except when specifically approved.
   a. Use metal or metal lined chutes with a maximum length of 20-feet.
   b. The minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them.
2. Buckets: Bucket design shall be such that concrete of the required slump can be

readily discharged. Bucket gates shall be essentially grout tight when closed. The bucket shall provide means for positive regulations of the amount and rate of deposit of concrete in each dumping position.

3. Pumps: Concrete may be conveyed by positive displacement pumps when approved. Pump shall be the piston or squeeze pressure type. Pipeline shall be steel pipe or heavy-duty flexible hose. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each use, the equipment shall be thoroughly cleaned. Flushing water shall be wasted outside the forms.

3.7 CONCRETE PLACEMENT

A. Mixed concrete which is transported in truck mixers or agitators or concrete which is truck mixed, shall be discharged within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations may be waived by ENGINEER if the concrete is of such slump after the 1-1/2 hour time or 300 revolution limit has been reached that it can be placed, without the addition of water to the batch. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the truck.

1. Placing Operation: Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by CONTRACTOR prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 4 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Concrete should not be allowed to drop through a cage of reinforcing steel. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screened to the proper level to avoid excessive shimming or grouting.
   a. Additional requirements for depositing concrete in walls include, but are not limited to:
      1) Deposit concrete in a continuous operation until section is completed.
      2) Place concrete in approximately horizontal layers 2 ft maximum thickness.
      3) Each layer of concrete shall be plastic when covered with the following layer.
      4) Rate of vertical rise not more than 4 ft per hour.
      5) Pump concrete or use a tremie having varying lengths for placing concrete in columns and walls to prevent free fall of more than 4 ft.
      6) Allow concrete to thoroughly settle before top is finished. Remove all laitance, debris, and surplus water from surfaces at tops of forms by screeding, scraping, or other effective means.

b. Additional requirements for depositing concrete in slabs include, but are not limited to:
   1) Deposit concrete in a continuous operation until section is completed.
   2) Concrete shall be deposited as nearly as practicable to its final position to avoid segregation due to rehandling or flowing.
   3) In sloping slabs, proceed uniformly from the bottom of the slab to the top for the full width of the placement.

2. Consolidation: Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8,000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

B. Cold Weather Requirements: Cold weather requirements shall conform to ACI 306 and this Specification. Special protection measures, approved by ENGINEER, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Provisions should be made to keep the concrete at a minimum temperature of 50 degrees F for 7 days. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 32 degrees F. No concrete shall be placed on frozen ground. The temperature of the concrete when placed shall be not less than 55 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals, or other materials shall not be incorporated in the concrete to prevent freezing. Calcium chloride shall not be used.

C. Hot Weather Requirements: Hot weather requirements shall conform to ACI 305 and this Specification. The temperature of the concrete placed during hot weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

3.8 CONSTRUCTION JOINTS

A. Construction joints shall be located as indicated on the Contract Drawings. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of ENGINEER. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours,

or until the concrete is no longer plastic, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints are required, a strip of 1-inch square-edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph 3.2, PREPARATION OF SURFACES.

3.9 FINISHING CONCRETE

A. Formed Surfaces

1. Repair of Surface Defects: Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and brush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by means approved by ENGINEER and finished slightly higher than the surrounding surface. For Class A and Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and white cement proportioned to produce a finished repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be reamed and filled by dry packing. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete, mortar patching material, and ambient air shall be above 50 degrees F while making repairs and during the curing period. Concrete with defects which affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed by ENGINEER.
2. Class A Finish: Where a Class A finish is indicated, fins shall be removed. A mortar mix consisting of one-part Portland cement and two parts well-graded sand passing a No. 30 sieve, with water added to give the consistency of thick paint, shall be prepared. White cement shall be used to replace part of the job cement. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads until all visible grout film is removed. The rubbing pads shall have on their surfaces the same sand-cement mix specified above but without any mixing water. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours. The temperature of the air adjacent to the surface shall be not less than 50 degrees F for

24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas.

3. Class B Finish: Where a Class B finish is indicated, fins shall be removed. Concrete surface shall be smooth with a texture at least equal to that obtained using Grade B-B plywood forms.
4. Class C Finish: Where a Class C finish is indicated, fins shall be removed. Concrete surfaces shall be relatively smooth with a texture imparted by the forms used.
5. Class D Finish: Where a Class D finish is indicated, fins exceeding 1/4 inch in height shall be chipped or rubbed off. Concrete surfaces shall be left with the texture imparted by the forms used.
6. See Specification Section 09 90 00 Painting and Finishes for required finishes.

B. Unformed Surfaces: In cold weather, the air temperature in areas where concrete is being finished shall not be less than 50 degrees F in accordance with ACI 306R. In hot windy weather when the rate of evaporation of surface moisture, as determined by methodology presented in ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; coverings, windbreaks, or fog sprays shall be provided as necessary to prevent premature setting and drying of the surface. The dusting of surfaces with dry materials or the addition of water during finishing will not be permitted. Finished surfaces shall be plane, with no deviation greater than 5/16-inch when tested with a 10-foot straightedge. Surfaces shall be pitched to drains.

1. Rough-Slab Finish: Slabs to receive fill or mortar setting beds shall be screened with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.
2. Float Finish: Slabs to receive a steel trowel finish and slabs where indicated shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated. Concrete that portrays stickiness shall be finished with a magnesium float in lieu of a wood float and left free of ridges and other projections. Float finish is normally specified for surfaces that will receive other treatment such as built-up roofing, nonslip surfacing material. Float Finish shall not be used on wearing surfaces.
3. Trowel Finish: Slabs where indicated, shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand. Trowel finish shall be used on wearing surfaces and where a smooth finish is required.
4. Broom Finish: After floating, slabs where indicated, shall be lightly troweled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.
5. See Specification Section 09 90 00 Painting and Finishes for required finishes.

3.10 CURING AND PROTECTION

A. General: All concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
Concrete with Type II or IIA, or V, low alkali cement	7 days
Concrete with Type IL cement	10 days

B. Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. All materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat shall be permitted near or in direct contact with the concrete at any time. Curing shall be accomplished by any of the following methods, or combination thereof, as approved.

C. Moist Curing: Concrete to be moist cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap, or saturated burlap. Once the moist curing has started the concrete surface must not be allowed to become surface dry for the entire curing period.

