TECHNICAL SPECIFICATIONS
FOR
Charles County Government Department of Public Works

Mattawoman Wastewater Treatment Plant (MWWTP)
Centrifuge Project RFP Number 18-25

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# TECHNICAL SPECIFICATIONS

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In addition to the technical specifications listed in this table of contents, all work shall comply with the Charles County Government Department of Planning and Growth Management Standards & Specifications for Construction (“Charles County Standard Specifications”), except as otherwise noted. Refer to the Charles County, Maryland website for Charles County Standard Specifications: https://www.charlescountymd.gov/pgm/cpis/standard-specs-construction

Note that the following Charles County Standard Specifications are not applicable to this Contract:

- 02566 – Low-Pressure Sewer Systems
- 03200 - Concrete Reinforcement
- 03300 – Cast-in-Place Concrete Structures
- 03310 – Portland Cement Concrete
- 03600 – Non-shrink Grouts and Mortars
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SECTION 01424

ARROW PANEL FOR MAINTENANCE OF TRAFFIC

Except as indicated herein, work shall be in accordance with the requirements of Charles County Standard Specifications Section 01424.

01424.01 GENERAL

Replace Article 01424.01.A with the following:

“At those locations where a traffic lane outside the wastewater treatment plant property owned by COUNTY is to be closed for purpose of construction, an arrow panel meeting the specifications noted below shall be used. The arrow panel shall supplement, but not replace, standard signing as required by the Manual on Uniform Traffic Control Devices, the Traffic Control Plan (TCP), and/or the Contract.”

END OF SECTION
SECTION 01660
TESTING AND STARTUP

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Definitions
B. Submittals
C. Preliminary Field Testing
D. Functional Testing
E. System Demonstration Testing
F. Startup
G. Meeting

1.02. DEFINITIONS

A. System: The combination of Subsystems that will collectively undergo sequential System Demonstration Testing, Startup, and delivery to County. Each System includes all components necessary for that System to function as intended, including structural/architectural components, HVAC, plumbing, process equipment, piping, power, automated controls, life safety, etc.

B. Subsystem: The multiple components of a System. Subsystems are generally defined as unit processes and support systems, including structural/architectural components, HVAC, plumbing, process equipment, piping, power, automated controls, life safety, etc.

C. System Delivery Plan: Contractor’s schedule for delivering Systems to County.

D. Preliminary Field Test: Field test to demonstrate that equipment is properly installed and ready for operation.

E. Functional Test: Field test to demonstrate successful operation and performance of equipment in all intended modes of operation, including operation from remote devices with the exception of the Plant PCS.

F. System Demonstration Testing: Continuous successful operation of a System in its entirety utilizing a testing fluid approved by the County for seven consecutive days prior to Startup of that System.

G. Startup: Continuous successful online operation of a System in its entirety utilizing actual process fluid and at actual service conditions for seven consecutive days prior to delivery of that System to County.

1.03. SUBMITTALS

A. Functional Testing Plans.
1. Submit at least 30 days prior to proposed Functional Testing date in accordance with procedures identified in the Contract.

2. Submit individual plans for each piece of equipment requiring a Functional Test.

3. Coordinate with County to determine testing fluid sources and include in Functional Testing Plans.

B. System Delivery Plan:

1. Submit within 60 days of Notice to Proceed in accordance with procedures identified in the Contract.

2. Define each System to be independently delivered to County after Startup. At a minimum, the System Delivery Plan shall include the following Systems:
   a. Solids Dewatering System

3. Include proposed start and finish dates for all System Demonstration Tests and Startup.

4. Incorporate into Progress Schedule.

5. Resubmit proposed changes in accordance with procedures identified in the Contract.

C. System Demonstration Testing and Startup Plans:

1. Submit a minimum of thirty days prior to proposed System Demonstration Test date in accordance with procedures identified in the Contract.

2. Identify all testing media sources and disposal locations including testing fluid, sludge, utility water, chemicals, process air, instrument air, etc. for both System Demonstration Testing, and Startup.

3. Identify all instrumentation and recording devices required to complete testing.

4. Identify any required laboratory testing.

5. Identify days during which the manufacturer’s representatives will be on Site.

1.04. GENERAL

A. Provide a minimum of fourteen days notice to County and County Engineer prior to all testing. County and County Engineer reserve the right to witness all testing.

B. Materials, Supplies, and Utilities:

1. County Furnished
   a. Sludge
   b. Utility water
2. Contractor Furnished
   a. All required tools, materials, and spare parts.
   b. All required instrumentation and monitoring devices, including temporary
devices required for testing (i.e. flowmeters, pressure gauges, level sensors,
etc.)
   c. All required fuel, lubricants, energy, equipment, and instruments.
   d. All required utilities not furnished by County.
   e. All required chemicals not furnished by the County.
   f. Laboratory services where specified or otherwise required.
   g. Provide means to convey designated testing fluid to testing location and to
disposal location unless otherwise indicated, including all temporary facilities
required (i.e. pumps, piping, etc.).
   h. Temporary power.

C. Connection to Existing Equipment and Facilities: Test all equipment and facilities to ensure
that they are in operating condition before the final tie-ins are made which connect new
equipment and facilities to existing equipment and facilities.

D. Contractor Operating Personnel:
   1. System Demonstration Testing:
      a. Provide the following on call personnel that are capable of arriving at the Site
within two hours after request by Contractor furnished and monitored alarms:
         1) Mechanic.
         2) Electrician.
   2. Startup:
      a. Provide County support as specified subsequently in this section during
normal working hours.
      b. Provide the following on call personnel that are capable of arriving at the Site
within two hours after request outside of normal working hours:
         1) Mechanic.
         2) Electrician.

1.05. PRELIMINARY FIELD TESTING
   A. Demonstrate the following:
      1. Equipment is permanently installed in the correct location and orientation.
2. Equipment is properly adjusted, aligned, and lubricated.

3. Equipment is prepared for operation in strict accordance with the Contract and with manufacturer’s recommendations.

B. Make all changes, adjustments and replacements required to comply with the requirements of the Contract.

C. Preliminary field testing shall be witnessed by the manufacturer’s representative where required by individual Specification sections.

D. Prerequisites:

1. Accepted System Delivery Plan.

2. Permanent power has been connected and unit is ready for operation.

1.06. FUNCTIONAL TESTING

A. At a minimum, Functional Tests shall include the following:

1. Verification that equipment meets the specified performance requirements in every detail and performs its intended function without any unusual vibration, noise or other signs of possible malfunction. Unless specifically identified otherwise in individual Specification sections, all performance testing shall be conducted during Functional Testing.

2. Motor testing where required.

3. Vibration testing where required.

4. Demonstration of successful operation in all control modes including all remote devices.

B. Prerequisites:

1. Accepted Functional Testing plan.

2. Preliminary Field Testing.

3. Manufacturer’s Installation Certificate.


5. Testing fluid shall be non-potable water or treated plant effluent

1.07. SYSTEM DEMONSTRATION TESTING

A. Operate System in simulated fashion as described in the accepted System Demonstration Testing and Startup Plan demonstrating all modes of operation. This shall include, when practical, simulation of extreme conditions (minimum and maximum design conditions, alarms, potential failure events, etc.) so as to check the response of instrumentation and control devices, bypass functions, pumping cycles, etc. Contractor shall be responsible for the complete operation of the System, including the positioning of valves, gates, switches, proper equipment devices, controls and associated components furnished and/or installed
under this Contract. County will provide operation of all existing treatment plant components unless otherwise specified.

B. If any component of the System fails to operate in accordance with the Contract during System Demonstration Testing, provide all necessary repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the System. Required adjustments to equipment shall be made by a qualified manufacturer’s representative. After the System is restored to proper operating conditions, restart the test. Operating time prior to System failures will not count towards the required test duration.

C. Equipment shall be powered from the permanent power source prior to System Demonstration Testing.

D. Prerequisites:

1. Accepted System Demonstration Testing and Startup Plan.
2. Functional Testing of all System components.
3. Manufacturer’s Certification of Equipment Compliance for all associated equipment.
5. Required training for all System components not specifically identified in individual Specifications sections as post Startup training.
7. Permanent safety and protection devices installed and operational. Safety devices shall include, but not be limited to, fall protection, hand railing, grating and floor plates, leak detection, motor thermal and overload protection, emergency power generation, equipment lockouts, floatation devices, fire alarms and systems, ventilation systems, and lighting in operational areas in or directly related to the System being tested. All open excavations in or adjacent to the operational areas shall be covered.
8. Verification that all required lubrication equipment and materials are readily available to Contractor at the Site.
9. System piping, valves, instruments, control panels, and electrical equipment properly labeled in accordance with the Contract.

E. Testing fluid shall be approved by County and supplied by Contractor, unless otherwise noted.

1.08. STARTUP

A. During Startup, County will operate the System under actual operating conditions and test for successful operation in the various operating modes required by the Contract under the direction and responsibility of the Contractor. County will provide all required sampling and laboratory testing required for operation of System during Startup unless otherwise noted.

1. Provide the following support to County:

   a. Routine maintenance of new equipment and devices.
b. Non-routine operations and maintenance, such as cleaning clogged pumps, etc.

c. Notify County prior to performing actions related to Startup or shutdown of Systems including, but not limited to, valve and gate operation, electrical shutdown, change in process flow configuration, etc.

B. If any component of the System fails to operate in accordance with the Contract during Startup, provide all necessary all repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the System. Required adjustments to equipment shall be made by a qualified manufacturer’s representative. After the System is restored to proper operating conditions, restart the test. Operating time prior to System failures will not count towards the required test duration. Examples of System failures include, but are not limited to the following:

1. Tank overflows.
2. Equipment failures and/or malfunctions.
3. Instrumentation failures and/or malfunctions.
4. Tank or piping failures and/or leakage.
5. Loss of power to equipment and/or devices.
6. Controls malfunctions.

C. Upon successful completion of Startup, the System shall be delivered to County for partial utilization.

D. Prerequisites:

2. Provide County with up-to-date record Drawings showing all components as they are installed. The record Drawings shall cover all major components of the System including power feed, control and alarm annunciation, and piping.
3. Seven days written notice prior to proposed actual beginning of Startup date. Startup cannot commence without County and County Engineer acceptance of proposed actual beginning of Startup date.

1.09. SYSTEM DEMONSTRATION TESTING AND STARTUP MEETINGS

A. At least 14 days prior to the proposed start date for each System Demonstration Test, conduct a meeting with County and County Engineer to review testing plans, finalize testing procedures, verify status of associated equipment and prerequisites, and coordinate all aspects of System Demonstration Testing and Startup. Representatives of County, County Engineer, and Contractor shall attend the conference.

B. Prerequisites:

1. Accepted System Demonstration Testing and Startup Plan.
2. Completion of all associated Functional Testing.
PART 2 PRODUCTS
Not used.

PART 3 EXECUTION
Not used.

END OF SECTION
SECTION 02030
DEMOLITION

PART 1   GENERAL

1.01. SECTION INCLUDES
   A. Demolition preparation and requirements.

1.02. REGULATORY REQUIREMENTS
   A. Conform to applicable codes for demolition of structures and facilities, protection of adjacent
      structures, dust control, runoff control, and disposal of materials.
   B. Obtain required permits from authorities.
   C. Notify affected utility companies before starting demolition operations and comply with their
      requirements.
   D. Do not close or obstruct roadways, hydrants, parking areas, and egress width to exits without
      permission.
   E. Conform to applicable regulatory procedures if a hazardous environmental condition is
      encountered at the Site.

1.03. HAZARDOUS ENVIRONMENTAL CONDITIONS
   A. Hazardous material testing has not been performed. If an unknown unforeseeable hazardous
      environmental condition is encountered at the Site, or if Contractor or anyone for whom
      Contractor is responsible creates a hazardous environmental condition, immediately:
      1. Secure or otherwise isolate such condition;
      2. Stop all work in connection with such condition and in any area affected thereby;
      3. Immediately notify County and County Engineer and promptly thereafter confirm such
         notice in writing.
   B. Resume work in connection with such condition or in any affected area only after responsible
      party has obtained required permits related thereto and County delivers to Contractor a
      written notice specifying under what special conditions affected work may be resumed safely.

1.04. SALVAGE
   A. Unless otherwise specified, all demolished materials and equipment shall become the
      property of the Contractor and shall be removed from the Site by the Contractor.

1.05. DEMOLITION, REMOVALS, AND RELOCATIONS
   A. General
      1. Ensure that all hardware items and replacement equipment are on hand prior to
         attempting any demolition, modification, or remedial work.
2. Equipment, conduits, cables and materials that are abandoned in place shall be provided with tags, labels and nameplates indicating “Spare Equipment” or similar text.

3. Contractor shall take necessary precautions to insure against damage to existing materials or equipment to remain in place, to be reused or to remain the property of the County. Repair or replace damaged materials and equipment at no additional cost to the County.

B. Equipment Demolition and Removals

a. Carefully dismantle and salvage electrical equipment, switches, fixtures, instruments, conduits, cables, wiring, control panels, etc. as necessary to perform the proposed changes.

b. Where electrical equipment is removed or relocated, also remove all wiring back to source panelboard, MCC, switch or to last remaining device on the same circuit. Associated conduits, hangers, supports, etc. shall be removed unless otherwise noted or required to maintain the support and operation of remaining equipment.

c. Remove all extraneous wires and exposed conduits for all mechanical, and electrical devices to be removed or abandoned.

d. Wires shown for removal which are in underground duct banks, or embedded conduit shall be removed unless otherwise noted.

e. Contractor shall disconnect and remove related equipment and conduit mounting hardware, equipment mounting racks, and equipment associated with materials to be removed unless otherwise required to maintain the support and operation of remaining equipment.

f. Any conduit abandoned in concrete slabs, walls, or other inaccessible locations shall be left empty except for a nylon pull wire. Ends shall be capped and labeled as spare for future use.

g. If cables cannot be removed due to a collapsed or deformed duct, etc. cut cable at duct entrance at each end and tag cable as “Abandoned Cable”, “collapsed duct” or similar text. Notify the County of these conditions.

C. Equipment Relocations

1. Re-route conduits and lighting fixtures as necessitated by architectural, mechanical, and HVAC changes and for new electrical work.

2. Provide materials, and hardware for patching, plugging, and refurbishing equipment intended for reuse. Provide new nameplates for reused work.

3. Where the work specified herein or under other divisions necessitates relocation of existing equipment, foundations, conduits, wiring, etc. perform all work and make necessary modifications to existing work as required to leave the completed system in a finished and workmanlike condition.

4. Contractor shall include all necessary equipment and components as required to relocate equipment from the existing locations to the new proposed locations. Equipment shall be tested prior to being disconnected and relocated. Any deficiencies in the equipment operation shall be brought to the attention of the
County Engineer. Once the equipment has been fully tested, the Contractor shall schedule the relocation of the unit(s). After the unit(s) has been relocated and reconnected, Contractor shall perform testing as required to demonstrate the operation of the unit(s).

D. Structure Repairs & Refinishing

1. Rehabilitate and relocate items of equipment as required.

2. Fill and patch penetrations, holes, damaged surfaces, etc. to match adjacent surfaces and restore a smooth finish to floors, ceilings, and walls.

1.06. SUBMITTALS

A. Provide demolition plans prior to beginning the associated work. At a minimum, demolition plans shall include the following:

1. Protection of existing facilities.

2. Dust control.


4. Sequence of work.

5. Removal of material.

6. Access and egress of demolished and removed materials.

1.07. RECORD DRAWINGS

A. Accurately record actual locations of capped utilities and subsurface obstructions.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01. GENERAL

A. No demolition work shall begin prior to receipt of written approval from County.

3.02. PREPARATION

A. Provide, erect, and maintain temporary barriers, signs, and security devices for demolition materials and equipment.

B. Protect existing structures, equipment, appurtenances, architectural features, and materials which are not to be demolished.

C. Notify County and County Engineer at least 48 hours in advance of intended start of demolition operations in each affected area.

3.03. DEMOLITION REQUIREMENTS

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11123532 02030-3 DEMOLITION
A. General:

1. The continuous operation of the facility shall be maintained during the entire Project unless specific facility outages are allowed by the Contract and County. Provide all temporary facilities needed to maintain continuous operation during demolition.

2. Conduct demolition to minimize interference with adjacent structures, materials, or equipment. Repair all damaged facilities at no additional cost to the County.

3. Prevent movement and/or settlement of adjacent structures. Cease operations immediately if adjacent structures appear to be in danger. Notify County and County Engineer. Do not resume operations until directed by County.

4. Conduct operations with minimum interference to public or private accesses. Maintain access and egress to the Site at all times.

5. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

6. Provide dust control for all new and existing equipment. Cover all electrical equipment, control panels, and appurtenances and protect from dust. Suspended dust shall be kept to a minimum, and the Contractor shall clean up all dust at least once per day for the duration of all demolition and once after each demolition activity is complete.

7. Provide adequate ventilation in all areas of demolition work.

8. All new materials and equipment required for connections to existing facilities shall be on Site and ready for installation prior to commencing demolition required for connections.

9. Provide all required appurtenances to adequately support remaining piping, conduits, and duct banks after required portions are removed.

10. Completely remove all demolished materials from the Site.

11. Coordinate removal of demolished materials with County’s operating procedures.

12. Temporary staging of demolished materials on Site shall be in accordance with the approved demolition plan and shall be kept to a minimum.

13. Burning of debris on Site is not allowed.

14. Sale of removed materials at the Site is not allowed.

B. All conductors for both abandoned and demolished ductbanks shall be pulled completely.

C. Remove foundation walls and footings to a minimum of 2 feet below finished grade if additional removal is not required to construct new facilities.

D. Empty and clean buried tanks and associated piping scheduled for demolition.

E. Remove materials to be re-installed or retained in manner to prevent damage.

F. Backfill, compact, and rough grade excavated areas, including cavities created by removal of demolished items.
G. Remove temporary barricades, partitions, signs, etc. upon completion of each area of demolition.

H. Contractor shall remove interior and exterior concrete equipment pads for equipment to be removed and/or demolished. Remove exposed conduits, rebar, and concrete. Refinish existing floors for interior finished areas to a level condition.

END OF SECTION
PART 1  GENERAL

1.01.  SECTION INCLUDES

  A.  Removal and disposal of sludge, grease, grit and debris from tanks.

1.02.  REGULATORY REQUIREMENTS

  A.  Conform to applicable local and state codes for legal hauling and disposal of the sludge and grit.

  B.  Obtain necessary permits including those required by the State of Maryland for legal hauling and disposal of the sludge and grit.

  C.  Provide necessary treatment of sludge and grit which may be required for legal hauling and disposal.

  D.  Dispose of sludge and grit in a location and in a manner approved by the State of Maryland and any other associated regulatory groups.

  E.  For bidding purposes, the Contractor shall assume the sludge and grit may not be land applied and must be disposed of at a non-hazardous waste landfill. Contractor is responsible for conducting tests on the material, if required by disposal facility.

1.03.  SUBMITTALS

  A.  Contractor shall submit a copy of grit and sludge transportation and disposal permits to the County Engineer prior to starting grit and sludge removal from the tanks.

  B.  Contractor shall submit test results, if any are conducted.

  C.  Disposal manifests shall be provided to the Owner accounting for disposal of all grit and sludge that leaves the site.

PART 2  PRODUCTS

Not used.

PART 3  EXECUTION

3.01.  REMOVAL AND DISPOSAL

  A.  Contractor is responsible for providing labor, materials, equipment and supplies necessary to remove sludge and grit from tanks where required by the Contract. This shall include all pumps, piping supports, wiring, mechanical equipment, trucks, loaders, etc., required for complete operation.

  B.  Contractor is responsible for providing all dewatering and treatment which may be required to remove and dispose of the sludge and grit in accordance with state and local requirements.
C. Sludge and grit which is removed for disposal must be stored in leakproof, covered containers; containers must be covered when loading is not occurring. Covers shall be integral to the container. Tarping systems are not acceptable.

D. Grit and sludge must be removed from the site within 24 hours of the beginning of the tank dewatering process.

E. Removal of sludge and grit shall be accomplished in a manner that doesn’t allow spillage onto the plant site.

END OF SECTION
SECTION 02551
WATER MAINS

Except as indicated herein, work shall be in accordance with the requirements of Charles County Standard Specifications Section 02551.

02551.01 GENERAL

Replace Article 02551.01.A with the following:

“Water main installation shall include, but not necessarily be limited to, furnishing and installing below grade water pipe, fittings, and appurtenances of the size and type shown on the Plans, installed on a firm foundation true to line and grade in accordance with the Contract.”

END OF SECTION
SECTION 02552

WATER VALVES AND APPURTENANCES

Except as indicated herein, work shall be in accordance with the requirements of Charles County Standard Specifications Section 02552.

02552.01 GENERAL

Replace Article 02552.01.A with the following:

“Water valve and appurtenance installation shall include, but not necessarily be limited to, furnishing and installing below grade gate, and air release and vacuum valves or assemblies with appurtenant valve vaults or roadway valve boxes and accessories in accordance with the Contract.”

END OF SECTION
SECTION 02553
WATER SERVICES, WATER METER SETTINGS, AND VAULTS

Except as indicated herein, work shall be in accordance with the requirements of Charles County Standard Specifications Section 02553.

02553.01 GENERAL

Replace Article 02553.01.A with the following:

“Water services, water meter setting, and vault installation shall include, but not necessarily be limited to, furnishing and placing below grade water services with appurtenant meter housings, backflow prevention assembly/device, and connection to the water main in accordance with the Contract.”

END OF SECTION
SECTION 02561
SANITARY SEWERS AND SANITARY HOUSE CONNECTIONS

Except as indicated herein, work shall be in accordance with the requirements of Charles County Standard Specifications Section 02561.

02561.01 GENERAL

Replace Article 02561.01.A with the following:

“Sanitary sewer and sanitary house connection installation shall include, but not necessarily be limited to furnishing and installing below grade gravity pipe, fittings, and appurtenances of the size and type shown on the Plans, installed on firm foundation true to line and grade and in accordance with the Contract.”

END OF SECTION
SECTION 02563
SANITARY SEWER FORCE MAINS

Except as indicated herein, work shall be in accordance with the requirements of Charles County Standard Specifications Section 02563.

02563.01 GENERAL

Replace Article 02563.01.A with the following:

“Sanitary sewer force main installation shall include, but not necessarily be limited to, furnishing and installing below grade pressure rated pipe, fittings, and appurtenances of size and type shown on the Plans, installed on firm foundation true to line and grade and in accordance with the Contract.”

END OF SECTION
PART 1   GENERAL

1.01. SECTION INCLUDES
   A. Pressure testing of process piping systems.
   B. Required replacement or repair if test fails.