D. Membrane Curing:

1. Normal membrane curing compound shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete. Use a Dissipating curing compound for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring.
2. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam.
3. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface.
4. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period.
5. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions.
6. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage

specified.

7. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period.
8. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

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SECTION 03 60 00

GROUT

PART 1 GENERAL

1.1 REQUIREMENTS

A. CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.

B. Unless indicated otherwise, grout shall be provided as listed in this Section whether indicated on the Contract Drawings or not.

C. The following types of grouts are covered in this Section:

1. Cement Grout
2. Non-Shrink Grout – Class I (cement based)
3. Non-Shrink Grout – Class II (cement based)
4. Non-Shrink Epoxy Grout
5. Epoxy Anchor Grout for Adhesive Anchors
6. Topping Grout and Concrete/Grout Fill

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 60 00 Product Requirements
3. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. American Society for Testing Materials (ASTM)

1. ASTM C 33 Standard Specification for Concrete Aggregates
2. ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM C 150 Standard Specification for Portland Cement
4. ASTM C 307 Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
5. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
6. ASTM C 496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
7. ASTM C 531 Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
8. ASTM C 579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

9. ASTM C 580 Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
10. ASTM C 595 Standard Specification for Blended Hydraulic Cements
11. ASTM C 827 Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
12. ASTM C 881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
13. ASTM C 882 Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
14. ASTM C 939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
15. ASTM C 942 Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
16. ASTM C 1090 Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
17. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
18. ASTM C 1157 Standard Performance Specification for Hydraulic Cement
19. ASTM C 1339 Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts
20. ASTM D 648 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
21. ASTM D 695 Standard Test Method for Compressive Properties of Rigid Plastics

1.4 CONTRACTOR SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.

B. Provide the following submittals for each type of grout used on the project:

1. Test reports accompanied by a manufacturer's statement that previously tested material is of similar type, quality, and manufacture as that which is proposed for use on this project shall be submitted for:

    a. Cement
    b. Aggregates
    c. Retardants
    d. Bonding compounds
    e. Epoxy Resin

2. Certifications that grout used on the project contain no chlorides or other chemicals that cause corrosion.
3. NSF 61 certification includes inclusions and exclusions of it's certified use.
4. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.

5. Manufacturer’s certification that non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
6. Submit manufacturer's written warranty as indicated herein.
7. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grout.

1.5 DELIVERY, STORAGE, AND HANDLING

A. CONTRACTOR is responsible to protect all products during transportation, handling, and storage. Any damages occurring are the responsibility of the CONTRACTOR to replace at their own expense.

B. Grout and grout materials shall be stored in a dry shelter, protected from moisture, and for prepackaged grout, maintained in accordance with the manufacturer’s recommendations.

1.6 QUALITY ASSURANCE

A. The work shall be subject to inspection at all times by OWNER and ENGINEER for the purpose of determining that the work is properly executed in accordance with this specification. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.

B. All testing will be done by a testing laboratory at CONTRACTOR’S expense, except as otherwise indicated.

C. Field Tests

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by ENGINEER.
2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 31 00 - Cast-in-Place Concrete, at intervals during construction selected by ENGINEER.
4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C 579, Method B, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.

D. Construction tolerances shall be as indicated in Section 03 30 00 Cast-in-Place Concrete unless noted otherwise.

PART 2 PRODUCTS

2.1 WATER

A. Water for mixing and for curing shall be potable, shall not contain more than 1,000 mg/L of chlorides as Cl, nor more than 1,300 mg/L of sulfates as SO_4, and shall not contain impurities which may change the setting time by more than 25 percent or a reduction of

more than 5 percent of the compressive strength of the grout at 14 days when compared to the results for grout made with distilled water.

2.2 NON-SHRINK GROUT

A. General

1. NOT USED
2. Non-shrink cementitious grout shall be a flowable, prepackaged, inorganic, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. The manufacturer shall have at least 10 years' experience in the manufacture of cement based grouts. The manufacturer shall provide technical services and provide a representative at the jobsite for product training prior to product installation.
3. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the application.
4. Grout shall not contain chlorides or additives that may contribute to corrosion.
5. Grout shall be formulated to be used at any consistency from fluid to plastic.
6. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
   a. Minimum tensile splitting strength of 500 psi per ASTM C 496.
   b. Minimum flexural strength of 1,000 psi per ASTM C 580.
   c. Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C 882.
   d. Grout shall be certified for use in freeze/thaw environments.

B. Non-Shrink Grout

1. Application: Anchor bolts and reinforcing steel required to be set in grout in which the average working or operating temperature will be over 100 degrees F or in high fire risk areas; Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension; Storage tanks and other non-motorized equipment and machinery under 30 horsepower; Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.; Repair of holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material; and any other location not specifically listed in this Section or on the Contract Drawings.
2. Class I non-shrink grout shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
3. Class I non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
4. Grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827. The grout when tested shall not bleed or segregate at maximum allowed water.
5. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.
6. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.

2.3 EPOXY ANCHOR GROUT

A. Application: Anchor bolts and reinforcing steel required to be set in grout that is not in high temperature or high fire risk areas.

B. Epoxy anchor grout shall conform to ASTM C 881, Type IV, Class A, B, and C, Grade 3 with the exception of gel time.

C. Heat deflection temperature shall be a minimum of 139 °F per ASTM D 648.

D. Manufacturer shall certify that the epoxy anchor grout will maintain 90 percent of its strength up to a temperature of 125 °F.

E. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.

F. Epoxy anchor grout shall be capable of being used in submersed applications once cured.

G. Minimum compressive strength shall be 12,000 psi per ASTM D 695.

H. Overhead anchors and anchors in fire-resistive construction shall be cast-in anchors.

I. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar. Embedment shall not exceed 67 percent of the member depth.

J. Epoxy anchor grout shall be **Epcon C6+ by ITW Ramset/Red Head, Power-Fast Epoxy Injection Gel by Powers Fasteners, RE 500 by Hilti**, or equal.

2.4 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is defined 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 indicated herein for the application.

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

PART 3 EXECUTION

3.1 PREPARATION

A. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

B. Rough concrete lightly, but not enough to interfere with placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level, and maintain final positioning of components to be grouted.

3.2 GENERAL

A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by ENGINEER.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.