1.02. RELATED SECTIONS
   A. Section 15060 – PROCESS PIPING
   B. Section 15100 – PROCESS VALVES

1.03. REFERENCES
   A. AWWA C-600 - Installation of Ductile Iron Water Mains and Their Appurtenances

1.04. TEST REQUIREMENTS
   A. All piping systems shall be tested in accordance with AWWA Standard C-600 unless specified otherwise.
   B. One of the following procedures shall be used, as required by the pipe schedule:
      1. Procedure A – Pressurized pipes for liquid service shall be tested for a minimum of 2 hours at a test pressure equal to 1.5 times the maximum design pressure for the line during normal operations, but in no case less than 50 psig, unless otherwise specified.
      2. Procedure B – Gravity pipes for liquid service shall be subjected to an exfiltration test where the pipe is filled with clear water to provide a head of at least 5 feet above the top of the pipe at the highest point of the pipeline under test, or 1.5 times the maximum working pressure as determined by the County Engineer, whichever is higher, and then by measuring the loss of water from the line by the amount which must be added to maintain the original level. In this test, the test period (for taking measurements) shall not be less than four hours.
      3. Procedure C – Pressurized pipes for air service shall be tested using air only at a pressure of at least 1.5 times the maximum design pressure in the line during normal operations for a period of not less than two hours.
   C. A leakage test shall be conducted concurrently with the pressure test. The section tested shall be driptight with no signs of leakage.

1.05. SUBMITTALS
   A. For each test, submit completed the Flushing and Testing of Pressurized Pipes Tabulation Sheet (see form at end of this section).

1.06. PROJECT RECORD DOCUMENTS
A. Submit record documents in accordance with the Contract.

B. Contractor to complete and submit for each test the Flushing and Testing of Pressurized Pipes Tabulation Sheet for recording data for flushing and testing pressure pipe (see form at end of this Section).

1.07. REGULATORY REQUIREMENTS

A. Submit proof of testing as required by local, county or state agencies and this section.

1.08. FIELD MEASUREMENTS

A. Measure length of test section.

B. Measure quantity of water used to maintain test pressure during test period.

C. Measurements required to complete the Flushing and Testing of Pressurized Pipes Tabulation Sheet.

1.09. COORDINATION

A. Provide 48 hour notice to County when water for flushing and testing is required.

B. County shall operate all valves and hydrants unless Contractor has been authorized by County to operate water systems valves and hydrants.

PART 2 PRODUCTS

2.01. WATER SUPPLY

A. Water supplied for flushing and testing shall be clean, clear and from sources acceptable to the County Engineer.

B. All water for flushing and testing shall be furnished and disposed of by the Contractor at his expense.

PART 3 EXECUTION

3.01. PREPARATION

A. Contractor shall supply all plugs, pumps, weirs, gauges, etc., necessary to conduct the tests, including means to accurately measure the quantity of water used to maintain test pressure during the test period.

B. Contractor shall provide temporary restraint of all piping segments including unrestrained adapters, coupling, and expansion joints during pressure and leakage testing.

C. Flush all piping systems with water prior to testing.

3.02. TESTING

A. Pressure and leakage tests shall be conducted on all force main and pressure pipe.

B. The County Engineer shall witness all tests.
C. All test results shall be recorded on the Flushing and Testing of Pressurized Pipes Tabulation Sheet supplied by the County Engineer.

D. Pressurization - Each valved section of pipe shall be slowly filled with water. The specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe.

E. Air Removal - Before applying the specified test pressure, air shall be expelled completely from the pipe and valves.

F. Examination - Any exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, or valves that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated.

G. All visible leaks, regardless of the amount, shall be repaired.

H. If the section being tested fails to pass the pressure or leakage test, the Contractor shall determine, at his own expense, the source or sources of leakage, and he shall permanently repair or replace all defective materials and/or workmanship.

1. The extent and type of repair as well as results shall be subject to the approval of the County Engineer.

2. The completed pipe installation shall then be retested and required to meet the pressure and leakage requirements of this test.

I. Testing and retesting shall be completed prior to final paving.

J. The use of sealants, applied from outside or inside of pipe, is not acceptable.

K. Pressure gauges shall read in 1 psi increments for pressure tests >25 psi and 0.5 psi increments for pressure tests <25 psi.

L. Pumps or devices for makeup water to calculate the leakage shall be provided with calibration containers.

M. All test water must be removed from the interior of all stainless steel pipe by draining, blowing, mopping, etc. Water must not be allowed to stand for long periods of time within stainless steel pipe.

(continued)
# FLUSHING AND TESTING OF PRESSURIZED PIPES
## TABULATION SHEET

Job No. __________ Location

Contract No. __________ Contractor

Project

Contractor’s Representative _______________ Observed by ________________

### FLUSHING

<table>
<thead>
<tr>
<th>Date</th>
<th>Weather</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Section Flushed _____________ feet of ____-inch diameter pipe

Line Flushed _____________ hrs. __________ min. @ __________gal/min

Line Flushed Through _____________ Manhole # _____________

### PRESSURE AND LEAKAGE TESTING

<table>
<thead>
<tr>
<th>Date</th>
<th>Weather</th>
<th>Temperature</th>
</tr>
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<tbody>
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</tr>
</tbody>
</table>

Section Tested _____________ ft. of ____-inch diameter _____ pipe in ___-ft. laying lengths

Time Started __________ Time Finished __________ Elapsed Time __________

Test Pressure: Start _______ psi Finish _____ psi

Water to Make up Initial Pressure _______________________ gallons

Allowable leakage, as calculated _________ gallons

Actual leakage _________ gallons

Pass _____ Fail _____

\[ L = \frac{SD \sqrt{P}}{133,200^*} \]

\[ L = \text{Allowable leakage in gallons/hour} \]

\[ S = \text{Length of pipe tested (linear feet)} \]

\[ D = \text{Nominal diameter of pipe (inches)} \]

\[ P = \text{Average pressure during test, psi} \]

*Refer to C600 for additional allowance leakage against closed metal-seated valves.

END OF SECTION
PART 1       GENERAL

1.01.   SECTION INCLUDES

A.   Formwork for cast-in-place concrete. Coordinate form type with tie and finish requirements. Walls to receive a rub finish shall not be formed using small modular panels.

B.   Form hardware, ties, etc.

C.   Form removal; coordinate with rub finish, curing, strength gain, and protection requirements.

1.02.   REFERENCES

A.   The publications listed below form a part of these Specifications.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI 301</td>
<td>Specifications for Structural Concrete Buildings</td>
</tr>
<tr>
<td>ACI 347</td>
<td>Recommended Practice for Concrete Formwork</td>
</tr>
<tr>
<td>ASTM A653</td>
<td>Steel Sheet, Zinc Coated</td>
</tr>
</tbody>
</table>

1.03.   SUBMITTALS

A.   Submit single page catalog cut showing the type of form to be used at above grade rub finished concrete wall construction.

B.   Submit single page catalog cuts showing the types of form ties with finishing cones; with and without waterstops, to be used on this project.

C.   Submit catalog cut to show material and finish for any stay-in-place metal form deck.

1.04.   COORDINATION

A.   Coordinate the installation of all embedded items that need to be included in the formwork.

B.   Coordinate casting of additional field cured concrete test cylinders to be compression tested at the Contractor’s direction for use in determining when forms can be stripped; for all formed concrete.

1.05.   DELIVERY, STORAGE, AND HANDLING

A.   Deliver form and accessory materials to site in an undamaged condition. Defective or damaged materials shall not be used.

PART 2       PRODUCTS

2.01.   MATERIALS

A.   Form materials shall be new wood, new plywood, or steel.
Do not use small (2 foot wide) modular panel form systems (ie: Symons, Olympic, Plum Creek, etc.) at above grade concrete that is specified to receive a rub finish. Do not use poor quality or used forms that will make a rub finish difficult to produce. Reference Section 03350, Concrete Finishes. Therefore, small panel and/or worn, used forms will not be allowed on exposed work.

B. Exposed Concrete Edges
   1. Exposed edges and outside corners of concrete shall be formed with 3/4-inch by 3/4-inch chamfer forming strips.

C. Forms shall be coated with a release agent which will not stain concrete, absorb moisture, reduce the bonding characteristics of additional concrete coatings, or negatively affect the rubbed finish process.

D. Form Ties
   1. Form ties shall leave no metal closer than 1-inch to the surface of the finished concrete.
   2. The end of the tie hole shall be cone shaped for sealing with plug mortar per Section 03350, Concrete Finishes.
   3. Snap ties can only be used at frost walls.

E. Joints for interruptions in concrete placement shall be per Section 03250, Concrete Joints and Accessories.

PART 3 EXECUTION

3.01. ERECTION-INSTALLATION-APPLICATION

A. Earth cut forms shall not be used. All footings, etc., shall be formed unless specifically shown otherwise on the Drawings.

B. Form surfaces shall be smooth and shall be removable in sections, such that no prying against the faces of the new concrete is necessary.

C. Design, engineering, and construction of formwork shall be the responsibility of the Contractor and must achieve the desired end results.

D. Erected forms shall be substantial and rigid, sufficiently tight to prevent leakage of laitance and properly braced and tied to maintain position and shape under the weight and pressure of the newly placed concrete.

   All joints between adjacent form panels shall be backed by a whaler or stud. Seal formwork using gaskets and caulk to prevent leakage on the preceding placement below or adjacent.

E. Inspection and cleanout openings shall be provided as required.

F. Provide formed openings where required for items to be embedded in or passing through concrete work.

   Locate and set in place items which will be cast directly into concrete.
Coordinate work of other sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, embedded frames, and other inserts.

G. Install chamfer forming strips on formwork at edges, outside corners, and weir locations.

H. Apply form release agent in accordance with manufacturer’s recommendations. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items. Do not apply form release agent where concrete surfaces will receive special finishes which are affected by agent.

I. Form Hardware

1. Tie layout shall be in a neat pattern when finished concrete is exposed.
2. No ties shall be broken off until the concrete is at least three days old.

J. Tolerances for finish formed surfaces and variations in dimensions shall be in accordance with the table below:

**TOLERANCES FOR FORMED SURFACES**

<table>
<thead>
<tr>
<th>1. Variation from plumb:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. In the lines and surfaces of piers, walls, etc.:</td>
<td></td>
</tr>
<tr>
<td>b. For exposed wall corners, control joint grooves, and other conspicuous vertical lines:</td>
<td></td>
</tr>
<tr>
<td>c. In any 20 feet of height</td>
<td>1/4 inch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Variation from level or from grades specified:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. In slab soffits, measured before removal of supporting shores:</td>
<td></td>
</tr>
<tr>
<td>b. At top of walls and in exposed lintels, sills, parapets, grooves, and other conspicuous horizontal lines:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Variation of the linear building lines from position in plan and related position of walls and partitions:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. In any bay</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>b. In any 20 feet of length</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>c. Maximum for the entire length</td>
<td>1 inch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Variation in the sizes and location of sleeves, floor openings, and wall openings:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Variation in cross-sectional dimensions and thickness of slabs and walls:</td>
<td></td>
</tr>
<tr>
<td>6. Footings:</td>
<td></td>
</tr>
<tr>
<td>a. Variations in dimensions in plan:</td>
<td></td>
</tr>
<tr>
<td>b. Misplacement or eccentricity:</td>
<td></td>
</tr>
<tr>
<td>c. Thickness:</td>
<td></td>
</tr>
</tbody>
</table>

**No limit but increased thickness must be maintained for**
minimum 5'-0" length.

*Tolerances apply to concrete dimensions only, not to positioning of reinforcing steel or embedded items.

3.02. FIELD QUALITY CONTROL

A. Prior to placing concrete, inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties (with waterstops and end cones), and other items are secure.

B. Clean and vacuum formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through cleanout ports.

D. During cold weather, remove ice and snow from within forms. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. De-icing salts will not be permitted. Reference Section 03370, Concrete Curing and Protection.

3.03. FORM REMOVAL

A. Assume full responsibility for the strength of all components from which forms are removed. No forms shall be removed prior to the attainment of at least 80 percent of the specified concrete compressive strength. Coordinate casting of additional sets of test cylinders to be field cured adjacent to structure and determine when each pair of cylinders shall be tested. 80 percent strength shall be based on the average obtained from two field cured cylinders tested concurrently.

B. Forms and supports shall remain undisturbed until the concrete has attained sufficient strength to support its own weight in addition to any contemplated loads (temporary or permanent) that may be placed upon it during subsequent work. In no event shall forms be loosened prior to 24 hours’ wet cure time. Re-shore at midspan where necessary.

C. No forms shall not be removed prior to attaining at least 80 percent of the required design strength after placing of concrete. Reference Section 03370, Concrete Curing and Protection for duration of curing requirements and duration of cold weather protection requirements which shall both continue for the durations stated, regardless of when forms are removed.

D. Non structural forms such as wall forms and slab edge forms are also subject to the 80 percent strength requirement.

END OF SECTION
SECTION 03200
CONCRETE REINFORCEMENT

PART 1  GENERAL

1.01.  SECTION INCLUDES

A. Reinforcing bars.

B. Bar supports and bolsters.

C. Detailed submittal requirements.

1.02.  REFERENCES

The publications listed below form a part of these Specifications.

A. American Concrete Institute
   - ACI 301  Specifications for Structural Concrete Buildings
   - ACI 315  Details and Detailing of Concrete Reinforcement
   - ACI 315R Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
   - ACI 318  Building Code Requirements for Structural Concrete
   - ACI 350  Environmental Engineering Concrete Structures
   - ACI 530  Building Code Requirements for Masonry Structures

B. American Society for Testing and Materials
   - ASTM A497 Steel Welded Wire Reinforcement, Deformed, for Concrete
   - ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement
   - ASTM E329 Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction

C. Concrete Reinforcing Steel Institute (CRSI) - Placing Reinforcing Bars


1.03.  SUBMITTALS

A. Reinforcement Shop Drawing - Submit shop drawings in accordance with ACI 301, ACI 315, ACI 315R, and as modified below.
   1. Shop drawings shall be clear enough so that every reinforcing bar in the structure can be located and shall be complete with all dimensions of the structure without the need to refer to the Contract Drawings.
   2. A reinforcing bar layout plan shall be provided for each slab or walkway level, and an elevation view reinforcing bar layout shall be provided for each wall.
3. Shop drawings shall clearly indicate all construction joints, expansion joints, and control joints. The Contractor shall coordinate with the reinforcement detailer so that all reinforcement interruptions and/or all splices can be shown and accounted for in the detailing.

4. Reinforcement shall be shown as bent where needed to clear waterstops and/or maintain uniform cover. Bars with bends shall be indicated schematically on the plan and elevation views.

5. Coordinate all openings and pipe penetrations in walls and slabs and indicate these on the reinforcement shop drawings. Formed openings larger than 8 inches in any direction shall be detailed with additional reinforcement around the opening.

6. Photocopies of Contract Drawings, in whole or in part, will not be acceptable.

7. Re-submittals of shop drawings shall have all revisions and/or corrections clearly highlighted to the County Engineer (e.g. labeled, clouded, etc.).

8. Final corrected copies of shop drawings (for file and to be used in the field) shall be submitted a minimum of 14 days prior to start of installation.

9. No fabrication of reinforcement shall commence until shop drawings are approved.

10. All reinforcement shall be shop fabricated. No reinforcement shall be field bent.

B. Submit record copies of mill test reports showing physical and chemical analysis.

C. Submit single (one)-page catalog cut for threaded rebar splicing system.

D. Submit single (one)-page catalog cuts, clearly marked to indicate reinforcement supports and bolsters to be used for bearing on-grade and for walls and elevated slabs.

1.04. COORDINATION

A. Coordinate all construction joints, expansion joints, and control joints so that all reinforcement interruptions and/or splices can be shown.

B. Locate all wall/slab openings and pipe penetrations on the shop drawings prior to submitting for approval.

C. Coordinate the supply of all reinforcement supports and bolsters.

1.05. QUALITY ASSURANCE

A. Reinforcement work shall conform to the applicable requirements of ACI 301, ACI 315, ACI 318, and CRSI referenced publications.

B. All reinforcement shall have the manufacturer’s mill mark rolled into the bar which shall indicate the producer, size, type, and grade.

C. All reinforcement shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

1.06. DELIVERY, STORAGE, AND HANDLING
A. Deliver reinforcement and accessory material to the site in an undamaged condition.

B. Reinforcement shall not be stored in direct contact with earth and shall be kept free of mud.

C. Bundles of bars may be loaded in or on structures, providing the Contractor avoids premature loading or overloading of the structure. Surface protection from rust stains, etc., shall be provided.

PART 2 PRODUCTS

2.01. MATERIALS

A. Deformed Reinforcement - ASTM A615, Grade 60.

B. Supports and Bolsters

1. Supports and bolsters shall be a non-bleeding and non-staining material where concrete surfaces remain exposed. Plastic, plastic tipped, or stainless steel supports shall be used for this purpose.

2. Supports bearing on grade, insulation, or soft material shall be continuous runner type supplied with continuous welded-on plates or minimum 4000 psi precast concrete blocks specifically cast for this intended use to assure proper support of reinforcement. Individual high chair supports will not be considered adequate.

The use of pavers, brick, or CMU to support reinforcement shall not be permitted.

2.02. SOURCE QUALITY CONTROL

A. Shop Inspection - The County Engineer reserves the right to inspect the manufacturer’s facilities while fabrication of reinforcement for this project is being performed.

PART 3 EXECUTION

3.01. ERECTION-INSTALLATION-APPLICATION

A. Placement of reinforcement shall be in accordance with ACI and CRSI referenced publications.

B. Reinforcement shall be spaced as shown on the approved shop drawings. Deviations, necessary because of interference with inserts, conduits, piping, small openings for ducts, etc., are allowable as long as four consecutive bars average out to the required spacing.

C. Where larger openings are encountered and reinforcement must be cut, equivalent splice bars must be placed at each side of the opening plus #5 diagonal bars enveloping the opening at each corner (reference Standard Detail on Contract Drawings).

D. Reinforcement shall be accurately located in forms and held in place before and during concreting by using supports of adequate strength and black annealed tie wire, #16 gage or heavier, to prevent bar displacement.

E. Tie wires shall be bent into the wall or slab so as to not intrude into the reinforcement concrete cover space.
F. Install supports and bolsters as specified in Part 2. Pavers, brick, or CMU supports shall not be permitted. Quantity of supports shall be adjusted to eliminate deflection of reinforcement.

G. The minimum distance between non-lap-spliced, parallel bars shall be two times the bar diameter, but in no case shall be less than 1-1/2 inches.

3.02. COVER

A. Clear concrete cover shall conform to ACI 318 and ACI 350 unless noted otherwise.

B. The clear cover shall be 2 inches for severe exposure to earth, water, or weather, and for structures such as wet wells, channels, tanks, and foundation walls.

C. The reinforcement of footings, base slabs, and other members in which concrete is deposited against the ground shall have 3 inches of concrete cover between it and the ground contact surface.

D. Ends of reinforcing bars shall extend to within 2 inches of the outside face of the members into which they frame or terminate.

3.03. DEVELOPMENT AND SPLICE LENGTHS

A. All splices of reinforcement shall be lap-spliced with bars placed in contact with each other and wired securely.

B. Minimum lap or development length for reinforcing bars shall be as indicated on Contract Drawings. Special splices, shown on the Contract Drawings, shall be lapped as shown.

C. Splices shall not be placed at points of maximum stress. However, in instances where they are unavoidable, the splice location in every second parallel bar shall be offset by alternating at least one and a half times the splice length.

D. Base mat bottom bar splices shall not coincide with wall dowel locations. Offset adjacent bottom bar splices.

E. Welding of reinforcing bars shall not be allowed unless specifically approved by the County Engineer.

F. Splices of ring bars for circular structures shall be lapped and splices shall be alternately staggered in every third ring by a distance of two times the splice length (reference Standard Detail on Contract Drawings).
3.04. MINIMUM REINFORCEMENT

A. Minimum Temperature and Shrinkage Reinforcement - Where no reinforcement is shown on the Drawings, the minimum cross sectional area of horizontal and vertical reinforcement in walls shall comply with ACI 318 Chapter 14 provisions. The minimum area of steel in structural slabs shall be 0.0018 times the gross concrete area in each direction, top and bottom of slab.

B. Temperature and shrinkage reinforcement shall not be spaced farther apart than 12 inches.

3.05. FIELD QUALITY CONTROL

A. Advise the County Engineer of intentions to place concrete at least 48 hours prior to concrete placement to allow for observation of installed reinforcement and embedded accessories, including waterstops, keyways, and other items (reference “Contractor Pre-Placement Checklist” in Section 03300, Cast-in-Place Concrete).

B. Any repairs, corrections, cleaning, removal of debris, etc., shall be accomplished prior to start of concrete being placed.

C. Cavities of wall forms and any deep formwork shall be checked by County Engineer before closing the form, as well as immediately prior to placing concrete.

D. Prior to concrete deposition, reinforcement shall be free from mortar, mud, loose mill and rust scale, grease, oil or any other coatings, including ice, which would reduce bond with the concrete.

E. Where there is a delay in depositing concrete, reinforcement shall be rechecked and cleaned when necessary. Cleaning shall be done by whatever mechanical means is necessary to return it to an acceptable condition.

END OF SECTION
SECTION 03250
CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.01. SECTION INCLUDES
   A. Concrete joints and joint location submittal requirements.
   B. Miscellaneous joint accessories.
   C. Bonding agent.

1.02. SUBMITTALS
   A. Submit one-page catalog cuts for joint filler material and joint sealant, clearly indicating which item(s) are to be used.
   B. Submit one-page catalog cuts for waterstops and waterstop accessories, clearly indicating which item(s) are to be used.
   C. Submit one-page catalog cut for bonding agent.
   D. Submit plan and elevation view(s) for each structure to show locations of all specified slab and wall joints as well as to show locations of additional joints proposed to facilitate construction. Coordinate with reinforcement shop drawings required per Section 03200, Concrete Reinforcement.

PART 2 PRODUCTS

2.01. TYPES OF JOINTS
   A. Construction Joint – The joint between two adjacent concrete placements, created by casting fresh concrete in contact with a previously cast (hardened) concrete. All typical reinforcement passes through the joint. A minimum of three days shall elapse between the casting of adjacent concrete placements for construction joints in liquid containment structures or as indicated on the Contract Drawings.
   B. Control Joint – A shrinkage-compensating joint with a groove formed in the face(s) of the concrete member in order to cause a weakened plane, intended to crack. Only 50 percent of the typical reinforcement passes through the joint. In walls and slabs thicker than 14 inches, this joint is created similar to a construction joint. In walls and slabs less than 14 inches thick, this joint can be created similar to a construction joint or be cast as a monolithic placement.
   C. Isolation Joint – The joint between two adjacent concrete placements, created by casting fresh concrete adjacent to a previously cast (hardened) concrete placement, but separated by a joint filler material, to allow for expansion and contraction of concrete.

2.02. MATERIALS
   A. Joint Forming Materials
1. Construction and control joints for interruptions in concrete placement in tank base slabs, mat foundations, beam and slab systems, and walls shall be made from lumber with custom cut holes or slots to pass reinforcing bars through and with standard keyway and waterstop if applicable. These “bulkheads” are to be securely fastened to the deck, wall, and/or beam forms. They shall be the same depth as the concrete section and produce dense, clean, straight edges (top, bottom, and sides) when stripped.

2. Construction joints for interruptions in slab-on-grade concrete placements shall be fabricated from either custom built lumber “bulkheads” or galvanized steel shaped to form a tongue-and-groove mechanical key joint with preformed knock-out holes. The steel shaped unit shall be the same depth as the concrete.