G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by ENGINEER, alternate grouting methods shall be submitted for acceptance by ENGINEER.
3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Drilled Anchors and Reinforcing Bars

1. General
   a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has reached its indicated strength in accordance with the manufacturer's instructions.
   b. CONTRACTOR shall identify position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.
2. Epoxy Adhesive Anchors
   a. Grout shall be proportioned and mixed with automatic equipment.
   b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
   c. Holes required for grouting shall be blown or vacuumed clean and are to be free of dust and standing water. Horizontal holes for grouting are to be drilled at a slight downward angle and with the inserted dowel or bolt bent to match.
3. Cement Based Non-Shrink Grout
   a. In places of high temperature or fire hazard, anchor bolts shall be grouted in using cement based non-shrink grout, Class I.
   b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
   c. When the bolt diameter is one-inch or less, the hole diameter should be a minimum of 2-inches. When the bolt diameter is greater than one-inch, the hole diameter should be at least twice the bolt diameter.
   d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
   e. The non-shrink grout should be placed in the holes in a non-sag (trowelable) consistency. The grout should be placed in the holes before the anchor and then the anchor inserted and vibrated to ensure proper coverage.

D. Topping Grout and Concrete/Grout Fill

1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by ENGINEER, the base slab shall be given a roughened textured surface by a close- spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots that shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by ENGINEER, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.4 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

3.5 CURING

A. Cement based grouts shall be cured per 03 30 00 – Cast-in-Place Concrete and per the manufacturer's recommendations.

- END OF SECTION –

SECTION 05 50 00
MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers materials, fabrication, and installation of miscellaneous metals, specialties, and appurtenances as specified and indicated.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 09 90 00 Painting and Finishes

1.3 RELATED SPECIFICATIONS

A. Fabrication and erection of the platforms, ladders and stairs shall be in accordance with the Specification for the Design, Fabrication and Creation of Structural Steel for Buildings of the latest edition of the A.I.S.C. Manual, and Section 1910.27 of the latest edition of the OSHA standards, except as specified herein.

1.4 REFERENCES

A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

1. Manual of Steel Construction

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 36 Standard Specification for Carbon Structural Steel
2. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASMT A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes
6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength
7. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
8. ASTM F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
9. ASTM F 594 Standard Specification for Stainless Steel Nuts

D. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

E. AMP 510 Metal Stairs Manual

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. CONTRACTOR shall submit complete shop drawings of fabricated items, such as vents, ladders, stairs, platforms, beams, pipe supports, and miscellaneous metals for approval to Engineer.

C. Shop drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the work.

D. Shop drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.

E. Submit manufacturer's catalog data and dimensional drawings for lifting eyebolts and inserts; ladder safety posts, manhole covers and frames, and anchor bolts.

F. Submit ICC ES Evaluation Reports for adhesive and wedge anchors and installer qualifications and procedures.

1.6 QUALITY ASSURANCE

A. Field Measurements: Take field measurement prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.

B. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units to the extent necessary for shipping limitations.

C. Fabricator Qualifications: Fabricators shall be regularly engaged in the manufacture of the types of steel specialties they are providing and shall have at least 5 years of experience in this specialty.

D. Qualifications: Qualify welding operators in accordance with the requirements of current AWS Standard. Provide certification that all welders employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within the previous 12 months. Ensure that all certifications are kept current.

PART 2 MATERIALS

2.1 CARBON STEEL

A. Materials for bolted or welded steel construction shall conform to ASTM A 36.

2.2 STAINLESS STEEL

A. All bolts, expansion bolts, nuts, washers, and expansion sleeve inserts used to attach metal supports shall be stainless steel Type 316.

B. All interior tank ladders, wall conduits, louvers, and other items required shall be

stainless steel unless noted otherwise.

2.3 HOT-DIPPED GALVANIZED

A. All vents, stairs, vault ladders, handrail, guardrail, stringers, beams, and miscellaneous items shall be galvanized (zinc coated) unless noted otherwise.

B. Zinc coating for plates, bolts, anchor bolts, and threaded parts shall in in accordance with ASTM A 153. Structural steel shall be zinc coated in accordance with ASTM A 123.

2.4 BOLTS

A. Steel anchor and connection bolts for non-corrosive service shall conform to ASTM A 307, Grade A or B, unless otherwise noted. Bolts shall be hot-dip galvanized and provided with self-locking nuts or lock washers and plain nuts.

B. Steel anchor and connection bolts for corrosive service shall be fabricated from stainless steel, unless indicated otherwise in the specifications or on the Contract Drawings. Corrosive service locations are listed below.

1. Buried locations
2. Submerged locations
3. Locations subject to occasional flooding
4. Inside hydraulic structures
5. Chemical handling areas
6. Inside buried manholes, vaults, and structures that do not have a gravity drain or sump pump
7. Inside trenches, containment walls, and curbed areas.

C. The nuts shall be capable of developing the full strength of the bolts. Bolts and cap screws shall have hexagon heads and nuts shall be heavy hexagon series. Bolts and nuts shall be installed with washers from material matching the base material of bolts. Lock washers fabricated from the material matching the bolts shall be installed where indicated.

D. The length of the bolts shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

2.5 LIFTING EYEBOLTS

A. Locate eyebolts and concrete inserts over the centerline of the piping at locations shown on the Contract Drawings. Eyebolts and inserts shall have a minimum safety factor of 3 and be rated for a working load of 3,000 pounds.

B. Provide inserts of the ferrule wing nut design with threads to match the eyebolts. Cast inserts in the roof slab of the vault at the locations identified on the Contract Drawings.

2.6 THREADED INSERTS

A. Threaded inserts shall be of ductile iron construction with standard National Course (NC) or United National Course (UNC) threads. Inserts shall be cast-in-place at the locations shown on the Contract Drawings. Inserts shall be fabricated by **Meadow Burke**, or

approved equal.

ADHESIVE ANCHORS

Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered without an ICC ES Report verifying strength and material equivalency. Anchors used inside potable water reservoirs shall be ANSI/NSF 61 certified.

Adhesive anchors shall be a two-component system consisting of an all-threaded anchor rod with nut and washer, and the adhesive capsule. Anchor rods shall be Type 304 stainless steel conforming to ASTM F 593 with nuts conforming to ASTM F 594. The adhesive capsules shall contain a polyvinyl or urethane methacrylate-based resin and accelerator within a sealed dual chamber foil capsule. Adhesive anchors shall be **HVA Capsule Adhesive Anchoring System,** or approved equal.