3. Control joints for slab-on-grade construction shall be saw cut within 12 hours after placement of concrete.

B. Joint Filler Materials

1. Isolation joint filler material shall be closed cell rigid foam, cork, or non-impregnated fiberboard such as “Conflex LT” by Masonite Corporation Building Products or equal.

2. Joint filler shall be compatible as a back-up material, with regard to sealant not bonding to or being stained by the joint filler. If the joint filler is a material that will bond to or stain the sealant, a non-bonding polyethylene strip shall be used to cover the joint filler material.

C. Joint Sealants

1. Sealant for non-submerged conditions are as specified in Section 07900, Joint Sealers.

D. Bonding Agent – Use a corrosion inhibiting, non-vapor barrier, extended open time bonding compound. Use “Armatec 110 EpoCem” by Sika Corporation; “Emaco P24” by BASF Chemical Company; “Duralprep A.C.” by The Euclid Chemical Company; or equal.

PART 3 EXECUTION

3.01. INSTALLATION OF CONSTRUCTION JOINTS

A. Construction Joints in Slabs-On-Grade

1. Joints shall be thoroughly vibrated during concrete placement.

2. After curing and finish, construction joint grooves shall be filled with backer rod and sealant.

3. Where “control joints” are indicated, joints shall be saw cut. Cutting shall be done as early as possible and within 12 hours after the concrete has set. (Wait just long enough that the blade does not ravel the edges of the fresh concrete.) The saw shall be guided to ensure straight cuts. The saw cut shall be a minimum of 1/8-inch wide and a depth of 1-1/2 inches.

4. After curing, the joints shall be vacuumed and then filled with backer rod and sealant as specified in Section 07900, Joint Sealers.
3.02. INSTALLATION OF ISOLATION JOINTS

A. Isolation Joints for Slabs-On-Grade

1. The floor shall be separated structurally from other building elements to accommodate differential movement. Isolation joints shall be used where shown on the Contract Drawings; at junctions with walls, columns, foundations, or other points of restraint, such as drain pipes, chimneys, etc.

2. Joint material shall be removed to the depth required for installation of sealant.

3.03. INSTALLATION OF JOINT ACCESSORIES

A. Sealant

1. Primer and sealant shall be installed in accordance with the manufacturer’s instructions.

2. The sealant depth shall be controlled by the use of joint-fillers or back-up materials. The back-up material shall be non-impregnated and compressible; such as backer rod.
   a. Backer rod shall be about 1/8-inch larger in diameter than the width of the joint to allow for compression.
   b. Where the depth of the joint does not permit the use of backer rod, a bond breaker (polyethylene tape) must be used to prevent bonding to the back of the joint.

3. Joint fillers shall be held back for sealants. Where joint filler is flush with the adjacent concrete, enough filler material shall be removed so the joint can be sealed to the specified depth per the following chart:

<table>
<thead>
<tr>
<th>Joint Width And Sealant Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Width (Inches)</td>
</tr>
<tr>
<td>1/4 to 1/2</td>
</tr>
<tr>
<td>1/2 to 1</td>
</tr>
<tr>
<td>1 to 2</td>
</tr>
</tbody>
</table>

4. Sealant shall be applied to both sides of all joints where accessible, but shall not be installed prior to successful liquid tightness testing when applicable.

5. Tool joints to compact sealant, remove air, and facilitate good bond.

B. Bonding Agent

1. Prior to placing fresh concrete against existing hardened concrete, apply a bonding agent.
   a. Apply bonding agent for toppings, equipment/ housekeeping pads, and patches.
   b. Do not apply a bonding agent on control joints.

END OF SECTION
1.01. SECTION INCLUDES

A. It is the intent of these specifications to produce high performance, high quality, dense, durable, watertight concrete. Contractor will be responsible for the final in-place concrete quality. Care shall be used during mixing, placing, curing, and finishing to achieve the desired end result. Contractor will be responsible to repair cracks, unsound concrete, and poor finishes to the satisfaction of the County, at no additional cost.

1.02. RELATED SECTIONS

A. Section 01400 – QUALITY CONTROL
B. Section 01420 - SPECIAL INSPECTIONS
C. Section 03100 - CONCRETE FORMWORK
D. Section 03200 - CONCRETE REINFORCEMENT
E. Section 03250 - CONCRETE JOINTS AND ACCESSORIES
F. Section 03350 - CONCRETE FINISHING
G. Section 03370 - CONCRETE CURING AND PROTECTION
H. Section 03600 – GROUT
I. Section 05505 – CONCRETE AND MASONRY ANCHORS

1.03. REFERENCES

The publications listed below form a part of this Specification.

A. American Concrete Institute (ACI)

| ACI 211.1 | Selecting Proportions for Concrete |
| ACI 301 | Structural Concrete for Buildings |
| ACI 302 | Guide for Concrete Floor and Slab Construction |
| ACI 304 | Measuring, Mixing, Transporting and Placing Concrete |
| ACI 305R | Hot Weather Concreting |
| ACI 306R | Cold Weather Concreting |
| ACI 309 | Practice for Consolidation of Concrete |
| ACI 318 | Building Code Requirements for Concrete |
| ACI 350R | Environmental Engineering Concrete Structures |

B. American Society for Testing and Materials (ASTM)
### 1.04. SUBMITTALS

A. Pre-concrete coordination meeting schedule.

B. Qualification statement regarding batch plant certification by MDOT.

C. Concrete Mix Designs - Concrete mixes used on this project shall be either established mixes verified by “Field Test Data” or new custom laboratory designed “Trial Mix.” Requirements for either option are as follows.

Following is a list of required submittals. All data shall be dated within the last year. Partial submittal will not be reviewed.

1. State amount and source of mix ingredients:
   - cement
   - pozzolans
   - fine aggregate
   - coarse aggregate
   - water
   - admixtures (including superplasticizer)

2. Certified tests of fine and coarse aggregates meeting requirements of ASTM C33 for gradation and deleterious substances.

3. Certified statement from source of fine and coarse aggregates pertaining to history of alkali-aggregate reactivity. If MDOT acceptance is not available, provide results from ASTM C1260 and C295 testing.

4. Soundness tests for fine and coarse aggregates.

5. Fine and course aggregate water absorption.
6. **Strength Test Reports** - The average strengths shall be higher than the required average compressive strengths \( f'_{cr} \) as per ACI 301, paragraph 4.2.3.3.

   a. For a mix design based on a laboratory Trial Mix, example of required compressive strength \( f'_{cr} = 4500 \text{ psi} + 1200 \text{ psi} = 5700 \text{ psi} \).

   b. For a laboratory Trial Mix, the actual mix shall contain the actual materials to be used in the final job mix, have a slump within 0.75 inches of the maximum allowable slump, and have an air content within 0.5 percent of the maximum allowable air content.

   c. For a mix based on established Field Test Data, provide backup and calculations to adjust \( f'_{cr} \) based on standard deviation per ACI 301.

7. Certified mill test analysis of cement, fly ash, and/or slag.

8. One-page admixture catalog cuts.

9. Typed letter signed by officer of supplier stating that all ingredients for proposed mixes are identical and from the same source as ingredients used for concrete in the above test reports.

   D. Submit one-page catalog cut for retarding admixture and surface-applied hot weather evaporation reducer.

   E. Submit special requests for embedment of conduit, etc.

   F. Submit concrete batch plant certification plus a filled-in sample batch plant ticket prior to the first concrete placement.

   G. Submit a “Contractor Pre-Placement Checklist” prior to each concrete placement (form attached at end of this specification).

1.05. **COORDINATION**

   A. Coordinate all concrete placements with architectural, electrical, HVAC, instrumentation, mechanical, plumbing, and structural drawings and specifications.

   B. Coordinate installation of all cast-in/embedded items including frames, hatches, anchor rods, etc. prior to start of concrete placement.

   C. Coordinate all concrete placements with testing requirements.

**PART 2 PRODUCTS**

2.01. **CONCRETE**

   A. **Concrete Mixes and Their Use**

<table>
<thead>
<tr>
<th>Mix</th>
<th>Description Of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Fill concrete below structures</td>
</tr>
<tr>
<td>B</td>
<td>All other concrete</td>
</tr>
<tr>
<td>Mix</td>
<td>Minimum 28-Day Compressive Strength (Psi)</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>A</td>
<td>2,500</td>
</tr>
<tr>
<td>B</td>
<td>4,500</td>
</tr>
</tbody>
</table>

(1) Fly ash content shall be 20 to 25 percent of total cementitious content. As an alternate to fly ash, use slag at 30 to 50 percent of total cementitious content. Maximum total cementitious content shall not exceed 675 lbs/CY.

(2) W/C ratio calculation shall include water content of fine and coarse aggregates that exceeds saturated surface dry (SSD) conditions.

B. All exterior concrete shall be air-entrained with an air content of 6 percent ±1 percent by volume.

C. Slump for all flatwork shall not exceed 3 inches and wall concrete, piers, and deep formed sections can be placed with a maximum slump of 4 inches unless otherwise noted.

D. Concrete with superplasticizer shall be designed for a final slump of 4 to 6 inches.

2.02 MATERIALS

A. Cement

1. Cement shall be Portland cement Type I or Type II and shall meet the requirements of ASTM C150.

2. If Type II cement is available, it shall be used for below grade construction and for liquid containing structures or when air temperatures at the time of placement are expected to exceed 80 degrees F.

3. High early-strength cement (Type III with a maximum tri-calcium aluminate (C₃A) content of 8 percent) shall only be used with advance written approval by the County Engineer.

B. Pozzolans

1. Fly ash shall meet the requirements of ASTM C618 Class F, except as modified below:
   a. Loss of Ignition, Maximum - 5.0 percent.
   b. Maximum Retained on #325 Sieve - 30 percent.

2. Fly ash analysis shall show results meeting requirements of ASTM C618 and shall show less than 5 percent calcium oxide (CaO).

3. Blastfurnace slag material shall meet the requirements of ASTM C989. A blend of Portland cement and ground iron blastfurnace slag shall contain no more than 50 percent slag. The resulting blend of cementitious material shall meet the requirements of ASTM C595.
4. Blastfurnace slag material shall be specifically manufactured to produce higher concrete strengths and provide greater resistance to chloride penetration and sulfate attack. Use “NewCem” by Blue Circle Atlantic, Inc. or equal.

C. Aggregates

1. Fine Aggregate (Sand)
   a. Natural or manufactured siliceous sand.
   b. Quantity of deleterious substances limited by Table 1 of ASTM C33.
   c. Graded within the limits of ASTM C33.

2. Coarse Aggregate
   a. Crushed stone or crushed gravel.
   b. Quantity of deleterious substances limited by Table 3 of ASTM C33 for Class 4S aggregates.
   c. Graded within the limits of ASTM C33.

3. Five cycle soundness tests for fine and coarse aggregates shall meet the requirements of ASTM C33.

PERCENT LOSS

<table>
<thead>
<tr>
<th></th>
<th>Magnesium Sulfate</th>
<th>Sodium Sulfate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Aggregate</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Course Aggregate</td>
<td>18</td>
<td>12</td>
</tr>
</tbody>
</table>

4. Source of fine and coarse aggregates shall not have a history pertaining to alkali-aggregate reactivity. The batch plant must show written material acceptability (relative to ASR) as provided by MDOT testing.

In the event that aggregate source with potential alkali-aggregate reactivity is unavoidable, at least two of the following measures shall be taken to minimize this reaction:
   a. Provide low alkali cement.
   b. Use lithium-based additives.
   c. Test aggregates to show non-reactive.
   d. Use fly ash or slag.

D. Mixing Water - Clear and potable.

2.03. ADMIXTURES, ETC.

A. General - Admixtures other than those specified may only be used after written approval by the County Engineer.
B. All admixtures proposed shall be selected in advance so that the appropriate trial mixes can be made.

C. Air entrainment admixture shall be added to provide entrained air in all exterior concrete in accordance with ASTM C260.

D. Mixes B shall all contain a water-reducing admixture that meets the requirements of ASTM C494 Type A. This admixture shall not contain chlorides.

E. If air temperatures are expected to exceed 85 degrees F during the placement of any flatwork, a retarding admixture shall be used that meets the requirements of ASTM C494 Type D.

F. Acceleration admixtures associated with cold weather concrete are not allowed. Reference Section 03370, Concrete Curing and Protection, for cold weather protection procedures.

G. Evaporation Reducer - For all concrete flatwork during hot and/or windy weather conditions, apply to freshly placed concrete prior to finishing. Use L&M Construction Chemicals “E-Con,” Conspec (by Dayton Superior) “Aquafilm,” or equal.

H. Bonding Agent - For all toppings, housekeeping pads, and patches; when placing freshly-mixed concrete against existing hardened concrete, use a corrosion inhibiting, non-vapor barrier, extended open time bonding compound. Use Sika Corporation “Armatec 110 EpoCem,” Sonneborn “Sonoprep,” or equal.

I. After material sources have been established and approved, these sources shall not be changed for the duration of the project.

J. The County Engineer may require that a field representative of the admixture manufacturer provide occasional service in the field to assure proper use of the admixture.

PART 3 EXECUTION

3.01. PREPARATION, MIXING, AND HANDLING OF CONCRETE

A. Batch Plant Requirements - Measurement of materials at the batch plant shall be in accordance with ASTM C94.

B. The batch plant used to supply concrete for this project shall meet the following requirements:

1. Weight Hoppers - The plant shall have separate weight bins for cement and aggregate.

2. Scales - Shall measure the actual weight within an accuracy of 0.1 percent of full scale or one graduation, whichever is less. Scales shall be sealed annually by the Official Sealer of Weights and Measures.

3. Heating and Cooling of Materials

   a. In cold weather, the batch plant shall be equipped to heat aggregates and water to produce concrete delivery temperatures at the project site in the range of 65 to 90 degrees F, taking into account air temperatures and site protection. Aggregates shall not contain ice or have frozen lumps nor shall they be heated to a temperature over 120 degrees F.
b. In warm weather, the batch plant shall be equipped to cool water with ice, and cool aggregates by shading and spraying with cool water, to obtain concrete delivery temperatures at the project site of no greater than 90 degrees F. The Contractor shall take into account drive time, slump loss, admixtures, flash set, etc. and reduce delivery temperatures as appropriate.

4. Moisture Content - The automated batch plant shall adjust aggregate weights dispensed based on their moisture content.

C. Mixing Methods

1. All concrete shall be ready mixed and meet the requirements of ASTM C94.

   The truck mixer shall be equipped with a water tank for carrying mixing water. Water added to the mixer shall be measured to the nearest gallon by use of a water meter. For all trucks arriving on site without an operating water meter, water shall only be added manually into the back of the truck using a calibrated container. Water carried within the truck water tank shall not be used unmetered.

   Water can be added to the mixer to attain initial slump, but only within the limits of the specified water/cement ratio. After addition of water, the concrete shall be mixed at least 30 revolutions in the mixing speed range.

   Mixers shall meet the requirements of the “Truck Mixer and Agitator Standards” Truck Mixer Manufacturer’s Bureau and shall bear their certification plate.

   Trucks shall be equipped with a revolution counting device.

2. A written delivery slip or ticket, prepared and signed by the plant operator shall be made out at the proportioning plant for each truck load batch. The delivery slip shall be given to the County Engineer as soon as the truck arrives at the job site, and each slip shall show the following information, which represents actual quantities of batched materials in each truck:

   a. Truck number.

   b. Date and time truck is batched.

   c. Ticket number.

   d. Mix designation of concrete.

   e. Cubic yards of concrete.

   f. Cement type and weight in pounds.

   g. Weight in pounds of each size and type of aggregate.

   h. Admixtures, weights in pounds and/or ounces.

   i. Moisture content of fine and coarse aggregates.

   j. Water added to the batch at the plant.

   k. Water added to the batch in transit or at the job site.
The driver and/or testing laboratory technician shall record the number of gallons of water added while in transit or at the job site. In no case shall the w/c ratio be exceeded.

Any truck delivering concrete to the job site without a delivery slip will be rejected and shall immediately depart from the job site.

3. After completion of mixing, (while in transit or a minimum of 100 revolutions) discharge may begin immediately, otherwise the mixer shall be revolved at the agitating speed.

The total time interval from when the cement makes contact with the aggregates to the completion of discharge shall not exceed 90 minutes. The County Engineer may reduce the total time limit in hot weather or under unusual conditions if unsatisfactory results are obtained.

4. Mixing at the Construction Site - If the time limits specified cannot be consistently achieved by mixing at the plant or in transit, concrete shall be mixed completely in the truck mixer following the addition of the mixing water at the point of deposition.

Trucks shall be loaded first with coarse and fine aggregates and admixtures during which time the drum may be revolved or rocked. Cement shall be added last and the drum shall remain stationary after the cement is added until water is added at the project site.

Mixing shall begin at the project site after the addition of water and shall continue for a minimum of 100 revolutions or until a uniform mix has been produced. Mixing time shall not exceed 15 minutes.

The entire load shall be discharged within 30 minutes after mixing at the Construction Site has been completed.

3.02. EMBEDMENTS IN CONCRETE

A. Embed no pipes other than electrical conduit in structural concrete.

B. Obtain approval from County Engineer for any variation from the following requirements unless shown on the Drawings. Make request in writing accompanied by suitable sketch.

1. Do not cut or displace any reinforcement.

2. Do not place conduit between concrete surfaces and reinforcement.

3. Restrict O.D. of conduit to 1/4 of slab thickness. Keep within middle half of that thickness.

4. Place parallel conduits at least 6 inches apart.

5. Conduits that cross must be bent such that they cross between 45 and 90 degrees from each other.

6. Conduits that cross can touch each other, but no more than three conduits can cross at any given location.

7. Do not embed conduit in beams.
3.03. CONCRETE PLACEMENT

A. Notify the Special Inspector, County Engineer, and testing lab a minimum of 48 hours in advance of placement to allow sufficient time for scheduling and observation of the work and for any corrective measures which are subsequently required.

B. Submit the attached “Contractor Pre-Placement Checklist” to the County Engineer for each scheduled concrete placement.

C. Preparation

1. Concrete placement shall not start until all reinforcement is secured in position, nor until the forms have been completely installed and cleaned; coated; form ties retightened; all sleeves, castings, pipe, conduits, anchors, forms for openings have been placed and anchored by the Contractor, nor until all water, snow, and ice have been removed from the space to be occupied by the concrete.

2. Finishing installation of reinforcing and finalization of formwork concurrent with starting of concrete placement is not acceptable.

D. All porous soil or concrete surfaces against which new concrete is to be placed shall be wetted down and dampened at least one hour prior to placement. Spraying from the concrete truck hose immediately prior to placement will not be considered sufficient.

E. Concrete shall be placed in accordance with ACI 302, ACI 304, and ACI 318.

F. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients.

G. Any concrete being placed shall not be allowed to free fall more than 5 feet as measured from the point of discharge to the bottom of the formed surface. All distances greater than 5 feet shall utilize elephant trunks with hoppers.

H. When placing concrete, sufficient illumination shall be provided in the interior of the forms so that the concrete, at place of deposit, is visible.

I. Concrete shall be placed and vibrated in layers not to exceed 12 inches.

J. Vibration shall be applied directly to the freshly-placed concrete by successive vertical penetrations of the vibrator. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of waterstops, reinforcement, and other fixtures.

“Pencil” vibrators shall be on hand and utilized where required.

Vibration shall be supplemented by forking or spading by hand in the corners of forms.

On floor slabs, the vibrator must not ride the form supporting the slab.

Since the duration of vibration required is dependent on the frequency, size of vibrator, and slump of concrete, the length of time must be determined in the field.

Vibrators shall not be used to move concrete laterally within the forms.

K. Place concrete continuously and at full depth of slabs (so as not to permit cold joints) between predetermined expansion, construction, and control joints.
3.04. PUMPING CONCRETE

A. Pumping Concrete - If the pump operator does not have direct visual contact with the location of concrete placement, two-way radio communications shall be provided.

3.05. CONCRETE WORK IN HOT OR COLD WEATHER

A. The Contractor shall conform to ACI 305, ACI 306, and Section 03370, Concrete Curing and Protection, when concreting during hot or cold weather.

3.06. EQUIPMENT AND HOUSEKEEPING PADS

A. The Contractor shall provide minimum 4-inch high concrete pads for all mechanical, plumbing, heating, air conditioning and electrical equipment.

B. If greater thicknesses are shown on Drawings or required by the equipment being installed, provide thickness required. Verify all sizes, locations and anchors with various Contractors.

C. If sizes are not shown on the Drawings, provide concrete pads 6 inches wider than the equipment in all directions.

D. Prior to placing concrete for housekeeping/equipment pads, use a bonding agent.

3.07. CONCRETE FINISHING

A. All flatwork concrete shall be finished immediately after placement per Section 03350, Concrete Finishes.

B. All formed concrete shall be finished after form removal.

3.08. CONCRETE CURING

A. All concrete shall be cured for a minimum of seven days (and simultaneously protected from hot or cold weather conditions). Submittals required for procedures; follow requirements of Section 03370, Concrete Curing and Protection.

3.09. INCOMPLETE STRUCTURES

A. Structures which are incomplete may not be capable of withstanding backfill, hydrostatic, surcharge, storage and other permanent or temporary loading conditions imposed during construction. Such loading conditions shall be the sole responsibility of the Contractor.

3.10. TESTING FOR QUALITY ASSURANCE

A. County shall hire and pay for the services of an independent testing laboratory to perform testing for quality assurance in accordance with this Section unless otherwise noted. This testing shall consist of materials verification, w/c ratio, temperature, slump, air content determination, weight per cubic foot of fresh concrete, and tests for the compressive strength. These test results can be used by the Contractor to supplement and assist his own quality control program.

B. Testing will be required for each placement in excess of 5 cubic yards.

C. Location of Field Tests - All sampling for field tests (cylinders, air content, slump) shall be performed at the delivery truck to allow proper correlation of the tests.
When concrete is being pumped, testing shall be performed at the pump discharge for meeting the requirements of this specification and to reflect material changes through the pump.

D. The following tests will be performed by the testing laboratory:

1. **Water/Cement (w/c) Ratio**
   a. The w/c ratio shall be calculated and recorded for each truckload of concrete delivered to the job site. This calculation shall account for all moisture in the mix including water added in transit and at the job site and moisture in both fine and coarse aggregates (adjusted for absorption).
   b. Concrete which exceeds the w/c ratio specified shall not be utilized.

2. **Temperature - Recorded for each batch of concrete delivered.**

3. **Slump tests shall be made on each batch of concrete delivered, in accordance with ASTM C143.**

4. **Air Content Test (Fresh Concrete)**
   a. Test for entrained air content in accordance with ASTM C231. Concrete which does not contain the proper amount of entrained air shall not be utilized.
   b. A minimum of two tests will be required for each day of operations. Also, at least one test shall be made for each 50 cubic yards and each class of concrete placed within a single day.
   c. In the event that test results are outside the limits specified, additional tests shall be required to show that concrete meets the specification requirements or the concrete shall not be used on this project.