WEDGE ANCHORS

Wedge type anchors shall be used only where indicated in the Contract Drawings. Wedge anchors shall be a stud type expansion anchor, torque controlled, with impact section to prevent thread damage. Stud and wedge shall be Type 304 or Type 316 stainless steel conforming to ASTM A 276. Nut shall be Type 304 or Type 316 stainless steel conforming to ASTM F 594 with washer of similar material. Wedge anchor bolts shall be Hilti Kwik Bolt 3, or approved equal. Anchors installed in non-submerged or non-corrosive environments may be carbon steel and be **Simpson Strong-Tie Strong** Bolt, or approved equal.

STEEL PIPE

Pipe for guard posts shall be Schedule 40 and pipe for vault vents shall be Schedule 10 conforming to ASTM A 53, unless noted otherwise on the Contract Drawings, and shall be hot-dip galvanized.

PART 3 EXECUTION

3.1 GENERAL

A. Except as otherwise shown, the design, fabrication, and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".

B. Install miscellaneous specialties as indicated on the Contract Drawings or as recommended by the manufacturer.

C. Store materials above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

D. Clean surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign matter before placing concrete.

E. Set embedded metalwork accurately in position and support it rigidly before concrete is placed and prevent displacement during and after placement of concrete.

F. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.

G. Welding shall be performed by metal-arc method or shielded metal arc method as per the American Welding Society's (AWS) "Welding Handbook". During welding component parts shall be adequately clamped or supported. Avoid irregular surface, non-uniform bead pattern, and high crown. Upon completion of welding, remove weld splatter, flux, slag, and burrs. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.

H. Adhesive Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. The hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions. Do not load the anchor until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

I. Wedge Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. The hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions.

J. Galvanizing Field Repairs:

1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

- END OF SECTION -

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SECTION 09 90 00 - PAINTING AND FINISHES

PART 1 - GENERAL

101.01 DESCRIPTION

A. The WORK included in this section includes surface preparation, furnishing and applying paints and coatings to the exterior surfaces of piping, valves, and fittings located in vaults, or as indicated on the drawings.

101.02 REFERENCES AND STANDARDS

A. Work covered by this specification shall meet or exceed the provisions of the latest editions of the following codes and standards in effect at the time of award of the contract:

1. OSHA Occupation Safety and Health Act: State of Utah and Federal

101.03 SUBMITTALS

A. CONTRACTOR shall supply shop drawings for approval on all paint materials prior to installation.

PART 2 - PRODUCTS

201.01 PAINT, SEALERS AND SURFACE FINISH MATERIALS

A. Paint for Exposed Piping: Exposed metal piping, fittings and valves shall be coated with a high solids two component epoxy coating system. The epoxy coating shall be Ameron, Amerlock 400, or approved equal. The color shall match the existing color in the vault or the filter gallery.

PART 3 - EXECUTION

301.01 SURFACE PREPARATION

A. All surfaces which receive paint or other coatings shall be prepared in accordance with the recommendations of the manufacturer of the material being used. Any loose coating, or corrosion scale on existing piping shall be completely removed with wire brushing, sand blasting, water blasting or other approved methods.

301.02 APPLICATION

A. Exposed metal piping, fittings and valves shall be painted in accordance with the manufacturer's recommendation and the resulting coating dry film thickness shall be not less than 7 mils.

B. Each coat shall be free of runs, skips or "holidays". All excess paint and/or drips on floors, walls, and other surfaces which are not designated for paint shall be removed.

C. All work shall be done in accordance with the manufacturer's recommendation.

- END OF SECTION -

SECTION 15 00 85 - PIPING SYSTEMS AND CONNECTIONS

PART 1 - GENERAL

101.01 SECTION INCLUDES

This section includes the pipe materials, connection methods and related work.

101.02 REFERENCES

This section contains references to the following documents. Al work specified herein shall conform to or exceed the applicable requirements of the referenced portions. In case of conflict between the requirements of this section and the listed documents, the requirements for this section shall prevail.

Reference	Title
ANSI BI.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI BI.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B18.2.1	Square and Hex Bolts and Screws Inch Series including Hex Cap Screws and Lag Screws
ANSI B18.2.2	Square and Hex Nuts
ANSI/AWWA C110/A21.10	Ductile Iron and Gray Iron Fittings
ANSI/AWWA C104/A21.4	Cement Mortar Lining for Ductile Iron Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile Iron Pipe

PART 2 - PRODUCTS

201.01 FLANGED ASSEMBLIES

A. STEEL PIPE AND FITTINGS

1. When pipe and fittings are designated on the drawings as steel, it shall be in accordance with section 15061 - Steel Piping, Fabricated Specials.

B. GASKETS:

1. Gasket material shall be as specified in paragraph 15085-2.03.

2. Gaskets for plain faced flanges shall be the full-face type. Thickness shall be 1/16-inch for pipe 10 inches and less in diameter and 1/8-inch for pipe 12 inches and larger in diameter. Unless otherwise specified, gaskets for raised face flanges shall match the raised face and shall be 1/16-inch thick for pipe 3-1/2 inches and less in diameter and 1/8-inch thick for pipe 4 inches and larger.

C. BOLTS AND NUTS

Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head carbon steel machine bolts with ANSI B18.2.2 standard hot pressed hexagon nuts. Threads shall be ANSI BI.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5. Bolts and nuts shall be cadmium plated.

201.02 GASKETS

A. Gaskets shall be NSF-61 approved and as follows:

1. EPDM: ethylene-propylene-diene-monomer.

2. Neoprene: neoprene.

3. Nitrile: nitrile (Buna-N)

4. Neoprene, CI.I.: Neoprene with cloth inserts.

5. Neoprene, oil resistant: neoprene with oil-resisting characteristics.

6. TFE: non-creeping tetrafluoroethylene (TFE) with insert filler.

7. Compressed gasketing consisting of organic fibers (Kevlar), rillers and styrene butadiene rubber (SBR) binder.

8. TFE bonded EPDM: TFE bonded to EPDM in full-face gasket having concentric convex molded rings.

201.04 COATINGS

A. Flange assemblies and fittings shall be coated in accordance with Section 09900.

- END OF SECTION -

SECTION 15 10 00 - VALVES AND ACTUATORS

PART 1 - GENERAL

101.01 THE REQUIREMENT

A. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for furnishing, coating, installing, adjusting, and testing of all valves, actuators, and appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents. This section includes butterfly valves with electronic mechanical actuators, butterfly valve with manual operation, and silent ball check valve.