5. **Unit Weight (density) of the fresh concrete shall be measured in accordance with ASTM C138. The unit weight shall be recorded at the same interval as required for air content testing as stated above.**

6. **Compressive Strength Test**
   a. Samples of concrete will be prepared and tested for compressive strength in accordance with ACI 301; ASTM C31, C39, and C172; except as modified herein.
   b. At least one sampling will be taken for each 50 cubic yards of each class of concrete placed within a single day. No more than one sampling may be taken from a single batch to satisfy this requirement.
   c. One sampling will consist of at least five (6) test cylinders. Contractor shall order additional sets of field cured test cylinders for determination of 80 percent strength gain to facilitate form removal and/or termination of cold weather protection.
   d. Each cylinder will be identified by a tag, furnished by the Contractor, which will be hooked or wired to the side of the container.
e. It is the Contractor’s responsibility that cylinders for verification of concrete quality be stored in a temperature-controlled curing box, provided by the Contractor on the construction site, for 24 hours after they have been molded and held at a temperature between 60 degrees F and 80 degrees F. Contractor shall provide high/low thermometer to verify temperature range.

f. After 24 hours, these samples will be transported to the testing laboratory and moist cured until tested. One cylinder will be tested at 7-days, three tested at 28-days, and two held in reserve for testing at 56-days as needed.

g. When field temperatures during the 24 hours immediately preceding the time of concrete placement have exceeded 90 degrees F, or have been less than 40 degrees F, or when freezing, hot weather, or other extraordinary field curing conditions are anticipated, or when requested by the County Engineer, Six (6) additional cylinders for quality verification shall be molded at each sampling for field curing periods of 5, 21, and 49-days. Field cured cylinders used for quality verification shall be tested: one at 7-days, three at 28-days, and two held in reserve for testing at 56-days as needed.

h. All field cure cylinders shall be located by the Contractor to be cured at the structure as near to the point where the sampled concrete was placed as practicable. These field cured cylinders shall receive the same protection and be subject to the same environmental conditions as that portion of structure represented.

i. Field cured cylinders shall be transported to the laboratory and stored at laboratory room temperature and conditions until testing.

j. When quality verification field cured cylinders fail to reach 85 percent of the specified compressive strength, immediately institute a program to improve field curing/protection conditions and/or mix design.

k. If the County Engineer has reason to believe that low field cured cylinder tests reflect concrete strengths in the structure, he shall have the authority to order additional tests provided for below.

l. Should the Contractor desire additional field cured cylinders to facilitate form removal, termination of cold weather protection, backfill, or any other reason, coordinate and pay the testing laboratory directly.

m. After job site storage, all concrete test cylinders shall be transported in rigid boxes specifically sized and constructed to prevent cylinders from becoming damaged from tipping, falling, rolling, or bumping.

n. After a mean value of a ratio between 7-day and 28-day strengths has been established from 10 or more samplings the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths.

o. Thereafter, should a 7-day test strength from any sampling be more than 10 percent lower than the 7-day strength which corresponds with the specified 28-day compressive strength:

1) immediately provide an additional seven days of wet curing in the affected area from which the deficient test cylinders were taken
p. From laboratory cured specimens, the strength level of concrete will be evaluated for acceptance based on criteria in ACI 301, Chapter 17. Concrete is considered satisfactory if all of the following conditions are satisfied:

1) the average of 28-day cylinder tests for any three consecutive samplings shall meet or exceed the strength required for the mix specified

2) no more than 1 of the compressive test cylinders shall have a strength less than that specified

3) no individual compressive strength test result falls below the specified strength by more than 500 psi

q. In the event that the above conditions are not met, additional tests shall be performed as outlined in the next section. Field cured specimens are not included in the above acceptance criterion. Field cured cylinder test results provide supplementary information only.

3.11. ADDITIONAL TESTS

A. When unsatisfactory test results arise, additional tests as outlined below shall be provided and paid for by the Contractor.

B. Compressive Strength - In the event that one or more standard samples represented by the average of the 28-day test cylinders fail to meet the strength requirements as outlined above, or if tests of field cured cylinders indicate the possibility of deficiencies in protection and curing, concrete core specimens shall be obtained and tested from the affected area.

C. Three cores shall be taken for each sample in which the strength requirements were not met. The drilled cores shall be obtained and tested in conformance with ASTM C42; the tests to be conducted by the Owner’s independent testing laboratory.

Coordinate locations with embedded items. Cores shall not include reinforcement.

A core specimen shall be taken perpendicular to the concrete surface and shall be taken from near the middle of a unit of deposit when possible and not near formed joints or obvious edges of a unit deposit.

The diameter of core specimens should be at least 4 inches. The length of specimen, when capped, shall be at least twice the diameter of the specimen.

The core specimens shall be carefully handled while transported to the laboratory. Cores shall be tested and evaluated in accordance with ACI 301, Chapter 17. On the same day as they are drilled, core holes shall be repaired with non-shrink grout by the General Contractor.

D. The concrete in question will be considered acceptable if the average of three core specimen compressive strength tests meet or exceed the strength required for the mix specified.

No individual strength test result shall fall below the specified strength by more than 500 psi.
E. Load Tests - If compressive strength requirements under the above procedure are not met by the results of core tests, then the County Engineer may order load tests pursuant to ACI 318. Such tests shall be at the Contractor’s expense.

F. Air Content - In the event that concrete placed by the Contractor is suspected of, or is tested and shown to not have proper air content or erratic air test results are obtained as specified above, the Contractor shall engage an independent testing laboratory to obtain and test samples for air content in accordance with ASTM C457 and to recommend modification to mix components or additives. The Contractor will be responsible for remediation to the satisfaction of the County Engineer/Owner.

3.12. REPAIR OF CONTRACTOR-CAST CONCRETE

A. Areas of concrete in which cracking, spalling, or other signs of deterioration develop during initial curing or thereafter until the end of the guarantee period shall be removed and replaced, or repaired in accordance with this Article.

B. The Contractor shall submit manufacturer’s product data sheets and recommended application procedures to the County Engineer for approval.

C. Random Cracks - Shrinkage or structural cracks exceeding the widths listed in the following table shall be repaired utilizing a low viscosity, two-component, injection system. First, lightly grind the crack surface to fully prepare and expose the extent of the crack, then remove all dust, debris or disintegrated material from crack or void by vacuuming. Injection shall be done using trained and experienced personnel utilizing modern, automated equipment. Manually operated hand pumps are not acceptable.

<table>
<thead>
<tr>
<th>In-Service Moisture Condition</th>
<th>Maximum Allowable Crack Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry air or protective membrane</td>
<td>0.016 inches</td>
</tr>
<tr>
<td>Fluid-retaining or exposed to weather and/or high humidity</td>
<td>0.012 inches</td>
</tr>
</tbody>
</table>

1. Where cracks extend through members, seal both sides. Inject in accordance with manufacturer’s recommendations. Injection system shall be either epoxy or hydrophilic urethane by Sika Corporation, Euclid Chemical Co., 3M Specified Construction Products, de neef Construction Chemicals, or equal.

2. Preparation, viscosity, and installation as recommended by the manufacturer.

D. Excessive Cracking - Concrete slabs containing an excessive amount of cracks as defined herein, and which will remain exposed, shall receive an epoxy mortar topping after sealing of cracks in accordance with the above paragraph.

Excessive cracking shall be defined as areas containing cracks averaging 0.016-inch wide or greater, and in excess of 15 linear feet of cracks per 100 square feet of slab. If cracking occurs in isolated areas of a given concrete slab, topping could only be required in the area of the cracks bounded by construction, expansion, or control joints pending County Engineer approval.

Epoxy mortar topping shall be concrete gray in color, shall be non-slip, and be applied to a minimum thickness of 1/8-inch. Proportions shall be 1 part resin to no more than 6 parts quartzite aggregate by volume. Surface preparations, priming, mixing, application and finishing
shall be in accordance with the recommendations, and under the supervision of the epoxy mortar topping manufacturer.

Contractor shall submit a suitable remedial product to the County Engineer for approval.

E. Spalls, honeycomb and/or damaged concrete shall be removed to sound concrete. For defective areas involving only the surface and/or the finish of the concrete, (less than 1 ½ inches deep) reference Section 03350, Concrete Finishes, for surface repairs.

For spalls involving depths generally more than 1 1/2 inches deep, utilize a polymer-modified cementitious repair mortar by Sika Corporation, Euclid Chemical Co., or equal.

Surface preparation, mixing, priming and application shall be in conformance with manufacturer’s recommendations. If a dry surface cannot be obtained, the Contractor shall submit a suitable remedial product to the County Engineer for approval.

F. Substrength Concrete

1. Concrete which fails to meet the strength requirements as outlined above in Additional Tests, will be analyzed by the County Engineer as to its adequacy based upon design loading and exposure conditions for the particular area of concrete in question.

2. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at his expense. The method of strengthening or extent of replacement shall be as defined by the County Engineer.

3. Concrete not requiring strengthening but still falling below the strength requirements, may be accepted by the County at the County's sole discretion and in accordance with the Contract.

G. Inadequate Air Content - Concrete which will be exposed to freeze-thaw cycles when in service, and which is found to have inadequate air content, shall be replaced to the extent defined by the County Engineer.

(Continued)
# CONTRACTOR PRE-PLACEMENT CHECKLIST
Mattawoman WWTP BFP Replacement

## Notification to Owner/County Engineer of Scheduled Placement
(minimum 48 hours in advance)

<table>
<thead>
<tr>
<th>Person Notified</th>
<th>Date</th>
<th>Time</th>
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<table>
<thead>
<tr>
<th>Date Scheduled for Placement</th>
<th>A.M. / P.M.</th>
<th>Time Scheduled for Placement</th>
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<table>
<thead>
<tr>
<th>Estimated Quantity of Concrete to be Placed</th>
<th>Cubic Yards</th>
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## Planning Information

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<th>Location</th>
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## Additional Description

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<table>
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<th>Finish Requirements</th>
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<th>Curing Procedures</th>
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<th>Special Requirements</th>
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## Pre-Placement Inspection
(circle or check-off all that apply and have been verified as ready)

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<tr>
<th>Imbeds in Place</th>
<th>Electrical</th>
<th>Mechanical</th>
<th>Plumbing</th>
<th>Sleeves</th>
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<tr>
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<th>Plumb, square, in tolerance verified</th>
<th>Form Ties - correct quantity and secure</th>
<th>Dimensions</th>
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<th>Fastened, supported</th>
<th>Welded</th>
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<th>Correct cover</th>
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<th>Hoses</th>
<th>Vibrators</th>
<th>Floats</th>
<th>Weather Protection</th>
<th>Curing</th>
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## Additional Remarks:

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## CONTRACTOR SIGNATURE

| __________________________ |
| __________________________ |

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END OF SECTION
PART 1 GENERAL

1.01. SECTION INCLUDES

A. Concrete finishes.
B. Sealing of concrete floors.
C. Plugging of tie holes and patching of surface defects.

1.02. REFERENCES

A. The publications listed below form a part of this Specification.
   1. American Society for Testing and Materials (ASTM) - ASTM C309, Liquid Membrane-Forming Compounds for Curing Concrete (note limited use on this project).

1.03. SUBMITTALS

A. Submit product data and manufacturer’s installation instructions for the following:
   1. Floor sealant (Type E).
   2. Plug mortar for tie holes.
   3. Patching mortar for minor surface defects.
B. Submit copy of ACI certification and/or experience record for the contractor performing the work.
C. Upon the completed installation of the liquid hardener, submit either the manufacturer’s warranty or letter from manufacturer approving the installation and confirming the extended warranty is in effect.

1.04. QUALITY ASSURANCE

A. Finishing foreman shall have ACI training and certification for concrete finishing and/or a minimum of five years’ experience as a finishing concrete foreman.

PART 2 PRODUCTS

2.01. MATERIALS

A. Floor sealer (Type E) shall be BASF Chemical Company “Kure-N-Seal,” The Euclid Chemical Company “Super Aqua Cure Vox,” Sika Corporation “Sikagard 701W,” or equal.
B. Plug mortar shall be a fast-setting hydraulic cement compound that can immediately stop running water or seepage leaks in concrete. Use BASF Chemical Company “Waterplug,” The
Euclid Chemical Company “Speed Plug,” L&M Construction Chemicals, Inc. “Duraplug,” or equal.

C. Patching Mortar mix design shall consist of 1 part Portland cement and 1-1/2 parts sand mixed to a thin masonry mortar consistency.

The sand and the Portland cement shall be obtained from the concrete batch plant where the concrete was purchased and shall be the same as used in the concrete.

D. Repair Mortar for deep surface repairs (greater than 1-1/2 inches deep) in new construction is specified in Section 03300, Cast-in-Place Concrete.

PART 3 EXECUTION

3.01. CONCRETE FINISHES

The finish of all walls shall be described below and in accordance with the schedule at the end of this section. Exposed tops of walls shall be finished, as described under slab and floor finishes.

A. As-Cast Wall Finishes

1. Type I - Rough Form Finish - No select form facing materials shall be specified for rough form finish surfaces. Tie holes shall be filled with Plug Mortar. Honeycomb and other surface defects up to 1-1/2 inches deep shall be filled with Patching Mortar. Deeper repairs shall be accomplished using approved concrete repair mortar as specified in Section 03300, Cast-in-Place Concrete. Fins exceeding 1/4 inch in height shall be removed. Otherwise, surfaces shall be left with the texture imprinted by the forms.

2. Type II - Smooth Form Finish - The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other approved material. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used.

The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection (see Section 03100, Concrete Formwork, for tolerances).

Tie holes shall be plugged and surface defects shall be patched as specified under Type I finish. All fins and irregularities shall be completely removed by grinding.

B. Rub Wall Finish - The following finish shall be produced on concrete with a Type II smooth form finish. Two foot wide modular panel form systems are not allowed on walls to receive a rub finish. reference Section 03100, Concrete Formwork. Where a rub finish is to be applied, the forms shall have been removed and necessary patching completed as soon after placement as possible without jeopardizing the structure and taking into account the required concrete strength gain, curing, and protection requirements. Reference Section 03370, Concrete Curing and Protection.
1. **Type IV - Rub Finish** - Concrete which has required less than seven days to gain adequate strength for form removal; forms shall be immediately removed. Maintain curing and protection during the finishing operations.

   a. Wet curing can be briefly interrupted for finishing as long as the concrete is not allowed to surface dry. Contractor shall be prepared to re-wet every 15 minutes or more often as needed (during periods requiring winter protection and heated enclosures, special attention shall be paid to avoid freezing water conditions both on the wall and around the site due to water runoff. Walls shall be moistened and covered tightly with poly immediately after form removal, followed by continuation of winter protection requirements).

   b. The rub finish shall be applied no later than the day following form removal (green concrete maximum seven days old). Surfaces shall be wetted and rubbed until uniform color and texture are produced.

   c. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process.

   d. The applicator shall use a carborundum brick or specialty power tool to vigorously work the wall surface in a circular motion to a smooth uniform finish.

   e. It is not intended to leave a thin mortar coating, “swirl,” or “fan” pattern visible on the wall.

   f. Should the surface start to dry out or get too stiff to work, the applicator shall re-wet the wall with either a pump or brush.

   g. When the area is complete, it will be smooth and dark to medium grey in color. The smooth surface will be equal to a medium grade of sand paper with no “bugholes,” globs, or excess material remaining.

   h. When viewed from a distance about 20 to 30 feet, the concrete will appear to be a uniform grey, creamy smooth surface.

   i. During periods requiring winter protection, immediately re-moisten the wall, tightly cover with poly, and continue curing and winter protection.

2. **Type V - Rub Finish** - Concrete which has required more than seven days to gain adequate strength for form removal; forms shall be immediately removed. Curing and protection are generally complete. (During periods requiring winter protection and heated enclosures, special attention shall be paid to avoid freezing water conditions both on the wall and around the site due to water runoff. Walls shall be moistened and covered tightly with poly immediately after form removal. Continuation of winter protection requirements is required during the finishing process.)

   a. The rub finish shall be applied no later than the day following form removal.

   b. Large areas more than 12 feet high or 24 feet long shall be marked off with chalk lines to produce a uniform overall pattern.

   c. The surface shall be soaked with water. The surface being worked on shall not be in the direct sunlight while finishing. Curing in direct sunlight is acceptable.
d. Immediately after soaking, apply the patching mortar mix with a rubber or cork float. The material is spread to form a thin paste over the area being worked on.

The applicator shall always work to a wet edge.

If the area starts to visually lighten up or dry, water can be added by shaking a wetted brush or using a pump sprayer to moisten the surface.

The coated area shall be permitted to set similar to waiting for a concrete floor to set.

e. The applicator shall use a carborundum brick or specialty power tool to vigorously work the material in a circular motion to a smooth rub finish.

f. It is not intended to leave a thin mortar coating, “swirl,” or “fan” pattern visible on the wall.

g. Should the mixture start to dry out or get too stiff to work, the applicator may re-wet the wall with either a pump or brush.

h. When the area is complete, it will be smooth and dark to medium grey in color. The smooth surface will be equal to a medium grade of sand paper with no “bugholes,” globs, or excess material remaining.

i. When viewed from a distance about 20 to 30 feet, the concrete will appear to be a uniform grey, creamy smooth surface.

j. Mortar rubbed walls shall be further cured by immediately spraying the surface with a clear liquid curing compound or a wet cure shall be maintained as specified in Section 03370, Concrete Curing and Protection, for an additional three days. (During periods requiring winter protection, immediately spray with a clear liquid curing compound or re-moisten the wall and tightly cover with poly; followed by continuation of winter protection for three days.)

C. Slab and Floor Finishes - The finish of all floors, slabs and tops of walls shall be described below and in accordance with the schedule at the end of this section. Reference Table 03350-1 at the end of this section for floor finishing tolerances

1. **Type B - Float Finish** - The procedure for a float finish is the same as for Type A – Scratch Finish up to roughening the surface.

   The slab is floated, with all high spots cut down and all low spots filled to produce a surface with a Class B tolerance. The slab shall be finish floated to a uniform sandy texture.

   Tops of walls shall be finished with a Type B – Float Finish, except initial floating shall be followed immediately with a light trowel, being careful not to trowel in bleed water. If bleed water is present, Contractor shall wait for its evaporation before applying trowel finish.

2. **Type C - Trowel Finish** - The surface shall first receive a Type B - Float Finish. It shall next be power troweled, and finally hand troweled for thorough consolidation. The first troweling after power troweling shall produce a smooth surface which is relatively free
of defects but which may still show some trowel marks. Additional troweling shall be done by hand after the surface has hardened sufficiently.

Apply only a light power trowel finish to slabs intended as walking surfaces prior to applying Broom Finish. Do not over power trowel; which can sometimes leave burn marks or irregularities in the concrete. These areas can be final troweled by hand.

The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface.

The finished surface shall be essentially free of trowel marks, uniform in texture and appearance and shall be plane to a Class A tolerance, except tolerance for concrete of tankage base slabs shall be to a Class B tolerance.

3. Type D - Broom Finish - First, finish the concrete with a Type B - Float Finish. After any bleed water has evaporated, the concrete shall be given a transverse scored texture by drawing a fine broom across the surface, perpendicular to the line of travel along the walking surface.

4. Type E - Concrete Floor Sealant - All exposed to view floor slabs, sidewalks, landings, etc. not scheduled to receive other coatings or coverings, shall be sealed as follows:
   a. Prior to applying floor sealant, thoroughly clean the concrete surface.
      1) Remove all dirt, oil, grease, and other foreign matter with caustics and detergents as needed.
      2) Use a high pressure power water blast to thoroughly rinse and leave a uniform appearance.
   b. Apply two coats of sealer in accordance with manufacturer’s recommendations.
      1) The first coating shall be applied as soon as possible after finishing and curing. The second coating shall be applied near project completion after installation of all equipment and piping and after completion of other related construction activities.
   c. Application procedure shall be in accordance with manufacturer’s instructions. Consult with the manufacturer in order to obtain the extended warranty.

D. Finish Schedules
   1. Floor Finishes - See Table 03350-1 for tolerances and Table 03350-3 for finish types at the end of this section.
   2. Wall Finishes - See Table 03350-2 at the end of this section.

3.02. TIE HOLES AND SURFACE DefECTS

A. General - Repair Contractor-cast concrete, including tie holes and surface defects less than 1-1/2 inches deep (honeycomb, pits, and other defective concrete areas greater than 1 square inch or 1/4 inch depth).

B. Tie holes shall be filled with specified Plug Mortar.
C. Surface defects less than 1-1/2 inches deep shall be removed down to sound concrete. If chipping is necessary, the edges shall be saw cut in a neat rectangular pattern, perpendicular to the surface or slightly undercut. No featheredges will be permitted.

1. The area to be patched and an area at least 6 inches wide surrounding it shall be dampened to prevent absorption of water from the Patching Mortar.

2. The quantity of mixing water shall be no more than necessary for handling and placing.

3. After surface water has evaporated, the Patching Mortar shall be applied.

4. The mortar shall be consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for approximately one hour before being finally finished.

5. The patched area shall be cured using a liquid curing compound. Metal tools shall not be used in finishing a patched area which will be exposed. Exposed surfaces shall be left uniform in appearance. Patching shall be completed prior to application of other specified surface finishes.

D. Surface defects greater than 1-1/2 inches deep shall be repaired per Section 03300, Cast-in-Place Concrete.

**TABLE 03350-1 - FLOOR FINISHING TOLERANCES**

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>Trowel finish including toppings shall be true planes within 1/8-inch in 10 feet, as determined by a 10-foot straightedge placed anywhere on the slab in any direction.</td>
</tr>
<tr>
<td>Class B</td>
<td>Float finish shall be true planes within 1/4-inch in 10 feet, as determined by a 10-foot straightedge placed anywhere on the slab in any direction.</td>
</tr>
<tr>
<td>Class C</td>
<td>Scratch finish and concrete fill shall be true planes within 1/4-inch in 2 feet, as determined by a 2-foot straightedge placed anywhere on the slab in any direction.</td>
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</tbody>
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**TABLE 03350-2 - WALL FINISHES**

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<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Rough Form Finish - All concrete not exposed to view. Below-grade, backfilled walls not receiving waterproofing or insulation.</td>
</tr>
<tr>
<td>Type IV or V (Exterior)</td>
<td>Rub Finish - Exterior exposed-to-view above grade wall areas. This finish shall be carried to a minimum of 6 inches below finished grade.</td>
</tr>
<tr>
<td>Type IV or V (Interior)</td>
<td>Rub Finish - Interior exposed-to-view curbs, equipment supports/pads, and housekeeping pads.</td>
</tr>
</tbody>
</table>

**TABLE 03350-3 - FLOOR FINISHES**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type B</td>
<td>Float Finish - at tops of walls and surfaces to receive a Type D - Broom Finish.</td>
</tr>
<tr>
<td>Type C</td>
<td>Trowel Finish - for general walking surfaces</td>
</tr>
<tr>
<td>Type D</td>
<td>Broom Finish (Preceded by a Type B – Float Finish) – for sidewalks and concrete landings.</td>
</tr>
<tr>
<td>Type E</td>
<td>Concrete Floor Sealant - for interior and exterior exposed to view slabs, sidewalks, and landings.</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 GENERAL

1.01. SECTION INCLUDES
   A. Curing and protection for all concrete slabs, beams, walls, and columns during:
      1. Normal weather conditions.
      2. Hot weather conditions.
      3. Cold weather conditions.
   B. Limited use of curing compound.

1.02. REFERENCES

   The publications listed below form a part of this Specification.

   A. American Concrete Institute
      1. ACI 305R - Hot Weather Concreting
      2. ACI 306R - Cold Weather Concreting
      3. ACI 308R - Guide to Curing Concrete
   B. American Society for Testing Materials
      1. ASTM C171 - Sheet Materials for Curing Concrete
      2. ASTM C309 - Liquid Membrane Forming Compounds for Curing Concrete

1.03. SUBMITTALS

   A. Prior to placement of any concrete, submit an outline indicating various curing and protection
      methods and procedures intended for use on this project during each of the following
      conditions:
      1. Normal weather conditions.
      2. Hot weather conditions.
      3. Cold weather conditions.
      Include procedures for slabs, beams, walls, columns, and footings.
   B. Submit single-page catalog cut for curing compound with fugitive dye specifically indicated.
   C. Submit single-page catalog cut for polyethylene film with material selection specifically
      indicated.
1.04. **COORDINATION**

A. Coordinate curing, protection, and rub wall finish to occur simultaneously as specified in Section 03350, Concrete Finishes.

B. The Contracting Officer and/or County Engineer shall make final determination of when hot weather or cold weather curing and protection requirements are in effect.

**PART 2 PRODUCTS**

2.01. **CURING WATER**

A. Water shall be potable.

B. Water shall be free of materials that have the potential to stain concrete.

2.02. **CURING COMPOUNDS**

A. Curing compound shall be a dissipating, VOC-compliant, water-based, liquid membrane-forming, including a fugitive dye, and conforming to ASTM C309, Type 1-D.


B. Curing compound shall be applied at twice the manufacturer’s recommended application rate.

2.03. **POLYETHYLENE FILM**

A. Polyethylene film shall be white (opaque) and shall meet the requirements of ASTM C171.

B. Polyethylene film used on this project shall be maintained in like new condition or shall be replaced. The Owner’s representative shall have the final decision when film condition becomes unacceptable.

2.04. **ADMIXTURES**

A. Accelerating admixtures associated with cold weather concrete are not allowed.

**PART 3 EXECUTION**

3.01. **PREPARATION**

A. All freshly placed concrete shall be protected from adverse weather and from defacement. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provisions shall be made for providing continuous curing and protection as required below.

3.02. **NORMAL WEATHER CURING AND PROTECTION**

A. Definition of Normal Conditions - All conditions not defined as either hot or cold weather.

B. Slabs, Beams, Curbs, Sidewalks, Toppings, and Other Flatwork
1. After finishing and immediately after the concrete surface has hardened enough to prevent dilution of the cement paste, provide continuous moist curing for at least the first 24 hours.

2. After the initial 24-hour period, cure for an additional six days with one of the following methods:
   a. Cover with waterproof paper.
   b. Cover with white polyethylene.
   c. Cover with burlap and continuous sprinkling with water.
   d. Continuous water soaking with no covering.

C. Strip Footings (Note: Strip footings include footings of foundation (frost) walls and retaining walls.)
   1. After finishing, apply curing compound at twice the manufacturer's recommended application rate.
   2. Curing compound shall be applied to and seamlessly cover all exposed surfaces.

D. Interruptions, not to exceed a total of four hours are permitted for the purpose of layout, shoring, finishing, or other required construction needs as long as the surface is not allowed to completely dry. Be prepared to spray the exposed surface every 15 to 30 minutes.

3.03. HOT WEATHER CURING AND PROTECTION

A. Conform to ACI 305R when concreting during hot weather except as modified below.

B. Definition of Hot Weather – When combinations of high air temperature, low relative humidity, and wind speed have the potential to cause the concrete to reach the critical evaporation rate (0.15 lbs/ft
\(^2\)/h), the Contractor and his concrete supplier shall exercise precautionary measures in preparing, delivering, placing, finishing and curing of the concrete.

The Owner's representative and/or County Engineer shall determine if hot weather conditions are in effect in accordance with ACI 305R. Note that it is possible to have hot weather conditions with air temperatures as low as 65 degrees F if low humidity and moderate wind speeds (as slow as 10 mph) exist. By default, when air temperatures exceed 80 degrees F, regardless of relative humidity levels and wind speed, hot weather conditions shall be in effect.

C. Curing of the concrete shall begin immediately after completion of the initial finishing operation.

D. Slabs, Beams, and Other Flatwork - After the initial 24-hour period of moist curing, continue wet cure for an additional six days with one of the following:
   1. Soak with water and cover with white polyethylene.
   2. Cover with burlap and continuous sprinkling with water.

E. Strip Footings and Isolated Column Footings (Note: Strip footings include footings of foundation (frost) walls and retaining walls.)
1. After finishing, apply curing compound at twice the manufacturer’s recommended application rate.

2. Curing compound shall be applied to and seamlessly cover all exposed surfaces.

3. After applying curing compound, completely cover the concrete with either waterproof paper or white polyethylene.

F. Interruptions, not to exceed a total of four hours are permitted for the purpose of layout, finishing, or other required construction needs as long as the surface is not allowed to completely dry. Be prepared to spray the exposed surface every 15 to 30 minutes.

3.04. COLD WEATHER CURING AND PROTECTION

A. Conform to ACI 306R when concreting during cold weather except as modified below.

B. Definition of Cold Weather - A period when the air temperature in the shade and away from artificial heat drops to 40 degrees F or lower at the time of concrete placement or at any time within the curing and protection period specified herein. When temperatures above 50 degrees F occur during more than half of any 24-hour period, the concrete shall no longer be regarded as cold weather concrete. The Owner’s representative shall monitor daily temperatures for determination of start and stop of cold weather concreting.

C. Methods of curing and protecting the concrete shall be such as will prevent drying. Labor, equipment, and materials necessary for cold weather curing and protection (including heating) shall be on site and set up (staged) in sufficient quantity before concrete placement begins.

D. Concrete must be cured and protected from cold weather simultaneously.

E. Curing and Protection

1. Slabs, beams, footings, and other flatwork shall be cured with one of the following:
   a. Coat with curing compound applied at twice the recommended manufacturer’s application rate, or
   b. Cover with polyethylene.

2. Walls and columns shall have forms left in place, tight for at least the first 24 hours and until field cured test cylinders show 80 percent strength gain. Apply twice the application rate of curing compound to the exposed top surface or cover with polyethylene. After the initial 24-hour period, cure for an additional six days with one of the following. (Note: Coordinate with rub wall finish requirements.)
   a. Leave forms in place, tight as above.
   b. Only after the field cured test cylinders show that the concrete has attained at least 80 percent of the required strength, forms can then be loosened and immediately removed;
      1) Apply curing compound at twice the manufacturer’s recommended application rate to all surfaces, or
      2) Cover tightly with polyethylene.
3. Protection shall proceed as follows:
   a. For Flatwork (Slabs, Beams, Toppings, Concrete Fill, Footings, Etc.)
      1) Cover with blankets and/or heated enclosure as required.
   b. For Walls and Columns (Note: Extra effort will be required to prevent freezing when using water to complete rub wall finishing.)
      1) Forms Left in Place, Not Loosened - Cover with blankets and/or heated enclosure as required.
      2) (Concrete has attained 80 percent strength) Forms Are Removed And Protection Period Ends

4. The length of the protection period for each type of member shall be as determined in the table below.

<table>
<thead>
<tr>
<th>Type Of Member</th>
<th>Service Category</th>
<th>Temperature Range</th>
<th>Type I or II Cement (Days)</th>
<th>Type III Cement (Days)(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill concrete</td>
<td>2</td>
<td>50°F – 70°F</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Slab-on grade</td>
<td>3</td>
<td>50°F – 70°F</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Slab-on metal deck</td>
<td>3</td>
<td>50°F – 70°F</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Walls(2)</td>
<td>3</td>
<td>50°F – 70°F</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Walls(2)</td>
<td>4(5)</td>
<td>50°F – 70°F</td>
<td>21(5)</td>
<td>14(5)</td>
</tr>
<tr>
<td>Beams</td>
<td>4(4)</td>
<td>50°F – 70°F</td>
<td>21(5)</td>
<td>14(5)</td>
</tr>
<tr>
<td>Slabs (other)(6)</td>
<td>4(4)</td>
<td>50°F – 70°F</td>
<td>21(5)</td>
<td>14(5)</td>
</tr>
</tbody>
</table>

(1) Obtain written approval by the County Engineer for the use of Type III cement.
(2) Walls that will not be service loaded (water tested or backfilled) for at least 60 days after placement.
(3) Walls that are to be service loaded soon after concrete placement.
(4) Formwork shall remain in place until the end of the protection period for Service Category 4 structural members.
(5) Protection period could be shortened based on concrete achieving at least 80 percent of the required design strength as determined by testing of field-cured cylinders.
(6) All structural slabs supported by temporary formwork.
(7) As an alternate, cold weather protection period can be terminated when field cured test cylinders show 80 percent strength gain.

F. Suitable means shall be provided for maintaining the deposited concrete within the temperature range as defined above. Curing provisions as stated above must be in place prior to exposing concrete to heat.

Heating may be provided by using a vented heating unit, insulated blankets, or a combination of both.

1. If blankets are to be used, they should be applied to the concrete as specified in ACI 306R, Chapter 7, Charts 7.3.1–7.3.4. Special attention should be given to corners and edges of concrete members which could require about three times the thickness of insulation to maintain concrete temperature, as compared to thickness that might be required for interior spaces. Also note that excessive amounts of blankets could raise
the temperature of the concrete too high which could cause an increase of thermal shrinkage and cause cracking due to thermal shock.

2. Where heated enclosures are provided, vent flue gases from combustion heating units to the outside of the enclosure. Place and direct heaters to avoid areas of overheating or drying of the concrete surface. Exposed concrete surfaces must be protected and cured. Where continuous moist curing is not practical, tightly adhered polyethylene or curing compounds shall be used.

G. Monitoring of Concrete Temperatures

1. In order to adjust and maintain cold weather procedures, various thermometers (supplied and maintained by the Contractor) shall be placed along concrete members that are undergoing cold weather protection, particularly at corners and edges of concrete members where it is more difficult to maintain the required temperature.

2. Monitoring of these temperatures must be done throughout the day, taking into account forecasted night conditions. Make timely adjustments to maintain an even temperature.

At a minimum, temperatures shall be recorded at start of work in the morning, at noon, and at end of work day (but early enough to have time to make necessary adjustments to cold weather protection).

3. Access to these thermometers must be made available for the Owner’s representative to perform spot-checking of the Contractor’s effectiveness to achieve proper cold weather protection.

4. Provide the proper type and sufficient quantity of thermometers to determine the temperature of the concrete. As a minimum, provide, locate, and maintain at least one Hi-Low thermometer and at least two surface thermometers for each placement of concrete which is simultaneously undergoing cold weather curing and protection.

H. Interruptions to Protection

1. Measures shall be taken to assure the concrete temperatures will not drop below 32 degrees F.

2. Interrupted time must be made up in accordance with ACI 306R, Section 7.7. Time lost from required period of protection shall be made up with twice the number of lost degree hours.

I. After the required protection period listed in the above table, concrete shall have curing coverings removed and be allowed to gradually dry out prior to lowering temperatures to freezing as described in the following table.
### Maximum Concrete Temperature Drops At End Of Protection Period

<table>
<thead>
<tr>
<th>Thickness Of Section, Inches</th>
<th>Maximum Gradual Decrease In Surface Temperature During Any 24 Hours After End Of Protection, °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 12</td>
<td>50</td>
</tr>
<tr>
<td>12 to less than 36</td>
<td>40</td>
</tr>
<tr>
<td>36 to 72</td>
<td>30</td>
</tr>
<tr>
<td>Greater than 72</td>
<td>20</td>
</tr>
</tbody>
</table>

J. Complete removal of curing compounds will be required prior to application of coatings or other toppings. A light abrasive blast or other mechanical means will be required.

END OF SECTION
SECTION 03600
GROUT

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Non-shrink grout for setting of equipment, precast units, and baseplates.

1.02. REFERENCES

The publications listed below form a part of this Specification.

A. American Concrete Institute

<table>
<thead>
<tr>
<th>ACI 304</th>
<th>Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI 305R</td>
<td>Hot Weather Concreting</td>
</tr>
<tr>
<td>ACI 306R</td>
<td>Cold Weather Concreting</td>
</tr>
<tr>
<td>ACI 309</td>
<td>Practice for Consolidation of Concrete</td>
</tr>
</tbody>
</table>

B. American Society for Testing and Materials

<table>
<thead>
<tr>
<th>ASTM C31</th>
<th>Method of Making and Curing Concrete Test Specimens in the Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C109</td>
<td>Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)</td>
</tr>
<tr>
<td>ASTM C143</td>
<td>Test Method for Slump of Portland Cement Concrete</td>
</tr>
<tr>
<td>ASTM C150</td>
<td>Portland Cement</td>
</tr>
<tr>
<td>ASTM C1019</td>
<td>Standard Method of Sampling and Testing Grout</td>
</tr>
<tr>
<td>ASTM C1107</td>
<td>Packaged Dry, Hydraulic-Cement Grout (Non-shrink)</td>
</tr>
</tbody>
</table>

1.03. SUBMITTALS

A. Submit single-page catalog cuts for proposed products.

PART 2 PRODUCTS

2.01. GROUT

A. Non-Shrink Grout - Shall be a flowable, non-staining, cement-base product, manufactured premixed, requiring only the addition of water or latex mix solution as supplied by the grout manufacturer at the job site.

1. For supporting smaller equipment of 10 HP or less, use non-shrink grout with a minimum strength of 5000 psi at 28 days with a fluid consistency. Also use for setting of precast sills, etc.

2. For support of heavy equipment or other large loads, and when stresses from vibrations are involved or when equipment will be subject to thermal movement, use grout specifically manufactured for such applications.
Provide County Engineer with manufacturer’s certification for the use intended, including 2-inch by 2-inch grout cube strength tests in accordance with ASTM C109. Grout tests shall achieve 5000 psi in 7 days and 7000 psi in 28 days with a fluid consistency.

3. Non-shrink grout shall be applicable for damp, corrosive environments.

B. Grout for patching and plugging concrete is as specified in Section 03350, Concrete Finishes.

C. Grout for reinforced masonry is as specified in Section 04300, Unit Masonry System.

D. Adhesive anchor systems used to install bolts into concrete and masonry and to install reinforcing dowels into concrete shall be as specified in Section 05505, Concrete and Masonry Anchors.

PART 3 EXECUTION

3.01. INSTALLATION

A. Prepare surfaces, mix products, and install grout per manufacturer’s instructions.

3.02. GROUT MIXING

A. When a scheduled grout placement will consist of 3 cubic yards or more, the grout shall be produced at a batch plant, not site mixed.

3.03. TESTING FOR QUALITY ASSURANCE

A. Quality assurance testing shall be conducted by the Owner with samples tagged and sent to an independent laboratory.

B. In general, testing will be conducted for each day where more than 1 cubic yard of grout is placed.

C. Coordinate 48 hours in advance with the County Engineer and testing laboratory to assure that testing can be accomplished. Provide free access to work and cooperate with the testing laboratory.

D. The following tests may be performed by the testing laboratory:

1. Slump Test - Made on each batch of grout produced, in accordance with ASTM C143. Grout which exceeds the manufacturer’s recommended slump shall not be used.

2. Compressive Strength Test

a. Samples of freshly mixed grout will be taken and tested by the testing laboratory for compressive strength in accordance with ASTM C1019 except as modified herein.

b. Each specimen will be identified by a tag, furnished by the Contractor, which will be attached to the side of the specimen.

c. It is the Contractor’s responsibility that specimens be stored in an approved storage box provided by the Contractor on the construction site for 48 hours
after they have been molded at a temperature between 60 degrees F and 80 degrees F.

d. After 48 hours, the specimens will be transported to the testing laboratory and moist cured until testing in accordance with ASTM C39. One specimen will be tested at 7 days, and two at 28 days.

e. Should a 7-day or 28-day test strength from any specimen be lower than the specified compressive strengths, the Contractor shall immediately correct the mix for the next grout placement operation. County Engineer will determine if installed grout must be replaced.

END OF SECTION
SECTION 03732
CONCRETE REPAIR

PART 1  GENERAL

1.01.  SECTION INCLUDES

A. Preparation of concrete and application of repair materials for cracks, joints, spalls, and deteriorated concrete.
B. Resealing of existing concrete joints.
C. Repair to reinforcement at saw cut concrete.

1.02.  REFERENCES

A. ASTM A615 - Deformed Steel Bars for Concrete Reinforcement.
B. AWS D1.4 - Structural Welding Code for Reinforcing Steel.

1.03.  SUBMITTALS

A. Submit single-page product data sheets (to confirm product selection) and single-page custom written outline installation instructions for proposed repair materials.
B. Do not submit catalogs.
C. Do not submit MSD sheets.
D. If Contractor elects to propose a substitute repair material manufacturer for approval, all of the above items shall be submitted for approval along with at least two references from completed projects with similar repairs. These references shall include project and name with phone numbers of the respective owner’s representative able to judge quality of the repair project.

PART 2  PRODUCTS

2.01.  MANUFACTURERS

A. Sika Corporation.
B. The Euclid Chemical Company.
C. BASF Chemical Company.
D. de neef Construction Chemicals, Inc.
E. 3M Specified Construction Products Department.
F. Or equal.

2.02.  MATERIALS
A. Concrete Repair including Spalls and Deteriorated Concrete

1. Sika Corporation Products
   a. Concrete and exposed reinforcement shall be coated with Sika Armatec 110.
   b. Concrete Loss Less Than 3 Inches Deep
      1) For vertical surfaces, use a polymer-modified repair mortar such as Sika Top 123 Plus.
      2) For horizontal surfaces (tops of walls), repair with Sika Top 122.
   c. Concrete Loss Greater Than 3 Inches Deep - Repair using cast-in-place concrete per Section 03300, Cast-in-Place Concrete.

2. The Euclid Chemical Company Products
   a. Concrete and exposed reinforcement shall be coated with Duralprep A.C. rust inhibitor primer.
   b. Concrete Loss Less Than 3 Inches Deep
      1) For vertical surfaces, use a polymer-modified repair mortar such as Duraltop Gel.
      2) For horizontal surfaces (tops of walls), repair with Duraltop Fast Set.
   c. Concrete Loss Greater Than 3 Inches Deep - Repair using cast-in-place concrete per Section 03300, Cast-in-Place Concrete.

3. BASF Chemical Company Products
   a. Concrete and exposed reinforcing steel shall be coated with Emaco P24.
   b. Concrete Loss Less Than 3 Inches Deep
      1) For vertical surfaces, use a polymer-modified repair mortar such as HB2 Repair Mortar.
      2) For horizontal surfaces (tops of walls), repair with HB2 Repair Mortar.
   c. Concrete Loss Greater Than 3 Inches Deep – Repair using cast-in-place concrete per Section 03300, Cast-in-Place Concrete.

4. Or equal.

B. Vertical or Horizontal Surface Concrete Cracks, Dry and Not Leaking

1. Sika Corporation Products - Use Sikadur 35, Hi-Mod LV epoxy resin injected into the crack with Sikadur 31 used as an exterior seal.

2. The Euclid Chemical Company Products - Use Duralith LV epoxy resin injected into the crack with Duralcrete Gel used as an exterior seal.
3. BASF Chemical Company Products - Use Concresive Standard LVI epoxy resin injected into the crack with Concresive Paste SPL used as an exterior seal.

4. Or equal.

C. Vertical or Horizontal Surface Concrete Cracks and Joints, Wet and/or Leaking

1. 3M Specified Construction Products Department - Use Scotch-Seal Chemical Grout 5610 (Gel), hydrophilic, urethane injected into the crack.

2. de neef Construction Chemicals, Inc. - Use Hydro Active Flex, hydrophobic polyurethane injected into the crack.

3. BASF Chemical Company – Use Concresive 1230 IUG, hydrophobic polyurethane injected into the crack.

4. Or equal.

D. Re-seal Existing Concrete Joints – Use a polyurethane sealant as specified in Section 03250, Concrete Joints and Accessories.

E. Repair of Saw Cut Concrete

1. Patch exposed reinforcement after saw cutting concrete with a plug mortar.

2. Plug mortar shall be a fast setting hydraulic cement compound as specified in Section 03350, Concrete Finishes.

2.03. REINFORCEMENT MATERIALS

A. Reinforcement - ASTM A615, Grade 60, deformed bars.

B. Splicing Sleeves - Mechanical wedge type; “Quick-Wedge” manufactured by ERICO Concrete Construction Products or equal.

PART 3 EXECUTION

3.01. EXTENT OF REPAIRS

A. Provide repairs for any concrete that is damaged, cut, or otherwise compromised by Contractor’s operations so that the finished facilities are structurally sound, consistent in appearance, and matching or exceeding the condition of the corresponding facilities prior to the start of construction.

3.02. EXAMINATION

A. Contractor shall coordinate with the County Engineer to determine which areas will be repaired.

B. Verify that surfaces are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

3.03. PREPARATION
A. Concrete Repair Including Spalls and Deteriorated Concrete - Preparation

1. To remove weak, spalled, delaminated, or other unsound concrete, use a 20-lb. chipping hammer.

2. At exposed reinforcing steel, abrasive blast to remove rust. Remove enough concrete around reinforcing bars to provide access. Splice in new reinforcing if section loss is more than 15 to 25 percent. At top of wall repairs, where removed concrete is 2 inches and greater, install a 4 X 4 – W2.0 X W2.0 welded wire reinforcing with 2 inch top cover.

3. Abrasive blast all concrete areas to be repaired to obtain surface profile as recommended by product manufacturer.

4. Saw cut as required to avoid feather edge of repair material and to provide a neat finished appearance.

5. Use high pressure water to clean areas prior to repairs.

B. Vertical or Horizontal Surface Concrete Cracks, Dry and Not Leaking – Preparation - While tanks are empty, random shrinkage or structural cracks that could possibly leak shall be repaired utilizing a low viscosity, 100 percent solids, two-component epoxy resin system. Remove all dust, debris or disintegrated material from crack or void by grinding followed by use of oil-free compressed air, vacuuming, or by other approved methods as may be required by manufacturer.

1. Crack or void must be dry at time of application.

2. Patching of vertical wall cracks shall be accomplished by epoxy pressure injection, as recommended by the repair materials manufacturer.

3. Provide temporary entry ports spaced to accomplish movement of fluids between ports. Limit port size diameter to be no greater than the thickness of the crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

4. After successful crack repair, continue wall preparation by grinding to remove excess injection material and surface seal. Blend wall finish with surrounding area.

C. Vertical or Horizontal Surface Concrete Cracks and Joints, Wet and/or Leaking – Preparation - Leaking cracks shall be repaired utilizing a low viscosity, hydrophobic, closed cell polyurethane foam injection system.

1. Lightly grind crack surface to remove efflorescence and to expose/open up the face of the crack.

2. Starting 6 inches away from the crack, drill injection holes at 45 degrees to intersect the crack at a minimum 6 inches deep from the crack surface.