B. All valves shall be furnished with pressure classes equal to or better than the pressure class of the pipe with which the valves are to be used. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

101.02 RELATED WORK SPECIFIED ELSEWHERE

A. Protective Coating: 09900

101.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes

The Building Code, as referenced herein, shall be the Uniform Building Code (UBC), as specified in Section entitled, Reference Standards. 01071

ANSI/NFPA 70-1984 National Electric Code

B. Commercial Standards:

ANSI B16.7-75	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
ANSI B16.5-81	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.
ASTM A 48-83	Specification for Gray Iron Castings

ASTM B 62-82a	Specification for Composition Bronze or Ounce Metal Castings.
ASTM A 536-84	Specification for Ductile Iron Castings.

101.04 CONTRACTOR SUBMITTALS

A. Shop drawings of all valves and actuators shall be furnished as specified in Section entitled, Contractor Submittals 01300

B. The Contractor shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed working for the label.

PART 2 - PRODUCTS

201.01 BUTTERFLY VALVES

A. General: The butterfly valve shall be designed expressly for waterworks applications. Valves shall meet or exceed the requirements of AWWA C504-15. Valves shall be of the size and class indicated in the Valve Schedule. All valves shall be of the AWWA C504-15 "B" Designation, bubble tight and sized for bi-directional water service, full rated pressure, and a line velocity of 16 feet per second. The valve build data shall be made available upon request by the Owner and shall be retained by the Valve Manufacturer for no less than 50 years unless noted longer. Actuators shall be sized for conditions given in Valve Schedule.

B. Pressure Class: Butterfly valves shall conform to ANSI/AWWA C504-15 Class 150B.

C. Flanges: Flanges shall be in conformance with ASME B16.1 Class 125. Flange faces shall be coated in accordance with Section 2.A.(18) Paint and Coatings. Flanges shall also have machined groves to improve gasket sealing.

D. Valve Lay Length: Flanged valve lay lengths shall be in accordance with AWWA C504-15, Table 1 short bodied valves.

E. Body: Valve bodies shall be ductile iron, ASTM A536 65-45-12. Carbon steel and Cast Iron are not acceptable material for the valve body.

a) The entire valve body, excluding shaft bores, shall be coated for corrosion protection.

F. Valve Tags: Valves shall be equipped with mechanically fastened stainless steel stamped or engraved tags as detailed in Section 2.A.(19) Marking. Painted lettering on tags will not be accepted.

G. Disc: The disc shall be ductile iron ASTM A536 65-45-12 or ASTM A536 60-40-18. Unless stainless steel, the entire disc and all its wetted surfaces shall be coated, without exception, in accordance with Section 2.A.(18) Paint and

Coatings. Disc pins shall extend completely through the valve and shall be mechanically fastened, and O-Ring sealed and shall be ASTM A240 Type 2205 Duplex Stainless Steel. Carbon steel is not an acceptable material for the valve disc.

H. Shaft: Shafts shall meet or exceed the requirements of AWWA C504-15 and the following:

a. Valve shafts shall be dual stub shafts of stainless steel ASTM A240 Type 2205 Duplex.

I. Elastomeric Seat: Valve seats shall be field replaceable and shall be secured to the valve disc by a 316-stainless steel seat retainer ring and secured by 316 stainless steel fasteners. Bronze and carbon steel seat retainer rings are not acceptable. Elastomeric valve seats shall be field replaceable in-line without having to remove the valves from service. The elastomeric seat material shall be EPDM. The valve shall be bi-directionally leak free in accordance with AWWA C504-15. The field replaceable seat shall not require special skills or tools to replace the seal. Elastomeric seat methods which use either irreplaceable vulcanized seats or which use hardened epoxy or grout in a dovetailed groove are not acceptable. Elastomeric seats with seams are not allowed.

J. Metallic Seating Surface: The metallic seating surface shall be located in the valve body. Seating surfaces shall be a highly wear resistant, double overlay welded 316 Stainless Steel in accordance with AWWA C504-15. The seat shall be applied through a high alloy weld overlay process and shall have a final surface minimum thickness of no less than 7 mils (0.18mm) in accordance with AWWA C504-10. Replaceable metallic seating surfaces in the body are not acceptable.

K. Shaft Seals: Shaft seals shall be appropriate for service specified. Shaft seals shall be composed of a minimum of 8 O-ring seals protecting both the OD and ID of the shaft bearings Elastomer packing material shall be EPDM. Shaft Seals shall be clearly shown on submittal drawings. Packing will not be allowed.

L. Shaft Bearings: Valve shaft bearings or radial shaft bushings shall meet or exceed the requirements of AWWA C504-15 and be corrosion resistant, self- lubricating sleeve type made of lead-free bronze.

M. Thrust Bearings: Valve thrust bearings shall be provided and shall meet or exceed the requirements of AWWA C504-15.

N. Hardware:

a. All fasteners and hardware shall be type 316 stainless steel.

b. Bolt sizes for all tapped holes shall be identified.

O. Paint and Coatings:

a. All valves shall be NSF/ANSI 61 certified.

b. All sharp edges to be coated shall have the necessary beveling or long radius to assure consistent coating thickness.

c. Any damage found after shipping to Owners warehouse shall be noted to the carrier and the Valve Supplier. Coating damaged in shipping shall be noted and properly field repaired by the Valve Manufacturer's Representative to the satisfaction of the Owner.

d. The Valve Manufacturer is required to have and follow a system of valve preparation and coating which assures a quality holiday free application and shall comply with the requirements of AWWA C550. The coating system shall be submitted for approval.

e. Coatings shall be either of the following:

i. An Owner approved 390-degree F plus, heat bonded fusion coated to a final dry film thickness no less than 12 mils.

ii. An Owner approved two-part liquid epoxy. A minimum of two separate 6 mill coats to a final dry film thickness DFT of no less than 12 mils.