3. Provide temporary entry ports in these drilled holes spaced 12 to 18 inches or as required to accomplish movement of fluid between ports. Provide temporary seal at concrete surface to prevent leakage of injected material.

4. Inject water into the crack to thoroughly flush out the crack to remove dirt, dust, and contaminants. Follow flush water by injecting polyurethane foam.
5. After successful crack repair, continue wall preparation by grinding to remove excess injection material and surface seal. Blend wall finish with surrounding area.

D. Re-seal Existing Concrete Joints – Preparation - At walls and slabs, grind and/or abrasive blast to clean previously sealed concrete joints of any old sealant and to abrade the surface to promote good bond of the new sealant.

E. Repair of Saw Cut Concrete – Preparation - At exposed ends of steel reinforcement, grind, chip concrete, or cut out steel by whatever means to create a minimum 1-inch deep pocket to receive repair mortar.

F. Repair reinforcement by welding new bar reinforcement to existing reinforcement or by installing sleeve splices. Strength of welded and/or spliced reinforcement to exceed original.

3.04. APPLICATION

A. Concrete Repair at Spalls and Deteriorated Concrete (3 inches or less thick)
   1. Apply bonding agent to prepared surface.
   2. Follow with a polymer-modified repair product installed per manufacturer’s recommendations.
   3. Tamp into place filling voids and bring surface flush with surrounding area.
   4. Finish trowel surface to match surrounding area.
   5. Cure per manufacturer’s specifications and Section 03370, Concrete Curing and Protection.

B. Concrete Repair at Spalls and Deteriorated Concrete (greater than 3 inches thick)
   1. Apply bonding agent to prepared surfaces.
   2. Install formwork and repair using cast-in-place concrete.
   3. Vibrate/tamp into place filling voids and bring surface flush with surrounding area.
   4. Finish trowel surface to match surrounding area.
   5. Damp cure for four days minimum. Protect during cold weather per Section 03370, Concrete Curing and Protection.

C. Vertical or Horizontal Surface Concrete Cracks, Dry and Not Leaking
   1. Inject epoxy material into prepared ports under pressure using automated equipment appropriate for application.
   2. Begin injection at lower entry port and continue until fluid appears in adjacent entry port. Continue from port to port until entire crack is filled.
   3. Remove temporary seal and excess adhesive.
   4. Clean surfaces adjacent to repair and blend finish.
D. Vertical or Horizontal Surface Concrete Cracks and Joints, Wet and/or Leaking

1. Inject cleaning water followed by polyurethane foam material into prepared ports under pressure using automated equipment appropriate for application.

2. Begin injection at lower entry port and continue until fluid appears in adjacent entry port. Continue from port to port until entire crack is filled and leakage is stopped.

3. Remove temporary seal and excess foam.

4. Clean surfaces adjacent to repair and blend finish.

E. Re-seal Existing Concrete Joints – using a backer rod or tape to control application depth of the approved polyurethane sealant.

F. Repair Saw Cut Concrete – by sealing ends of exposed reinforcement. Prepare recess to a saturated, surface-dry condition and patch hole with approved plug mortar.

END OF SECTION
SECTION 04300
UNIT MASONRY SYSTEM

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Unit masonry products and accessories including, but not limited to, the following:

1. Brick veneer for cavity wall.

2. Concrete Masonry Units (CMU)
   a. Single wythe interior partitions and infills.
   b. Masonry back-up at cavity wall with brick veneer.
   c. Other CMU where proposed.

3. Factory pre-mixed mortar.


5. Reinforcement, anchorage, and accessories.

1.02. REFERENCES

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI 216.1</td>
<td>Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies</td>
</tr>
<tr>
<td>ACI 530</td>
<td>Building Code Requirements for Masonry Structures and Related Commentaries</td>
</tr>
<tr>
<td>ACI 530.1</td>
<td>Specification for Masonry Structures and Related Commentaries</td>
</tr>
<tr>
<td>ASTM A951</td>
<td>Standard Specification for Masonry Joint Reinforcement</td>
</tr>
<tr>
<td>ASTM C90</td>
<td>Standard Specification for Loadbearing Concrete Masonry Units</td>
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<tr>
<td>ASTM C91</td>
<td>Standard Specification for Masonry Cement</td>
</tr>
<tr>
<td>ASTM C140</td>
<td>Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units</td>
</tr>
<tr>
<td>ASTM C173</td>
<td>Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method</td>
</tr>
<tr>
<td>ASTM C216</td>
<td>Standard Specification Facing Brick (Solid Masonry Units Made from Clay or Shale)</td>
</tr>
<tr>
<td>ASTM C270</td>
<td>Standard Test Method for Mortar for Unit Masonry</td>
</tr>
<tr>
<td>ASTM C305</td>
<td>Standard Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency</td>
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<tr>
<td>ASTM C404</td>
<td>Standard Specification for Aggregates for Masonry Grout</td>
</tr>
<tr>
<td>ASTM C476</td>
<td>Standard Specifications for Grout for Masonry</td>
</tr>
<tr>
<td>ASTM C780</td>
<td>Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry</td>
</tr>
<tr>
<td>ASTM C979</td>
<td>Standard Specification for Pigments for Integrally Colored Concrete</td>
</tr>
<tr>
<td>ASTM C1093</td>
<td>Standard Practice for the Accreditation of Testing Agencies for Masonry</td>
</tr>
<tr>
<td>ASTM C1314</td>
<td>Standard Test Method for Compressive Strength of Masonry Prisms</td>
</tr>
<tr>
<td>ASTM C1329</td>
<td>Standard Specification for Mortar Cement</td>
</tr>
<tr>
<td>BIA</td>
<td>Brick Industry Association</td>
</tr>
<tr>
<td>NCMA</td>
<td>National Concrete Masonry Association</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters Laboratories</td>
</tr>
</tbody>
</table>

1.03. PRECONSTRUCTION SUBMITTALS

A. Obtain written approval of submittals prior to use of the materials. Submit all masonry materials and accessories as one submittal.

B. Test results required by this Section shall be from an independent laboratory employing technicians with a current “Certification in Concrete Masonry Testing” by the National Concrete Masonry Association.

1. All required data shall be dated within 24 months or less prior to the date the submittal is received by the County Engineer.

C. Provide sampling, test data, and certificates for CMU.

1. Submit ASTM C140 test reports demonstrating compliance with ASTM C90. Include the following information:

   a. Face shell and web thicknesses.
   b. Testing for water absorption.
   c. Compressive strength tests.
   d. Density.

2. Samples obtained for ASTM C140 tests shall have the same configuration, dimension, concrete mix, and curing methods as CMU proposed for use in building construction. Test results for 8 x 8 x 16 stretcher units are sufficient.

   a. Note: If current tests of identical units as those proposed for the project are not available, the Contractor will be required to have current tests performed. ASTM C140 tests for CMU require at least 28 days for completion. Contractor is responsible for having CMU produced and shall have tests scheduled and performed, so that the testing lead time does not delay the project schedule.

3. Manufacturer’s letter(s) certifying that products meet or exceed specified requirements. Letter(s) shall identify this particular project.
a. Concrete Masonry Units – Letter shall list and apply to all units on the project; i.e., stretcher, sash, corner, solid, bond beam, lintel, etc.

D. Provide test results for brick units.
   1. Submit test results per ASTM C216 and ASTM C67 for the following:
      a. Grade of brick units.
      b. Initial rate of absorption.
      c. Testing for water absorption.
      d. Dimensional tolerances.
   2. Samples used in ASTM C67 tests shall have the same composition, method of manufacture, configuration, and dimension as brick proposed for use in the project.

E. Provide samples of clay brick.
   1. Samples are to be in the form of industry standard sample boards, with approximately 15 thin brick faces mounted on heavy cardboard, arranged in a running bond pattern.
   2. Samples are to represent the range color and texture variations to be expected in the proposed brick.

F. Factory Premix Mortar
   1. For each type of mortar that is proposed for use in the project, submit test results from a certified laboratory demonstrating that the mortar mix meets the property specification requirements of ASTM C270.
   2. Test methods shall be as prescribed by Section 6 of ASTM C270.
   3. Test report shall show:
      b. Water retention from ASTM C1506.
      c. Air content from ASTM C91.

G. Provide test data for grout mix. Submit the following data per ASTM C1019:
   1. List amount of mix ingredients.
      a. Cement.
      b. Hydrated lime.
      c. Fine aggregate.
      d. Coarse aggregate.
e. Water.
f. Admixtures (if proposed).

2. Slump test of grout.

3. Type and number of units used to form mold for specimens.

4. Compressive strength tests.

H. Provide manufacturer’s product data sheets for all products listed herein. Product data sheets shall be clearly marked up by Contractor indicating selected items. Mark the relevant item description, model number, material type, size, etc. as appropriate for the type of product.

I. Provide banded stacks (minimum five-brick stack) of actual samples of proposed products where matching to existing adjacent facilities. A satisfactory color match shall be determined and approved by County Engineer.

1.04. QUALITY ASSURANCE

A. Perform work in accordance with ACI 530, 530.1, listed references, and this specification.

B. Where conflicts occur between current referenced publications and this specification, the more restrictive requirements shall apply.

C. Failure to detect defective work or material does not prevent later rejection.

1.05. REGULATORY REQUIREMENTS

A. Requirements for fire rated masonry construction to be determined by ACI 216.1.

1. Construct according to referenced UL design or certified assembly tested by other recognized agency.

a. Contractor may submit calculations in accordance with ACI 216.1 as an alternative to listed designs.

b. Contractor may reference prescriptive designs for fire-rated assemblies as listed section 720 of the 2012 International Building Code with Maryland Amendments.

2. Penetrations in fire rated masonry shall be firestopped with assemblies and materials rated and approved for the applicable applications.

B. Provide access to the work as needed for inspections as required by the Contract and Chapter 17 of the 2015 International Building Code with Maryland Amendments.

1.06. ENVIRONMENTAL REQUIREMENTS

A. Adhere to ACI 530.1, Part 1.8 C, “Cold Weather Construction,” when the ambient temperature or the temperature of masonry units is 40 degrees F or less.

B. Adhere to ACI 530.1 Part 1.8 D, “Hot Weather Construction,” when ambient temperature is 90 degrees F or greater.
1.07. PRE-INSTALLATION CONFERENCE
   A. Convene one week prior to commencing work of this Section. Contractor shall coordinate meeting. County Engineer shall be present to review proposed work.

1.08. DELIVERY, STORAGE, AND HANDLING
   A. Inspect masonry units for damage. Return damaged units exceeding ASTM Standards.
   B. Store to permit air circulation while preventing moisture intrusion.
   C. Factory premixed mortar accepted in unbroken, labeled packaging. Return hardened, partially set, caked, contaminated, or deteriorated materials.
   D. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

PART 2 PRODUCTS

2.01. MANUFACTURERS - CONCRETE MASONRY UNITS
   A. Allied Concrete Products, LLC, Richmond, VA
   B. Hagerstown Block Co., Hagerstown, MD
   C. Tidewater Block, LLC, Suffolk, VA
   D. Or equal NCMA member plant

2.02. CONCRETE MASONRY UNITS
   A. Hollow and Solid Load Bearing Block Units: ASTM C90, normal weight, 1900 psi compressive strength.
   B. Standard Block Units: ASTM C90, 1900 psi compressive strength - standard gray color.
   C. Standard Block Units – Size and Shape:
      1. Provide special units for 90-degree corners, bond beams, lintels, jambs and bullnose corners.
         a. Bond Beam Units: 8 inches high; combined to make multi-course assemblies. Bond beam units may be of the knock-out web type, except where undersides are exposed to view, in which case blocks must have solid bottoms.
         b. Lintel Units: 8 inches high with solid bottoms and open ends. Knock-out web units to be added as necessary to make multi-course assemblies.

2.03. MANUFACTURERS – BRICK UNITS
   A. Glen-Gery Corporation, Wyomissing, PA
   B. The Belden Brick Company, Canton, OH
2.04. BRICK UNITS

A. Face Brick – ASTM C216, Grade SW, color and texture: to match existing adjacent building.

B. Size and Shape – Nominal modular size if 4 inches wide by 2-1/4 inches high by 8 inches long. Provide special units for 90 – degree corners, lintels, and lipped.

2.05. FACTORY PREMIX MORTAR

A. Field mix mortar is not allowed.

B. Factory premixed mortar composed of mortar cement for load-bearing and reinforced masonry per Table 2 of ASTM C270, Type S property.

C. Factory premixed mortar for non-load-bearing clay masonry veneers per Table 2 of ASTM C270, Type N property.

D. Mortar Color: ASTM C979, Mineral oxide pigment; color; to match adjacent building units; manufactured by Solomon Grind-Chem Service, Inc.; Davis Colors; or approved equal.

E. Antifreeze compounds are prohibited.

F. Admixtures containing chlorides are prohibited.

G. Factory premix mortar is inclusive of all ingredients (including sand) except clear potable water for mixing. Liquid water repellant admixture per paragraph H, following may also be added in the proportions recommended by admixture manufacturer.

2. Maxi-Mix, Inc., Brampton, Ontario, Canada (888) 822-3777
3. Or equal

2.05 GROUT

A. Grout for use in concrete masonry walls shall comply with ASTM C476 and shall develop a minimum compressive strength of 3,500 psi at 28 days.

B. Fine grout shall contain only fine aggregate.

C. Coarse grout shall contain fine and coarse aggregate.

D. Aggregates shall comply with ASTM C404.

E. Allowable Grout Pour Heights
UNIT MASONRY SYSTEM

<table>
<thead>
<tr>
<th>GROUT TYPE</th>
<th>MAXIMUM GROUT POUR HEIGHT (FEET)</th>
<th>MINIMUM GROUT SPACE DIMENSIONS (IN. X IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>1</td>
<td>1-1/2 x 2</td>
</tr>
<tr>
<td>Fine</td>
<td>5</td>
<td>2 x 3</td>
</tr>
<tr>
<td>Fine</td>
<td>12</td>
<td>2-1/2 x 3</td>
</tr>
<tr>
<td>Coarse</td>
<td>1</td>
<td>1-1/2 x 3</td>
</tr>
<tr>
<td>Coarse</td>
<td>5</td>
<td>2-1/2 x 3</td>
</tr>
<tr>
<td>Coarse</td>
<td>12</td>
<td>3 x 3</td>
</tr>
</tbody>
</table>

1. Grout space dimension is the clear dimension between any masonry protrusion and shall be increased by the diameters of any horizontal bars within the grout space.

F. All grout shall be of fluid consistency with a slump of 8 to 10 inches.

G. Antifreeze compounds are prohibited.

H. Admixtures containing chlorides are prohibited.

2.06. MANUFACTURERS - REINFORCEMENT, ANCHORAGE, FLASHINGS, AND ACCESSORIES

A. Wire-Bond, Inc.; Hohmann & Barnard, Inc.; or equal.

2.07. REINFORCEMENT, ANCHORAGE, FLASHINGS, AND ACCESSORIES

A. Reinforcement, anchorage, and accessories to be as shown in the following table:

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>WIRE-BOND ITEM</th>
<th>HOHMAN &amp; BARNARD ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable Veneer Tie and Horizontal Joint Reinforcement - Ladder configuration, 9 gage cross ties spaced 16 inches O.C.; 9 gage side rods, 3/16-inch eye and pintle wires, 9 gage seismic veneer wire: stainless steel.</td>
<td>Series 800 Level Eye Ladder with plastic Seismic Clip</td>
<td>Ladder Type #270 with Seismiclip Interlock System</td>
</tr>
<tr>
<td>Adjustable Veneer Tie with offset channel slot and slot anchor</td>
<td>#1301-X channel slot with slot anchor #2103</td>
<td>Gripstay 362-CX with Gripstay slot anchor head 363</td>
</tr>
<tr>
<td>Compressible Filler for Horizontal Joints - Closed cell neoprene sponge, 1/4-inch by 2-3/4-inch minimum or other dimensions as detailed, self-adhesive backing where beneficial for ease of construction.</td>
<td>#3300</td>
<td>#NS – Closed Cell Neoprene Sponge</td>
</tr>
<tr>
<td>Compressible Filler for Vertical Joints - Closed cell neoprene sponge; thickness as detailed, width as needed to fill entire joint except for sealant depth.</td>
<td>#3300</td>
<td>#NS – Closed Cell Neoprene Sponge</td>
</tr>
<tr>
<td>Rubber Control Joint</td>
<td>#2902</td>
<td></td>
</tr>
<tr>
<td>Joint Stabilizing Anchor - Stainless steel with 3/16-inch rods, allowing movement parallel to wall.</td>
<td>#1700</td>
<td>#&quot;Slip-Set&quot; Stabilizer</td>
</tr>
<tr>
<td>COMPONENT</td>
<td>WIRE-BOND ITEM</td>
<td>HOHMAN &amp; BARNARD ITEM</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Vertical Bar Positioner – Hot Dip</td>
<td>#3403 or #3404 – Rebar Positioners</td>
<td>#RB or #RB-Twin Rebar Positioners</td>
</tr>
<tr>
<td>Galvanized 9 gage wire to position vertical reinforcement at location in grouted cells as detailed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cavity Grout Support - Fabric mesh to block flow of grout below desired elevation, 1/2-inch maximum openings in mesh; non-corrosive fibers.</td>
<td>#3612</td>
<td>#MGS- Mortar/Grout Screen</td>
</tr>
<tr>
<td>Weep and Vent Inserts - Full height of head joint, polypropylene, multiple hexagon or round tube configuration, color gray.</td>
<td>#3601 Cell Vents</td>
<td>#QV – Quadro-Vent</td>
</tr>
<tr>
<td>Mortar Drop Control Device - Staggered height plastic device designed to catch and suspend dripped mortar above weep height.</td>
<td>Cavity Net DT</td>
<td># Mortar Net</td>
</tr>
</tbody>
</table>

B. Cleaning Solutions
1. Mortar and Grout Remover by ProSo Company, Inc.
2. Efflorescence Control System by ProSo Company, Inc.
3. Or equal

C. Air and vapor barriers (AVB), adhesives, joint assemblies, flashings, end dams, sealants, and other related products shall be coordinated and selected to provide a fully integrated and functional installation. Where detailed requirements are not listed in the Contract, the existing facilities shall serve as the basis for minimum quality and performance standards.

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that field conditions are acceptable and ready to receive work.
B. Beginning of installation means installer accepts existing conditions.
C. New masonry work installed into or adjacent to existing conditions shall match existing construction unless otherwise instructed.
D. Items provided by other sections shall be properly sized and located.
E. Ensure that built-in items are in proper location, and ready for roughing into masonry work.

3.02. PREPARATION

A. Direct and coordinate placement of metal anchors or reinforcing supplied by other sections.
B. Provide bracing of masonry construction. Maintain in place until building structure provides permanent bracing.
C. Wet brick masonry units having initial absorption rates in excess of one gram per min. per square inch when measured in accordance with ASTM C67, so the initial rate of absorption will not exceed one gram per min. per in² when the units are used. Lay wetted units when surface dry. Do not wet brick masonry units having an initial absorption rate less than 0.2 grams per in².

3.03. FACTORY PRE-MIX MORTAR

A. Factory premix mortar requires strict adherence to manufacturer’s instructions and recommendations.

B. Hand mixing of mortars is not allowed.

3.04. TOLERANCES

A. Site tolerances per ACI 530.1 apply, with the following exceptions:

<table>
<thead>
<tr>
<th>Dimension of Elements</th>
<th>±1/8 in.</th>
<th>+1/8 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortar Joint Thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grout Space or Cavity Width</td>
<td>-1/4 in., + 3/8 in.</td>
<td></td>
</tr>
</tbody>
</table>

3.05. COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain courses to uniform dimension.

C. Form bed and head joints of uniform thickness.

D. Lay concrete masonry units in running bond.
   1. Coursing: One unit and one bed joint to equal 8 inches.

E. Lay brick units in running bond unless otherwise indicated (soldier and other decorative coursing).
   1. Coursing – Three units and three bed joints to equal 8 inches.

F. Mortar Joints Exposed to View: Tooled concave.

G. Cut mortar joints flush where cavity insulation is applied.

3.06. PLACING AND BONDING

A. Lay first course in full bed of mortar.

B. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

C. Lay hollow masonry units with full face shell mortar coverage on head and bed joints.

D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
E. Buttering corners of joints or excessive furrowing of mortar joints are prohibited.

F. Remove excess mortar as Work progresses and provide full joinery to prevent moisture intrusions.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Units with broken corners or edges shall not be used in exposed work.

H. Return facing wythe against back-up wythe closing cavity off at all jamb openings. Install 1/2-inch thick compressible filler and sealant at joint between facing and back-up wythes.

I. Interlock external corners.

J. Isolate masonry partitions from vertical structural steel or concrete framing members with movement joint.

K. Isolate non-bearing masonry partitions from structure above with compressible filler.

L. Unfinished Masonry: Protect at day’s end with secured weatherproof covers. Step back for joining new work, no toothing permitted. Remove loose mortar, expose joint, and wet masonry only as required by ACI 530 and ACI 530.1.

M. Replace frozen mortar at Contractor’s expense.

3.07. VENTS AND WEEPES

A. Install cavity vents in exterior wythe at 16 inches on center horizontally at top of cavity wall air space.

B. Install cavity weeps in exterior wythe at 16 inches on center at bottom of cavity wall air space and above flashing; align with vents above.

C. Install cavity weeps above lintels, shelf angles, and other flashing locations.

3.08. CAVITY AND SINGLE WYTHE WALLS

A. Build inner wythe ahead of outer wythe.

B. Install insulation between horizontal joint reinforcing and hold in place with adhesive that is compatible with the associated AVB and pintles.

1. Coordinate with installation of flashings and fluid-applied air and vapor barrier.

C. Provide closure of air space for the full height of the wall cavity at building corners, utilizing insulation board.

D. Mortar shall not accumulate in cavity air space or plug cavity weeps. Install mortar drop control device per manufacturer’s instructions at base of cavity, above lintels, and at other locations recommended by manufacturer.

E. Bevel mortar bed joint next to airspace to reduce falling mortar.

F. Build interior masonry walls full height unless otherwise noted.
3.09. REINFORCEMENT AND ANCHORAGES

A. Provide bond beams, lintels, and vertically reinforced masonry as required by Contract for all walls; interior and exterior, bearing and non-bearing.

B. Horizontal joint reinforcement shall be continuous; install at vertical spacing of 16 inches o.c.
   1. Lap straight runs and prefabricated corners and tees 9 inches.
   2. Place first row in second joint above foundation, immediately above the base-of-wall bond beam course.
   3. Place in first joint below top of walls.
   4. In first joint, above and below openings.
      a. Extend 16 inches each side.
   5. Under top-of-wall bond beam.

C. Install veneer ties at maximum 16 inches o.c. vertically and horizontally. Place around perimeter of openings, within 12 inches of openings.

D. Bridge across control joints using joint stabilizing anchors at 32 inches o.c. vertically.

E. Connect new to existing masonry using joint-stabilizing anchors. Anchors shall be bent to form a 90-degree “L.” The stationary (vertical) leg shall be fastened to the existing wall.

F. Connect interior masonry and exterior masonry wall using joint stabilizing anchors spaced 16 inches o.c. vertically. Set in grout filled cavities supported by cavity grout support.

3.10. GROUTED AND REINFORCED COMPONENTS

A. Grout for bond beams, pilasters, etc., as specified in Part 2.

B. Lay masonry units with core cells vertically aligned, unobstructed and clear of mortar.

C. Reinforcing steel per Section 03200, Concrete Reinforcement.

D. Retain vertical reinforcement in position at top and bottom of cells. Splice reinforcement per Section 03200, Concrete Reinforcement.

E. Consolidate grout without displacing reinforcing.

F. When grouting is stopped for more than one hour, terminate grout 1-1/2 inches below top of upper masonry unit to form a positive key.

G. Low Lift Grouting: Place first lift of grout to 16 inches height, rod and vibrate for consolidation. Place subsequent lifts in 8-inch increments, rod and vibrate for consolidation.

H. High Lift Grouting:
   1. Provide cleanout opening no less than 4 inches high at bottom of each grouted cell by cutting one face shell of masonry unit. Space cleanouts 32 inches o.c., maximum, in solid grouted masonry.
2. Clean out masonry cells with high pressure water spray prior to grouting and permit complete water drainage.

3. After inspection by Owner’s representative, seal openings with masonry units.

4. Pump grout into spaces with tremie or vibrate. Maintain water content in grout to intended slump without aggregate segregation.

5. Limit grout lift to 48 inches, rod and vibrate for consolidation. Wait 30 to 60 minutes before placing next lift.

I. Grout Slump Test: Test slump of each batch of grout produced. Submit test results to Owner’s representative within 24 hours of each test.

3.11. MASONRY FLASHINGS

A. Masonry flashings shall be coordinated with the finished assembly and installed in accordance with the supplier’s instructions.

3.12. LINTELS

A. Provide reinforced concrete masonry unit lintels over openings where steel or precast concrete lintels are not indicated or specified in the Contract.

   1. Set in mortar beds at proper elevation.

   2. Use lintel block units with solid bottoms where underside of blocks will be visible.

   3. Do not splice reinforcing bars.

   4. Maintain minimum 8-inch bearing on each side of opening.

      a. Provide bond break where necessary.

3.13. MOVEMENT JOINTS

A. Movement joints shall be classified and installed using the following:

   1. Veneer Expansion Joint: Separates masonry veneer into segments to prevent cracking.

   2. Masonry Control Joint: Separates concrete masonry into segments to prevent cracking due to movement. Stabilizing anchors are to be installed across joints to maintain alignment between segments.

   3. Building Expansion (Isolation) Joint: Through-the-building joint that separates the building into discrete sections, so that stresses developed in one section do not affect the integrity of the entire structure.

B. Install movement joints as specified or detailed.

C. Do not continue horizontal joint reinforcement through movement joints, except at bond beams.

D. Do not bridge control joint with mortar.
E. Movement joints shall be constructed as a continuous vertical line from the foundation to the top of the wall, interrupted only by bond beams. Movement joints shall be continued through parapet walls.

F. Form building expansion joint as indicated.

3.14. BUILT-IN WORK

A. Embed items furnished by other sections where specified.

B. Embed anchor bolts and plates solidly in grout where indicated.

C. Coordinate spacing and placement of built-in items with other trades.

D. Place items plumb, level, or in proper alignment for their intended use.

3.15. MORTAR QUALITY CONTROL

A. Adhere to the following:
   1. Retain the same material sources throughout project.
   2. Consistent proportions of all components, particularly water-premix ratios.
   3. Minimal re-tempering to avoid color variations and structural weakening.
   4. No acid cleaning. Excessive or too early cleaning of any kind may damage mortar.
   5. Tool thumbprint hard joints; too soft a joint will lighten mortar color and too hard a joint will darken color.
   6. Unused mortar shall be discarded within 2-1/2 hours after initial mixing.

3.16. CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and pilasters. Coordinate with other Sections of work to provide correct size, shape, and location.

B. Obtain County Engineer’s approval prior to cutting or fitting masonry work where not indicated, or where appearance or strength of masonry work may be impaired.

3.17. CLEANING

A. Remove excess mortar and mortar smears without degrading mortar bond integrity.

B. Replace defective mortar and masonry units.

C. Clean soiled and effloresced surfaces.

D. Use non-metallic tools in cleaning operations.

3.18. PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners and surfaces which may be damaged by construction activities.
PART 1 GENERAL

1.01. SECTION INCLUDES

A. Structural steel including bridge crane runway beams, monorail beams, and supports.

1.02. REFERENCES

The publications listed below form a part of these Specifications.

<table>
<thead>
<tr>
<th>ASTM A36</th>
<th>Structural Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A123</td>
<td>Zinc (Hot-Dipped Galvanized) Coating on Steel Products</td>
</tr>
<tr>
<td>ASTM A325</td>
<td>High Strength Bolts for Structural Steel Joints</td>
</tr>
<tr>
<td>ASTM A992</td>
<td>Structural Steel Shapes (Grade 50)</td>
</tr>
<tr>
<td>ASTM F1554</td>
<td>Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength</td>
</tr>
<tr>
<td>AWS D1.1</td>
<td>Structural Welding Code</td>
</tr>
<tr>
<td>AISC</td>
<td>Specification for the Design, Fabrication and Erection of Structural Steel for Buildings</td>
</tr>
<tr>
<td>SSPC</td>
<td>Steel Structures Painting Council</td>
</tr>
</tbody>
</table>

1.03. SUBMITTALS

A. Submit documentation to show current AISC Quality Certification.

B. Shop drawings shall include complete fabrication drawings to show anchor bolt layout, erection plans, and individual detail drawings for each piece of structural steel to be furnished for this project.

C. The drawings shall include a complete bill of materials, all fabrication/erection details, weld sizes, bolts, connection plate sizes and all dimensions.

D. In general, all beam connections shall be full depth, using 3/8-inch thick clip angles on each side of the web (except one side for channel connections) and 3/4-inch diameter bolts. (Other connections, bracing, hangers, etc., shall be minimum 2-bolt connections unless shown otherwise.)

1.04. QUALITY ASSURANCE

A. Fabricator shall be an AISC Quality Certified Fabricator specializing in performing the work of this section with minimum five years' documented experience.

B. The facilities shall be suitably enclosed to provide quality control and a consistently controlled environment during production, and the facilities shall also have sufficient capacity and equipment capable of producing the work all within the allotted time.

C. Weld procedures and welder personnel must be AWS qualified. Maintain procedures and certificates on file.

D. Fabricate structural steel members in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
PART 2  PRODUCTS

2.01.  MATERIALS

A.  Structural Steel Members

   1.  W-Shape Beams - ASTM A992.

B.  Bolts - ASTM A325, Type 1, 3/4-inch diameter.

   ASTM F153 or F2329 for galvanized bolts as a fabricated assembly.

   ASTM F593, Grade 316-SH (70 ksi yield) for stainless steel.

C.  Anchor Rods (Bolts) - ASTM F1554, Grade 36.

D.  Welding Materials - AWS D1.1; type required for materials being welded.

E.  Baseplate Grout - 7,000 psi non-shrink per Section 03600, Grout.

   Note: Grades or types listed shall be considered minimum standards.

2.02.  FABRICATION

A.  All structural material shall be straightened in the shop before any work is done on it.  All
    shearing shall be neatly and accurately done.  Flame cutting may be used provided it is
    performed by a machine.

B.  All shop fabrication shall be made by the process of welding unless otherwise noted.
    Welding shall be in accordance with the standards of the American Welding Society (AWS)
    for fusion welding and flame cutting in building construction.  Members to be jointed by
    welding shall be accurately cut to size.

C.  All holes shall be either drilled or punched.

D.  Surface of the plates or members to be welded shall be free from rust, grease or scale at the
    time of the welding for a distance of 2 inches from the welding edge.  Welds shall be free of
    defects, cracks, porosity, etc., to conform to AWS standards.

E.  Minor imperfections in the welding may be chipped off and the defect rewelded.  Finished
    welded joints shall be reasonably smooth and free from grooves, depressions and other
    irregularities and unsound material.  Distortion due to welding shall not be corrected by
    blows.

F.  Employ skilled welders capable of meeting the qualification tests for the type of welding which
    they are to perform.  All welders shall be subject to the qualifications test prescribed by the
    standard qualification procedure of the American Welding Society.

G.  The County Engineer shall have the right at any time to call for and witness the making of the
    test specimen by any welder in accordance with the above and to observe the physical test of
    the test specimens.  Materials shall be furnished and all tests shall be made by, and at the
    expense of the Contractor.
2.03. FINISH

A. Prepare structural component surfaces in accordance with SSPC SP-6.

B. Shop prime structural steel members that are not galvanized. Do not prime where field welded.

C. Field touch up and top coat all painted steel framing after installation.

D. Use zinc rich touch-up paint for galvanized surfaces.

PART 3 EXECUTION

3.01. EXAMINATION

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

B. Beginning of installation means erector accepts existing conditions.

3.02. ERECTION

A. Loading, transporting, unloading and piling of structural material shall be so conducted that the steel and shop paint coat will be kept clean and free from injury from rough handling. Material shall be piled on suitable skids so as not to rest upon the ground or in water.

B. Furnish all equipment, labor, temporary bracing, and accessories required for the erection of structural steel. Assume all risk from accidents and damage to persons and property resulting from steel erection until the work is completed.

C. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Field weld components indicated on approved drawings.

E. High strength bolts shall be used for all steel connections that are not welded. Surfaces of the bolted parts shall fit solidly together. Surfaces when assembled shall be free of dirt, oil, loose scale, etc., and other defects that would prevent solid contact or otherwise hinder the development of friction between the parts. Bolts shall be assembled with a hardened washer under the bolt head and nut. All nuts shall be tightened to achieve the bolt tension recommended by the manufacturer.

F. Do not field cut or alter structural members without approval of the County Engineer.

G. After erection, mechanically clean and prime or touch-up welds, abrasions, and surfaces not shop primed. Field top paint all steel not galvanized.

END OF SECTION
PART 1   GENERAL

1.01.   SECTION INCLUDES

A.   Open web steel joists.
B.   Bolted diagonal bridging.
C.   Welded horizontal bridging.
D.   Bearing plates.
E.   Miscellaneous framing at roof openings.

1.02.   REFERENCES

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ASTM A108</td>
<td>Steel Bars, Carbon, Cold-Finished, Standard Quality</td>
</tr>
<tr>
<td>ASTM A36</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>ASTM A325</td>
<td>High Strength Bolts for Structural Steel Joints</td>
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<tr>
<td>AWS D1.1</td>
<td>Structural Welding Code</td>
</tr>
<tr>
<td>SJI</td>
<td>Standard Specifications for Long Span Steel Joists</td>
</tr>
<tr>
<td>SSPC</td>
<td>Steel Structures Painting Council</td>
</tr>
</tbody>
</table>

1.03.   SUBMITTALS

A.   Provide documentation to show manufacturer to be certified by the Steel Joist Institute (SJI).
B.   Shop Drawings
   1.   Indicate standard designations, configuration, sizes, spacing, and locations of joists.
   2.   Joist bridging, connections, and attachments.

1.04.   QUALITY ASSURANCE

A.   Perform Work in accordance with SJI Standard Specifications.
B.   Coordinate the location, supply, and installation of supplemental framing for all roof loads in excess of 100 pounds and/or roof openings exceeding 18 inches.

1.05.   QUALIFICATIONS

A.   Fabricator and Erector - Company specializing in performing the work of this Section with minimum five years’ experience and shall be a member of the SJI.
B.   Welder personnel shall be AWS qualified and maintain certificates on file.

1.06.   DELIVERY, STORAGE, AND HANDLING
A. Deliver and store products at the site on wood blocking to keep out of mud and water.

PART 2 PRODUCTS

2.01. FABRICATORS

A. Vulcraft Group.
B. Quincy Joist Company.
C. A fabricator being submitted as a substitution shall be a member of the SJI and subject to approval by the County Engineer.

2.02. MATERIALS

A. Open Web Steel Joist Members – Type K Series.
B. Bridging shall be [bolted diagonal cross bracing using 1/2-inch minimum ASTM A325 bolts and] horizontal welded bracing as indicated on the Drawings.
C. All steel shall be shop primed and field-painted.
D. Structural Steel For Supplementary Framing - ASTM A36.
E. Supplemental framing at roof openings shall be L4 x 4 x 1/4 painted steel unless shown otherwise on the Drawings.
F. Welding Materials - AWS D1.1; type required for materials being welded.

PART 3 EXECUTION

3.01. EXAMINATION

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

3.02. ERECTION

A. Erect and bear joists on supports.
B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment until completion of erection and installation of permanent bridging and bracing.
C. Weld supplemental framing between joists to support metal deck at roof openings.
D. After joist alignment and installation of supplemental framing and bridging, field weld joist seat to steel framing.
E. Do not permit erection of decking until joists are braced, bridged, and secured.
F. Do not field cut or alter structural members without approval of joist fabricator.
G. After erection, prime welds, abrasions, and surfaces not shop primed.

END OF SECTION
SECTION 05505
CONCRETE AND MASONRY ANCHORS

PART 1
GENERAL

1.01. SECTION INCLUDES
A. Post-installed chemical adhesive anchor system for installing bolts and reinforcement dowels into concrete and masonry.
B. Limited use of post-installed mechanical anchors in concrete.
C. Cast-in anchors for attachment to concrete and masonry.
D. Embedded anchors for attachment to masonry.

1.02. REFERENCES

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACI 318 Ap.D</td>
<td>Building Code for Structural Concrete</td>
</tr>
<tr>
<td>ACI 355.2</td>
<td>Qualifications of Post-Installed Mechanical Anchors in Concrete</td>
</tr>
<tr>
<td>ACI 355.4</td>
<td>Qualifications of Post-Installed Adhesive Anchors in Concrete</td>
</tr>
<tr>
<td>ASTM A153</td>
<td>Zinc Coating (Hot-Dip) on Iron and Steel Hardware</td>
</tr>
<tr>
<td>ASTM A325</td>
<td>Structural Bolts, Heat Treated, 120/105 ksi Tensile Strength</td>
</tr>
<tr>
<td>ASTM A449</td>
<td>Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use</td>
</tr>
<tr>
<td>ASTM A615</td>
<td>Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement</td>
</tr>
<tr>
<td>ASTM E488</td>
<td>Strength of Anchors in Concrete and Masonry Elements</td>
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<tr>
<td>ASTM E1512</td>
<td>Testing Bond Performance of Bonded Anchors</td>
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<tr>
<td>ASTM F593</td>
<td>Stainless Steel Bolts, Hex Cap Screws, and Studs</td>
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<tr>
<td>ASTM F594</td>
<td>Stainless Steel Nuts</td>
</tr>
<tr>
<td>ASTM F1554</td>
<td>Anchor, Steel, 36, 55, and 105-ksi Yield Strength</td>
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<tr>
<td>AC308</td>
<td>Acceptance Criteria for Post-installed Adhesive Anchors in Concrete</td>
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<tr>
<td>ICC-ES</td>
<td>Zinc Coating, Hot-Dip</td>
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<tr>
<td>ASTM F2329</td>
<td>Acceptance Criteria on for Post Installed Mechanical Anchors in Concrete</td>
</tr>
<tr>
<td>ICC-ES</td>
<td>Acceptance Criteria for Post-Installed Adhesive Anchors in Masonry</td>
</tr>
</tbody>
</table>

1.03. SUBMITTALS
A. Submit catalog cuts for post-installed anchor products to be used for anchoring bolts and dowels into concrete and masonry. Catalog cuts (do not submit whole catalogs) shall be clearly marked to include:
   1. Manufacturer’s installation instructions.
   2. Allowable temperature range for anchor installation and curing.
B. Submit the ICC-ES Evaluation Service Report (ESR) for proposed anchor system.
C. Submit data on threaded rods to be used, including materials, sizes, lengths, etc.
D. Submit letter from anchor manufacturer which indicates successful completion of product installation training.

PART 2 PRODUCTS

2.01. MATERIALS

A. Adhesive anchor system shall be a high-strength, premeasured, two-part, self-mixing, cartridge-type epoxy adhesive.

B. Adhesive system used to install threaded rod anchors and reinforcing bars into concrete shall be “SET-XP (ESR-2508)” by Simpson; Strong-Tie Company, Inc., “HIT-HY 150 MAX (ESR-2262) or HIT-RE 500-SD (ESR-2322)” by Hilti, Inc., or equal.

C. Adhesive system used to install threaded rod anchors and reinforcing bars not grouted masonry shall be “SET (ESR-1772)” by Simpson; Strong-Tie Company, Inc., “HIT HY 150 MAX (ESR-1967)” by Hilti, Inc., or equal.

D. Adhesive system used to install threaded rod anchors into hollow core masonry using a mesh screen tube; shall be “SET (ESR-1772)” by Simpson; Strong-Tie Company, Inc. or equal.

MINIMUM REQUIRED ULTIMATE LOAD CAPACITIES

<table>
<thead>
<tr>
<th>ROD (DOWEL) SIZE (INCHES)</th>
<th>MINIMUM EMBEDMENT(1) (INCHES)</th>
<th>MINIMUM ULTIMATE TENSILE STRENGTH(2) (LBS.)</th>
<th>MINIMUM ULTIMATE SHEAR STRENGTH(2) (LBS.)</th>
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</thead>
<tbody>
<tr>
<td>3/8” (#3)</td>
<td>3-1/2”</td>
<td>6,000</td>
<td>5,000</td>
</tr>
<tr>
<td>1/2” (#4)</td>
<td>4-1/2”</td>
<td>10,000</td>
<td>9,000</td>
</tr>
<tr>
<td>5/8” (#5)</td>
<td>5-1/2”</td>
<td>14,000</td>
<td>15,000</td>
</tr>
<tr>
<td>3/4” (#6)</td>
<td>6-3/4”</td>
<td>18,000</td>
<td>20,000</td>
</tr>
<tr>
<td>7/8” (#7)</td>
<td>7-3/4”</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>1” (#8)</td>
<td>9”</td>
<td>43,000</td>
<td>33,000</td>
</tr>
</tbody>
</table>

(1) Provide these minimum embedment depths unless noted otherwise.
(2) These ultimate strengths shall be based on bond strength to minimum 2,000 psi concrete.

E. Stainless Steel Nuts – ASTM A594, Type 316.

F. Stainless Steel Threaded Rods – ASTM A593, Type 316.

G. Reinforcing Steel Dowels – ASTM A615, Grade 60 deformed bar.

H. Cast-in Anchor Rods (Bolts) – ASTM F1554 anchor rods [galvanized to ASTM A153 or F2329]. Use 3/4-inch diameter rods (L-bolts) bent 90 degrees with 3-inch hook.

I. Threaded rods and anchor bolt accessories, including nuts, washers, etc. shall be of the same material as the rods/bolts.

J. Mechanical Anchors – Mechanical (expansion-type) anchors are not allowed unless specifically requested (for a special application) by the Contractor and approved by the County Engineer in writing.
PART 3 EXECUTION

3.01. INSTALLATION OF ADHESIVE ANCHOR SYSTEMS

A. All bolted connections to concrete and masonry shall utilize an adhesive anchor system as specified above.

B. Threaded stainless steel rods shall be used for all anchor bolt applications, (unless noted otherwise in the Contract).

C. Provide templates or other means to accurately locate anchors.

D. Drilled holes shall be cleaned out and shall be free of dust and trapped water by using oil free compressed air and brushes.

E. Masonry wall (cores) shall be filled with masonry grout where anchors are to be installed. In existing construction where masonry cores are not (and cannot be) grout filled (hollow core masonry), manufacturer’s mesh screen tube shall be used with adhesive anchor installation.

F. Install adhesive anchors in accordance with manufacturer’s recommendations.

G. Bolts installed into concrete and masonry shall not be closer than 6 inches on centers.

H. All structural members bolted to concrete and masonry shall be made with a minimum of two 5/8-inch diameter anchors at each end of member.

I. Anchor bolts and dowels shall be clean and free of coatings or other contaminants that would impair bonding to the chemical adhesive.

J. Threaded rods shall be long enough to project through the entire depth of nut and shall be cut off at 1/2 inch beyond the top of nut.

K. Anchor bolts shall not be installed in concrete less than seven days old, or older if recommended by the manufacturer.

L. Adhesive anchors shall be installed following all criteria as listed in the respective ESR. Adhesive shall be fully cured prior to applying load on anchor.

3.02. INSTALLATION OF CAST-IN ANCHORS

A. All cast-in anchors shall be hot-dip galvanized unless noted otherwise in the Contract.

B. Provide templates or other means to accurately place anchors.

C. Anchors shall be secured in place to not allow displacement during placement of concrete or masonry grout.

D. Concrete or masonry grout shall be thoroughly vibrated around the anchors for proper bonding of the anchors.

E. Anchor rods shall be long enough to project through the entire depth of nut and shall be cut off at 1/2 inch beyond the top of nut.

F. Concrete or masonry grout shall be at full 28-day compressive strength prior to applying load on anchor.
3.03. INSTALLATION OF MECHANICAL ANCHORS

A. Mechanical (expansion-type) anchors are only allowed for overhead (ceiling) applications where thru-bolting cannot be performed. Mechanical anchors are not allowed for any other use unless specifically requested (for a special application) by the Contractor and approved by the County Engineer in writing.

B. Mechanical anchors shall support static tension loads not exceeding 200 lbs. per anchor.

C. Drilled holes shall be cleaned out and free of dust.

D. Anchors shall be fully seated prior to pretension. Pretension in accordance with manufacturer’s instructions.

E. County Engineer may request any/all of these mechanical anchors to be proof-loaded.

END OF SECTION
PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Remove existing roof coverings, insulation, roof edge blocking, parapet copings, flashings and roof drain strainers and clamps down to existing cast-in-place concrete roof deck. Perform demolition, handling, transport and disposal work in accordance with Section 02030 and all applicable Federal, State and local laws and regulations.

B. Furnish and install a complete and weathertight replacement roof system, including:

1. A complete roof covering and insulation system including vapor retarder, roof cover board, insulation, thermoplastic membrane, adhesives, flashings, blocking, sealants and accessories,

2. Modifications as required to rooftop equipment curbs and supports to accommodate the increased insulation thickness, and re-installation of equipment as required, including any necessary extension of wiring or ducts.

3. New retrofit roof drains to be inserted in existing roof drain leaders.

4. New metal copings and flashings as required to provide a weathertight system.

5. Fasteners, anchors, and sealants as required to provide a weathertight system.

C. The Work includes all electrical, HVAC and plumbing work that is incidental to the installation of the roof replacement system.

D. Roof system to be warranted as required by this Section.

1.02. REFERENCES


E. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

F. ASTM D741 – Standard Test Method for Determination of Total Aromatics and Total Saturates in Lube Basestocks by High Performance Liquid Chromatography with Refractive Index Detection
1.03. SYSTEM DESCRIPTION

A. Major system components are described below. The work includes all components necessary to provide a weathertight and warranted roof.