P. Marking:

a. All parts subject to disassembly prior to shipment shall be marked for identification and match marked. Match marking information shall be submitted in the O&M manual.

b. Casting markings shall conform to the appropriate section of MSS-SP-25. Each valve shall be marked with the Valve Manufacturer's name, valve size, body material, and pressure rating cast into the body of the valve. Lettering shall be a minimum of ½ inch tall and project a minimum of 1/10 inch from the body.

c. Each individual piece of equipment shall bear a stainless-steel nameplate attached with stainless steel screws or rivets, upon which there shall be engraved or stamped the following minimal information. Painted lettering on tags shall not be accepted.

i. Valve Manufacturer's name or trademark

ii. Valve Manufacturer's serial number

iii. Valve Size

iv. Valve Pressure Rating

Q. Approved Valve Manufacturers

a. Av-Tek Inc.

b. Pratt

c. Bray

d. VAG

e. or approved equal

R. Valve Manufacturer Warranty:

a. The Valve Manufacturer shall warrant all valves against material and workmanship defects for a period not less than 12 months. The warranty period shall start at installation or at no more than two months from delivery; whichever comes first. Any valve component failure during the warranty period shall be corrected by the Valve Manufacturer.

b. The Valve Manufacturer shall have an authorized warranty service center within the continental United States of America.

201.02 DOUBLE OFFSET BUTTERFLY VALVES

A. General: The butterfly valve shall meet all requirements for butterfly valves and shall be of the double offset design. Zero and single offset butterfly valve designs are not acceptable.

B. Approved Valve Manufacturers

f. Av-Tek Inc. – DEX 2504

g. VAG - EKN

h. or approved equal

201.03 WEDGE GATE VALVES

A. General: Knife-gate valves shall be supplied as follows:

1. Seat: Metal seated with raised face for positive seating
2. Flow Direction: Unidirectional
3. Body style: Wafer or flanged
4. Body Material: cast stainless steel (2- to 12-inch valves), semi-steel bodies with stainless steel linings (14-inch valves and larger)
5. Gate and Wetted Parts Material: 316 Stainless, gate to be finish-ground on both sides to prevent packing or seat damage
6. Stem: Rising stem with valve nut
7. NSF-61 Certified
8. Pressure rated: 10 to 60 psi

201.04 ELECTRIC MOTOR VALVE ACTUATORS

A. The actuator for the flow control valve shall be suitable for inching/positioning service. The actuator for the new valves shall be suitable for operation of a quarter turn valve and be rated for 60 starts per hour, as a minimum. The actuator is required to drive the valve to any position (fully open, intermediate, and fully closed).

B. The actuators shall be self-contained units consisting of electric motor, integral reversing contractor starter, gearbox, limit switches, torque switches, manual override handwheel with declutching level, and other devices as specified.

C. The actuator for the flow control valve shall be furnished and sized by the valve supplier and shall be factory mounted. The actuator for the existing butterfly valve shall be sized assuming the torque requirements of the existing valve are two times a standard AWWA butterfly valve.

D. The actuators shall be sized to produce at least 1.8 times the operating torque required. Stall torque of motor shall not exceed the torque capacity of the valve.

E. The actuators shall comply with AWWA C540. Manufacturer shall provide certified drawings and affidavit of compliance as specified in AWWA C540.

F. Operating time for both actuators shall be a minimum of two (2) minutes, maximum five (5) minutes from FULLY OPEN to FULLY CLOSED, or the reverse.

G. The actuator motor and all electrical enclosures shall be NEMA 4X, as a minimum. The control enclosure shall include a space heater.

H. Motor:

1. Motors shall be specifically designed for valve actuator service and shall be high starting torque, totally enclosed, nonventilated construction.

2. Motors shall operate on 480-volt, 3-phase, 60-Hz power.

3. Motor insulation shall be NEMA Class F, as a minimum.

4. Motors shall be equipped with internal temperature relay to protect against motor overheating.

I. Gearing:

1. All gearings shall be of steel construction.

2. Actuators shall be permanently lubricated at the factory. Lubrication shall be suitable for operation at any angle and in ambient temperatures of -20 degrees F to 140 degrees F.

J. The drive shall include a lost motion device with hammer blow effect to allow the motor to reach full speed before engaging the valve load.

K. The actuators shall include a LOCAL/OFF/REMOTE weatherproof selector switch or pushbutton and an OPEN/STOP/CLOSE weatherproof selector switch or pushbutton.

1. In the LOCAL position, the actuator shall be controlled by the OPEN/ STOP/CLOSE switch. Motor shall drive the valve to its fully OPEN or CLOSED position when the pushbutton is momentarily depressed. Motor shall stop in mid-travel when the stop button is depressed.

2. In the REMOTE position, the actuator shall accept a momentary contact OPEN/CLOSE control signal and drive the valve to its fully OPEN or CLOSED position.

L. Provide a Form C dry contact for remote indication of the REMOTE status of the selector switch.

M. Provide Form C dry contacts to remotely indicate if the valve is in either the FULLY OPENED or FULLY CLOSED position, for the existing 30-inch valve actuator.

N. Provide a 4-20mA analogue signal corresponding to valve travel and position.

O. The actuators shall be equipped with automatic double-acting limit switches capable of being field adjusted to trip at any point between FULLY OPENED and FULLY CLOSED valve positions.

P. The actuators shall be equipped with automatic double-acting torque switches. Torque switches shall operate during the complete valve cycle to protect the valve and actuator from excessive loads caused by obstructions in either direction of travel.

Q. The actuators shall be equipped with handwheels for manual operation and shall include an automatic clutch to positively disengage the handwheel at any time the drive motor control is energized. Handwheel operator shall be designed in such a way that failure of the motorized gearing shall not prevent hand operation of the valves.

R. Actuators shall include a mechanical indicator that will provide continuous visual indication of valve position. In addition, actuators shall be equipped with replaceable LED indicating lights that will indicate if the valve is in either the FULLY OPENED or FULLY CLOSED position.

S. Actuators shall be supplied with a control power transformer.

T. Failure Position: Valve actuators shall fail in the last position on loss of power or control signal.

U. Manufacturer:

1. AUMA

2. Rotork

3. Limitorque.

PART 3 - EXECUTION

301.01 VALVE INSTALLATION

A. All valves, gates, operating units, stem extensions, valve boxes, and accessories shall be installed as shown and specified. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. All valves shall be installed to provide easy access for operation and maintenance and to avoid conflicts between valve operators and structural members or handrails.

C. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittal.

- END OF SECTION -

SECTION 16 00 00 - ELECTRICAL PROVISIONS

PART 1 - GENERAL

101.01 WORK INCLUDED

A. Furnish all labor, materials, and equipment as required by the plans and specifications to provide a complete and workable electrical system. This specification describes the types of materials, methods, and management to be utilized. This includes the work listed in this division as well as equipment furnished under other divisions not specifically mentioned herein.

101.02 CODES AND STANDARDS

A. All equipment, materials, and methods of design and installation are to comply with the National Electrical Code, the basic Electrical Regulations of the State of Utah, the Occupational Safety and Health Act (OSHA), and the requirements of any local codes at the site. Codes and standards of the following organizations may be referred to in this section and shall be considered as the minimum acceptable. A reference herein to any portion of the standard or code is not to be considered as negating any other portion of the standard or code.

1. American National Standards Institute, Inc. (ANSI)
2. Institute of Electrical & Electronic Engineers (IEEE)
3. American Society for Testing & Materials (ASTM)
4. Underwriters Laboratories, Inc. (UL)
5. National Electrical Manufacturers Association (NEMA)
6. Insulated Cable Engineers Association (ICEA)
7. National Electrical Code (NEC)
8. Illuminating Engineering Society (IES)
9. International Society for Measurement and Control (ISA)

B. Where the plans or these specifications require a higher degree of workmanship or quality of material than the above codes and standards imply, then these plans and specifications will prevail.

101.03 EQUIPMENT, MATERIAL AND WORKMANSHIP

A. All equipment and material are to be new, free from defects, of current manufacture, and listed by Underwriters Laboratories, Inc., (UL) where UL

requirements apply. All materials are to be products of reputable and experienced manufacturers. Similar items in the project are to be of the same manufacturer. Use only equipment and materials of industrial quality and durability, and capable of long, reliable, trouble free service.

B. The Owner reserves the right to operate defective equipment or that equipment which fails to conform to detailed specifications or does not operate satisfactorily until the defects are corrected or the equipment is repaired or replaced, without cost for depreciation, use or wear. Rejected equipment will be removed from operation only at times approved by the Owner. All equipment furnished under this section will be guaranteed for a minimum period of one (1) year from date of acceptance against defective materials, design, and workmanship.

C. Provide protection for materials and equipment against loss or damage throughout the contract. Protect everything from the effect of weather prior to installation. Store items to be installed in indoor location.

D. Any item subject to corrosion under damp conditions and items containing insulation such as transformers and motors are to be kept in heated locations.

E. Following installation, protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation.

F. Cap all conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed.

G. Lay out work carefully in advance.

H. Do not cut or notch any structural member or building surface without specific approval of the Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, pavings, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical equipment. Following such work, restore surfaces neatly to new conditions using skilled craftsmen of the trades involved at no additional cost to the Owner.

I. All work will be performed by accomplished, qualified and experienced personnel working under continuous competent supervision.

101.04 PERMITS

A. Obtain and pay for all permits and inspections pertinent to the electrical installation and obtain such permits from the proper governing body before any progress payment will be certified for electrical work.

SECTION 16 00 00 - ELECTRICAL PROVISIONS

101.05 SITE INSPECTION

A. Prior to submitting a bid, visit the project site and ascertain conditions affecting the proposed work and all existing electrical facilities.

101.06 TEMPORARY INSTALLATION

A. Temporary installation is to conform to the requirements of the National Electrical Code and the State and local governing bodies.

101.07 RECORD DRAWINGS

A. Maintain a neatly marked set of record drawings showing installation location, and/or routing of conduits, junction boxes, and outlets. Mark this set to show current job progress and any deviation from the contract drawings. These drawings will be available upon demand of the Engineer. After final inspection, transfer all record information to the Engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

103.01 CLEAN-UP

A. Continuously remove debris, cuttings, crates, cartons, etc.

B. Before acceptance, carefully clean all cabinets, panels, boxes, wiring devices, cover plates, etc. Replace all damaged or blemished fixtures.

- END OF SECTION -

SECTION 16 10 23 - WIRE AND CABLE

PART 1 - GENERAL

101.01 SECTION INCLUDES

A. Wire and cable.

B. Wiring connectors and connections.

101.02 RELATED SECTIONS

A. Section 16111 - Conduit.

B. Section 16130 - Boxes.

101.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

201.01 GENERAL

A. All conductors, include grounding conductors, shall be copper. Aluminum conductor wire and cable will not be permitted. Insulation shall bear UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electrical Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400 and fixture wires shall conform to Article 402. All wiring shall have wire markers at each end.

201.02 LOW VOLTAGE WIRE AND CABLE

A. Power and Lighting Wire

1. All wire rated for 600 Volts in duct or conduit for all power and lighting circuits shall be Class B stranded Type XHHW or THHW.

2. Wiring for 600-volt class power and lighting shall be as manufactured by BICC Cables, Okonite, or equal.

B. Control Wire

1. Control wire in duct or conduit shall be the same type as power and lighting wire indicated above, or as indicated on the drawings.

2. Control wiring shall be No. 14 AWG, or as indicated on the drawings.

3. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by American, Carol Cable, or equal.

4. Control wires shall be type SIS when indicated on the drawings.

C. Instrumentation Cable

1. Instrumentation cable shall be rated at 300 volts.

2. Individual conductors shall be No. 18 AWG stranded, tinned copper, unless otherwise indicated. Insulation shall be color coded PVC with nylon overcoat: black-white for two-conductor cable and black-red-white for three-conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 20 AWG stranded tinned copper drawn wire, and a PVC outer jacket.

4. Two conductor shielded cable shall be Belden Type 9318.

5. Three conductor shielded cable shall be Belden Type 9366.

6. Instrumentation cable shall not be larger size than what is specified.

D. Serial Communication Cable

1. Cable shall be two twisted pair.

2. Individual conductors shall be No. 22 AWG stranded tinned copper, twisted pair with a tinned copper drain wire, foil aluminum-polyester shield. Insulation shall be color coded polyethylene. Cable shall have a chrome PVC outer jacket.

3. Cable shall be Belden Type 8723, or equal.

SECTION 16 10 90 – SUPPORTING DEVICES

PART 3 - EXECUTION

301.01 GENERAL

A. The Contractor shall provide and terminate all power, control, and instrumentation conductors except where indicated.

301.02 INSTALLATION

A. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.

B. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

C. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

D. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.

301.03 SPLICES AND TERMINATIONS

A. General

1. All wire taps and splices shall be properly taped and insulated according to their respective classes.

2. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

3. Excess control and instrumentation wire shall be properly taped and terminated as spares.

B. Control Wire and Cable

1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In junction boxes, motor control centers, and control panels, all control wire and spare wire shall be terminated to terminal strips.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4-20 mA system.

D. Power Wire and Cable

1. All 120/208-volt branch circuit conductors shall not be spliced.

2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of two layers of varnished cambric tape overtaped with a minimum of six layers of high temperature tape.

3. All medium voltage shielded power cable shall have stress cone terminations. Terminations shall be installed per manufacturer's instructions.

- END OF SECTION

SECTION 31 23 23
EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers excavating, backfilling, and compacting of disturbed areas for structures and roadways as directed by ENGINEER.

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control and Materials Testing
3. Section 01 45 23 Testing Agency Services
4. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
5. Section 31 11 00 Clearing, Grubbing and Stripping
6. Section 31 23 15 Excavation and Backfill for Buried Pipelines
7. Section 31 23 19 Dewatering

1.3 REFERENCES

A. The latest edition of the following publications form a part of this Specification to the extent referred. The publications are referred to in the text by basic designation only.

B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
3. T 88 Standard Method of Test for Particle Size Analysis of Soils
4. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
5. T 191 Standard Method of Test for Density of Soil In Place by the Sand Cone Method
6. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. D 422 Standard Test Method for Particle Size Analysis of Soils
2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3)
3. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
4. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft3)
5. D 2487 Standard Practice for Classification of Soils for Engineering Purposes

(Unified Soil Classification System)

6. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

D. The latest Edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction.

E. The latest Edition of the American Public Works Association (APWA) and Associated General Contractors of America Standard Plans and Standard Specifications.

1.4 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:

1. Submit gradations and proctors for structural fill materials and backfill materials.

PART 2 PRODUCTS

2.1 WALL BACKFILL MATERIAL

A. Wall backfill material shall consist of native or import fill material meeting soils classifications A-1, A-2 or A-3 of AASHTO M 145, with a maximum particle size no greater than 6 inches in any dimension and shall be capable of meeting the compaction requirements.

1. Wall backfill material shall be free from frozen lumps, rocks larger than 6 inches in the largest dimension, roots, trash, lumber and organic material.

2.2 STRUCTURAL FILL

A. Structural fill material, if required, shall meet the following requirements.

1. Material shall be imported non-expansive granular soil meeting the gradation below with a PI less than 6 and shall be free of frozen lumps, roots, trash, lumber and organic material.

Sieve Size (Square Opening)	Percent By Weight Passing Screen
4-inch	100
3/4 inch	70-100
No. 40	10-60
No. 200	0 - 15

2.3 CLSM

A. Structural fill for restoration of the Weir House shall be CLSM per Section 03 31 05 Controlled Low Strength Material.

2.4 3/4" WASHED ROCK

A. 3/4" Washed Rock shall consist of hard, durable particles of stone or gravel, screened or crushed, to the required size and gradation. The material shall be free from vegetation matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradation when tested in accordance with AASHTO T 27 or ASTM C 136.

Sieve Size (Square Opening)	Percent By Weight Passing Screen
3/4-inch	100
3/8 inch	78-92
No. 4	0 - 50
No. 8	0 - 5
No. 200	0 - 3

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavation shall be performed to the lines and grades indicated. Excavated material not required or not satisfactory for backfill shall be removed from the site.

B. Excavations shall be braced and supported as needed to prevent the ground adjacent to the excavation from sliding or settling. Slides shall be promptly removed and corrected by CONTRACTOR.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with granular fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth of 6 inches.

3.3 DEWATERING

A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

3.4 BACKFILL

A. Backfill material shall not be placed against concrete structures that have not been properly cured. No backfill material shall be placed until concrete has cured for a minimum of 7 days or until the compressible strength is 3,400 psi, whichever is greater.

B. Backfill material shall be placed in no more than 6-inch loose lifts for compaction by hand operated machine compactors, and 8 inches loose lifts for other than hand operated machines.

C. Structural fill placed beneath foundations, footings or the floor slab shall be placed and compacted to at least 96% of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D 1557.

D. CLSM placement as part of the Weir House restoration shall be from bottom of excavation to 1 foot above the footing and shall be for a minimum of 15 feet from the edge of the building.

E. Backfill material shall be placed and compacted to at least 95 percent of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D-1557.

F. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and re-compacted to the minimum required compaction prior to placing any additional fill material.

G. CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If it is determined that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.

H. Sufficient personnel, equipment, sumps or other means should be provided to maintain the site in an acceptable dry condition for the duration of this contract.

I. Excavations shall be so braced and supported as needed to prevent the ground, adjacent to the excavation, from sliding or settling. Localized slides or settlements shall be promptly removed and corrected by CONTRACTOR.

3.5 FINISHED GRADE

A. The finished subgrade and grade of the fill shall not vary more than 0.05 feet from the established grades and cross sections shown on the Contract Drawings.

3.6 COMPACTION TESTS

A. Compaction testing shall be the provided and paid for in accordance with Section 01 45 00 – Quality Control and Materials Testing.

B. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, structural fill, Untreated Base Course and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

1. Testing of Backfill Materials
    a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00.
    b. Contractor shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork

quantities:

1) One (1) test per 1.0 feet of backfill thickness placed per structure.

c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.

d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.

e. Quality Assurance tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to CONTRACTOR. If ENGINEER requires retesting of backfill, CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to OWNER.

f. If compaction fails to meet the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid for by CONTRACTOR.in accordance with Section 01 45 23 – Testing Agency Services. The confirmation tests shall be performed in a manner acceptable to ENGINEER. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.

2. Field Density Tests

a. Tests shall be performed in sufficient numbers to meet the requirements of Section 01 45 00 and to ensure that the specified density is being obtained.

- END OF SECTION -