1. Vapor Retarder – Provide a vapor retarder system recommended by the roof membrane manufacturer and approved by the roof manufacturer as part of a system meeting wind uplift and warranty requirements. The vapor retarder is to provide a continuous and well-secured barrier to water and water vapor.

a. At concrete roof decks, adhere the system directly to the concrete, including primer recommended for application.

2. Insulation – Provide flat and tapered boards of rigid polyisocyanurate insulation, secured to the vapor retarder and to each other with a two-component urethane foam adhesive.

3. Roof Board - Glass mat water-resistant gypsum board or other manufacturer-approved product:

a. Adhered to the top surface of insulation if required to obtain system approval and warranty by membrane manufacturer.

4. Roof Membrane – Fully adhered roofing system, secured to the insulation or roof board with two-component urethane foam adhesive or manufacturer-recommended adhesive.

5. Flashings, copings, blocking, termination accessories, adhesives, sealants, walk pads, and all other components needed to provide a complete warranted and weathertight roof.

1.04. PERFORMANCE REQUIREMENTS
A. System to be assembled of components which will be secured, adhered or fastened by such methods as have been tested by the roof membrane Manufacturer, or tested by certified independent laboratories, such that the assembly has been proven capable of resisting the applicable wind forces computed in compliance with the 2015 International Building Code for the criteria stated below:

1. Ultimate design wind speed \( (V_{ult}) \) of 120 miles per hour (Figure 1609.3(2) for Risk Category III buildings).

2. Exposure D.

3. System to resist a wind uplift force of no less than 45 psf.

1.05. QUALITY CONTROL

A. Submit all copies of complete submittals to roof membrane manufacturer for their approval prior to submission to County. Once approved by manufacturer, submit copies of complete submittal to County.

1.06. SUBMITTALS

A. Submittal shall include the following:

1. Product data sheets on each product proposed for use to accomplish the Work of this Section.

2. Shop Drawings
   a. Roof plan(s) drawn to scale.
   b. Large-scale drawings showing standard and special details that include conditions of interface with the specific construction design depicted by the Documents for this project. These shall include, but not be limited to:
      1) Copings and flashings at roof perimeter
      2) Flashing at all different types of roof penetrations
      3) Roof curb modifications if required
      4) Connection to roof drains

3. Letter from the roof membrane manufacturer including the following:
   a. Statement that the applicator has been trained and approved by the roofing manufacturer to install the system as submitted.
   b. Statement that the roof system has been designed to meet the performance requirements specified in 1.05 of this Section.
   c. Statement that the roof systems, as submitted by the Contractor and reviewed by the manufacturer, is warrantable after manufacturer’s final inspection and correction of any defects identified by that inspection.
4. Sample warranty, fully executed, with any and all amendments, except for signatures and acceptance dates.

1.07. PRE-INSTALLATION CONFERENCE

A. Prior to scheduled commencement of the roofing installation and associated work, conduct a meeting at the project site with the installer, abatement subcontractor, County, County representatives, roofing manufacturer’s representative, and any other persons directly involved with the performance of the work. The installer shall record conference discussions to include decisions and agreements reached (or disagreements) and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to roofing work.

1.08. DELIVERY, STORAGE, AND HANDLING

A. Store products in a weather protected environment, clear of ground and moisture. Store adhesives, caulking, primers, etc., at room temperature (60 to 80 degrees F).

1.09. ENVIRONMENTAL REQUIREMENTS

A. Do not apply roofing components during wet or inclement weather, or during periods when ambient temperatures are, or are projected to be, below or above those recommended by the roofing manufacturer.

B. Do not apply roofing components to damp or frozen substrates.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

D. Do not allow products deleterious to the membrane to come in direct contact with membrane.

1.10. WARRANTY

A. In addition to the manufacturer’s standard warranty, the manufacturer shall provide a 15-year total roofing system warranty with extended peak gust wind speed coverage for winds of up to 100 miles per hour.

B. Warranty to commence following final inspection by the roofing manufacturer’s inspector. Two fully executed copies of the warranty document shall be delivered to the County.

C. In the event of a wind-related problem, wind speed shall be determined by the U.S. Weather Station nearest to the site.

PART 2 PRODUCTS

2.01. ROOF MEMBRANE MANUFACTURER

A. Roofing membrane material to be thermoplastic polyolefin (TPO) as provided by Carlisle, Johns-Manville, GAF, or equal as approved by the County Engineer.

B. Roofing assembly to be as provided and approved by named manufacturer. Components meeting requirements in the following Articles to create a complete, watertight, and warranted roof.
2.02. MEMBRANE MATERIAL - THERMOPLASTIC POLYOLEFIN

A. Roofing system to be Sure-Weld TPO by Carlisle Syntec, JM TPO-1 by Johns-Manville, EverGuard TPO 45 by GAF, or equal as approved by the County Engineer.

B. Membrane to be free of streaks, particles of foreign matter, pinholes, cracks, tears, and shall be uniform thickness.

C. When unrolled in the relaxed position, membrane shall be free of wrinkles, distortions and blisters.

D. Membrane to be .045 TPO, color white, meeting Energy Star requirements for reflectivity, and meeting the following physical properties:

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTY</th>
<th>TEST METHOD</th>
<th>PERFORMANCE VALUES EXCEED ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breaking strength</td>
<td>ASTM D751</td>
<td>225 lbf</td>
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<tr>
<td>Elongation</td>
<td>ASTM D751</td>
<td>25%</td>
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<tr>
<td>Tear resistance</td>
<td>ASTM D751</td>
<td>55 lbf</td>
</tr>
<tr>
<td>Ozone resistance</td>
<td>ASTM D1149</td>
<td>No cracks</td>
</tr>
<tr>
<td>Heat aging 28 days at 240°F per ASTM D573</td>
<td>ASTM D751</td>
<td>Maintain 90% of original tested value for breaking strength and elongation; 60% for tear resistance</td>
</tr>
<tr>
<td></td>
<td>ASTM D751</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ASTM D624</td>
<td></td>
</tr>
<tr>
<td>Britteness temperature</td>
<td>ASTM D2137</td>
<td>-40°F</td>
</tr>
<tr>
<td>Water resistance (change in weight after immersion 7 days @ 150°F)</td>
<td>ASTM D471</td>
<td>+8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-2</td>
</tr>
<tr>
<td>Water vapor permeability maximum, perm mils</td>
<td>ASTM E96</td>
<td>1.0 or less</td>
</tr>
<tr>
<td>Thickness tolerance</td>
<td>ASTM D751</td>
<td>+10%</td>
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<tr>
<td>Weight – pounds per square foot</td>
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<td>0.23 psf</td>
</tr>
</tbody>
</table>

E. Flashing to be reinforced and unreinforced TPO. Use premolded fabricated shapes on corners, pipes, and tubing or difficult turns.

1. Tensile Strength - 1300 psi (minimum), ASTM D412.

2. Elongation - 300 percent (minimum), ASTM D412.


4. Tear Resistance - 150 lbs/in (minimum), ASTM D624.

5. Thickness - 0.060-inch and .045.

F. Related Materials

1. Bonding Adhesive - Compatible with materials to which membrane is to be bonded; furnished by roofing membrane manufacturer.

2. Cleaner/Primer - Wash supplied by manufacturer to remove weathering or other substances from membrane surface in preparation for splicing, bonding or tapes.

4. Sponge Tubing and Compressible Filler - As recommended by roofing membrane manufacturer.

5. Splice adhesive, termination bars, fastening plates, and reinforced strips to be furnished by roofing membrane manufacturer.

6. Edge Sealant and Water Block Seal - Shall be compatible with materials with which they are used and supplied by roofing manufacturer.

7. Wood Nailers
   a. Southern Pine No. 2; minimum Fb for single use up to 6-inch wide: 1,250 psi; E = 1,600,000 psi.
   b. Preservative treated without arsenic or chromium.
      1) Wolman E as manufactured by Arch Wood Protection, Inc., of Smyrna, GA.
      2) ACQ as manufactured by Chemical Specialties, Inc, of Charlotte, NC.
      3) Micronized Copper and Quaternary (MCQ) Treatment, "Micropro" by Osmose, Inc., of Griffin, GA.
      4) Or equal.

8. Fasteners
   a. Provide stainless steel fasteners for use in contact with preservative treated lumber, masonry or concrete.
   b. Provide fasteners of dimension and type:
      1) Per roof membrane manufacturer’s directions to meet performance and warranty requirements
      2) As shown on approved shop drawings
      3) Where not specifically indicated: suitable to the materials to be fastened and of dimension and configuration to provide the strongest possible connection and longest service life

2.03. VAPOR RETARDER

A. System recommended by the roof membrane manufacturer, and approved by the roof manufacturer as part of a system meeting wind uplift and warranty requirements. The vapor retarder shall provide a continuous and well-secured barrier to water and water vapor.

1. Carlisle 725TR.
2. JM Vapor Barrier SA.
3. GAF UnderRoof 2.
4. Or equal.

2.04. ROOF COVER BOARD

A. To be installed as a substrate covering material or insulation retention cover.
B. Membrane manufacturer-approved 1/2-inch thick glass mat water resistant gypsum board.
   1. Insulation retention cover to be adhesively secured to insulation.

2.05. INSULATION

A. Insulation – Closed-cell polyisocyanurate foam core laminated to a glass reinforced mat facer. Approved or supplied by roofing system manufacturer.
   1. Board Density - 2 lbs/cubic foot.
   2. Board Size - Largest board that fully and firmly attaches to substrate. Use smaller boards if irregularities are too great.
B. Board Thickness
   1. Boards to be layered to achieve a minimum overall thickness in roof field of 5 inches.
   2. Flat Boards - Minimum of 1-1/2-inch thickness per layer.
   3. Tapered Boards - Boards to be layered with flat boards to achieve the minimum thickness as indicated on drawings, while providing minimum slope to drain of 1/4 inch per foot in roof field. Drainage to approximate drainage patterns as shown on roof plans.
C. Thermal Conductivity – Minimum LTTR per ASTM C1289-11 of R5.7 per inch.
D. Board Edges - Square cut (diagonal dimension 1/4-inch maximum and ends not more than 1/8-inch maximum out of square).
E. Compressive Strength - 20 psi.
F. Water Vapor Permeance - 2.0 or less per ASTM C355.

2.06. FLASHINGS AND COPINGS

A. Flexible Flashings - As recommended or supplied by the roofing manufacturer.
B. Prefabricated (Boot) Flashings - Used for vent pipes, etc., to be provided by roofing manufacturer. Install 8 inches above finished membrane (min.).
C. Sheet Metal Flashings and Copings
   1. Minimum 24 gauge base metal with AZ50 aluminum-zinc alloy coating conforming to ASTM A792.
2. Factory-applied two-coat fluoropolymer system with 70 percent polyvinylidene fluoride (PVDF) top coat.
   
a. Color as selected by County from manufacturer’s standard colors.

3. Fabrication
   
a. Fabricate in general conformance with profiles and designs shown on approved drawings.

   b. Conform to SMACNA Architectural Sheet Metal Manual for necessary profiles not shown.

   c. Provide lapped joints and mitered corners with backing and sealants.

   d. Secure as required by roofing membrane manufacturer to meet warranty and performance requirements.

2.07. INSULATION AND MEMBRANE ADHESIVE
   
   A. Two-component low-rise urethane foam adhesive.

   B. Accepted by the roof membrane and insulation manufacturers as a component in a roof system warranted as required by this section.

   C. Fully compatible with, and effective in adhering to, the vapor retarder.

2.08. WALKWAYS
   
   A. Walkway Pads - Provide roofing manufacturer’s standard walkway pads for systems with exposed membrane.

   B. Provide 60 walkway pads.

   C. Walkway Layout Pattern – to be coordinated with County.

2.09. RETROFIT ROOF DRAINS
   
   A. Aluminum drain tube, flange, strainer and clamp ring assembly purposely designed for retrofit installation to existing drain bodies.

   B. Equipped with a mechanical seal to provide a watertight connection to the inside surface of existing drain leaders.

   C. Provide with nominal drain tube size to fit existing drain leader size.

   D. Marathon Roofing Products Aluminator or equal.

PART 3 EXECUTION

3.01. EXAMINATION
   
   A. Ensure that deck is supported and secure; surfaces and site conditions are ready to receive work.
B. Ensure deck is clean and smooth, free of depressions, waves, or projections.

C. Ensure deck surfaces are adequately dry and free of snow or ice to receive the work, including fasteners, adhesives, etc. Snow removal or cleaning to be performed by roofing contractor without extra payment as part of contract.

D. Verify that all roof openings, curbs, pipes, sleeves, ducts, vents through roof, and wood nailing strips are solidly set.

E. Notify County immediately of any conditions that might potentially compromise either the performance of the roof system or the warranty of the roof system.

3.02. SUBSTRATE BOARD INSTALLATION

A. Install 5/8-inch thick glass mat water resistant gypsum board.

1. Install with two-component low-rise urethane foam adhesive or mechanically as approved in writing by roofing membrane manufacturer.

B. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.

C. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface. Tape joint.

3.03. VAPOR RETARDER APPLICATION

A. Install vapor retarder in strict accordance with manufacturer’s instructions.

3.04. INSULATION APPLICATION

A. Install insulation in accordance with roofing membrane manufacturer’s and insulation manufacturer’s instructions, and these specifications. Adhere layers of insulation to vapor retarder and to each other with adhesive in a manner approved by the roofing membrane manufacturer to attain the specified warranties.

B. Do not install pieces of insulation less than 12 inches in any dimension.

C. Install tight to blocking and roof penetrations.

D. Apply no more insulation than can be covered with membrane in same day. If insulation becomes wet for any reason, remove and replace at no expense to the Owner.

E. All joints between layers to be staggered.

F. Provide a 3-foot x 3-foot tapered sump centered on each roof drain.

1. Vary sump dimensions as required to avoid aligning roof insulation valleys with major rooftop equipment.

3.05. ROOF CURBS AND PENETRATIONS

A. Extend the heights of roof curbs, vents through the roof and other penetrating building utilities and equipment and remount equipment as required to provide sufficient flashing height above the roof surface.
1. Provide alterations to, or extensions of, electrical and HVAC lines or ducts as required to reconnect equipment.

3.06. FLASHINGS AND ACCESSORIES

A. Apply appropriate flashing to seal roofing where vertical elements such as: electrical, mechanical, heating and ventilating, or structural components penetrate the roof system.

B. Install roofing expansion joints as indicated in accordance with the drawings and manufacturer’s instructions or recommendations.

C. Install retrofit roof drains as shown on drawings and in accordance with manufacturer’s instructions.

D. Install parapet flashing. Coordinate with installation of scuppers and downspouts per manufacturer’s instructions and approved shop drawing.

3.07. MEMBRANE APPLICATION

A. Apply membrane in accordance with manufacturer’s instructions. Membrane joints to be fully completed each day, including each seam in each roof area, with all seam adhesives and seam sealants.

B. Roll out membrane, free from wrinkles or tears. Place sheet without stretching.

C. Overlap edges and ends a minimum of 3 inches and apply splicing cement. Prior to closing splice, apply in-seam sealant. Close splice and seal with continuous bead of lap sealant (seal permanently waterproof). Self-adhesive flashing strips as furnished and approved by the roofing membrane manufacturer are acceptable where use of such materials complies with warranty requirements.

D. Shingle joints on sloped substrate in direction of drainage; apply joint sealant to provide watertight seal.

E. Seal membrane around roof penetrations.

3.08. CLEANING

A. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

B. Repair or replace defaced or disfigured finishes caused by work of this section.

3.09. PROTECTION

A. Protect building surfaces against damage from roofing work, which may include complete covering with tarps.

END OF SECTION
PART 1    GENERAL

1.01. DESCRIPTION OF WORK

A. Joint Sealers and accessories including, but not limited to the following:

1. Sealants and caulking for non-submerged uses.
2. Backer rods and accessories
3. Trowel grade exterior flexible patching compound for use at cable tray penetrations.

1.02. REFERENCES

G. SWRI - Sealant, Waterproofing Restoration Institute.

1.03. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Manufacturer’s Product Data – Manufacturer’s literature describing performance characteristics validating product compliance with performance criteria specified and application procedures.
2. Samples – Submit samples illustrating manufacturer’s extended color range.

1.04. WARRANTY

A. Provide manufacturer’s five-year standard material warranty.
B. Include coverage for replacement of sealant materials which fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Provide all joint sealers of the same type from a single manufacturer.

B. Provide USDA and NSF approved sealants when indicated.

2.02. JOINT SEALERS

A. Multi-Component, Non-Sag Polyurethane Sealant - Sika “Sikaflex 2cNS,” BASF “MasterSeal NP 2,” or equal with +50 percent movement capability for vertical joints; ASTM C920, Type M, Grade NS, Class 25. USDA approved; SWRI validated; UL classified (fire resistance).


C. Silicone Sealant - Sika “SikaSil C990 or 995”, Pecora “864,” or equal. ASTM C920, Type S, Grade NS, Class 25 or 50.


E. Single Component Spray Applied Elastomeric Sealant – 3M Fire Dam Spray 200, Specified Technologies SpecSeal AS200, Tremco TremStop Acryilc SP; or equal with +25 percent movement capability; ASTM E84, max flame spread <25, smoke developed <50.

F. Single Component pre-pressurized expanding polyurethane foam sealant equal to Sika “Sika Boom.”

2.03. EXTERIOR PATCHING COMPOUND

A. Trowel grade exterior flexible patching compound.

1. Designed for adherence to a variety of substrates, including plastic, metal, concrete and masonry.

2. Tested to 100% elongation without rupture of joints.

3. Workable for application to a vertical surface at ½” thickness.


5. Intended for exterior use.

B. Shur-Stik Permanent Patch 100 by Gardner-Gibson, Tampa FL

C. Or equal.

2.04. ACCESSORIES

A. Low VOC Primer - As recommended by manufacturer for particular sealant and substrate.
B. Joint Cleaner - Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.

   2. Size required for joint design.

D. Closed-Cell Backer Rod - Industrial Thermo Polymers Limited “101 Standard Backer Rod,” Deck-o-Seal “Kool-Rod” or equal closed-cell polyethylene rod designed for use with cold-applied joint sealants for on-grade or below-grade applications.
   2. Size required for joint design.

E. Joint Filler - Canzac “Expansion Joint Filler,” Sonneborn(R)/ChemRex “Expansion Joint Filler,” or equal closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 1/4 inch (6 mm).
   1. Size required for joint design.

F. Bond Breaker - Pressure-sensitive tape recommended by sealant manufacturer to suit application.

2.05. COLOR

A. Sealant Colors –Match to adjacent materials as directed by County representative or County Engineer.

PART 3 EXECUTION

3.01. EXAMINATION

A. Inspect all areas involved in work to establish extent of work, access, and need for protection of surrounding construction.
   1. Verify that substrate surfaces and joint openings are ready to receive work.
   2. Verify that joint backing and release tapes are compatible with sealant.

3.02. PREPARATION

A. Remove loose materials and foreign matter which impair adhesion of joint filler.

B. Clean joints and saw cuts by grinding, sandblasting, or wire brushing to expose a sound surface free of contamination and laitance. Prime joints.

C. Ensure structurally sound surfaces, dry, clean, free of dirt, moisture, loose particles, oil, grease, asphalt, tar, paint, wax, rust, waterproofing, curing and parting compounds, membrane materials, and other foreign matter.
Where the possibility of joint filler staining of adjacent areas or materials exists, mask joints prior to application.

1. Do not remove masking tape before joints have been tooled and initial cure of joint filler has taken place.
2. Work stained due to failure of proper masking precautions will not be accepted.

3.03. INSTALLATION

A. Back-Up Material

1. Install appropriate size backer rod, larger than joint where necessary according to manufacturer’s recommendations.
2. Install polyethylene joint filler in joints wider than 1/4 inch (6 mm) to back-up material per manufacturer’s recommendations.
3. Do not install epoxy joint filler over backer rod.
4. Install mineral wool backer material at locations where elastomeric spray applied sealants are scheduled to be used by pressure fitting snugly into joint space.

B. Bond Breaker - Install bond-breaker strip in joint to be sealed on top of back-up material to prevent adhesion of sealant to back-up material. Install per manufacturer’s recommendations.

C. Sealant

1. Prepare sealants that require mixing. Follow manufacturer’s recommended procedures, mixing thoroughly.
2. Mix only as much material as can be applied within manufacturer’s recommended application time period.
3. Apply materials in accordance with manufacturer’s recommendations. Take care to produce beads of proper width and depth, tool as recommended by manufacturer, and immediately remove surplus sealant.
4. Apply materials only within manufacturer’s specified application life period. Discard sealant after application life is expired or if prescribed application period has elapsed.

D. Expansion Joint Systems

1. Install per manufacturer’s instruction for the system and as required by substrates and conditions encountered.

3.04. CLEANING

A. Remove uncured sealant and joint filler with sealant manufacturer’s recommended solvent. Remove cured sealant and joint filler by razor, scraping, or mechanically.

B. Remove all debris related to application of sealants from job site in accordance with all applicable regulations for hazardous waste disposal.

END OF SECTION
PART 1 GENERAL

1.01. SECTION INCLUDES

A. Non-rated and fire rated, and acoustic steel doors and welded frames.

B. All doors shall be extra heavy duty, Grade III, 1-3/4-inch thick, Model 2, seamless design per SDI-100-91.

1.02. REFERENCES

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<th>Description</th>
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<td>Steel Door Institute Standard and Test Methods for Steel Doors and Frames</td>
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<tr>
<td>ANSI A117.1</td>
<td>Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People</td>
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<td>Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings</td>
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<td>Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process</td>
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<td>ASTM E2074</td>
<td>Methods of Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies</td>
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<tr>
<td>Door Hardware Institute (DHI)</td>
<td>The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder’s Hardware</td>
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<td>NFPA 80</td>
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<td>SDI</td>
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<tr>
<td>UL 10B</td>
<td>Underwriters Laboratory Standard for Fire Tests of Door Assemblies</td>
</tr>
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</table>

1.03. SUBMITTALS

A. Shop Drawings - Indicate door and frame elevations, reinforcement, closure method, cut-outs for louvers, undercuts, and finish.

B. Manufacturer’s Product Data - Indicate door and frame configurations, location of cut-outs for hardware reinforcement, anchor types, and spacings.

1.04. QUALITY ASSURANCE

A. Conform to requirements of SDI-Fact File and ANSI A117.1.

1.05. QUALIFICATIONS

A. Manufacturer - Company specializing in manufacturing the products specified in this section with minimum five years’ documented experience and current member of the Steel Door Institute (SDI).
1.06. REGULATORY REQUIREMENTS
   A. Fire Rated Doors and Panel Construction – Conform to UL 10C.
   B. Fire Rated Door Construction – Rate of rise of 450 degrees F across door thickness.
   C. Installed Door and Frame Assembly – Conform to NFPA 80 for fire rated class as scheduled.

1.07. DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, protect, and handle products to site under provisions of this section. Store off
      ground in weathertight enclosure while affording proper air circulation.
   B. Accept doors and frame on site in manufacturer’s packaging.
   C. Break seal on-site to permit ventilation and inspect for damage.

1.08. FIELD MEASUREMENTS
   A. Verify that field measurements are as indicated on shop drawings and instructed by the
      manufacturer.

PART 2 PRODUCTS

2.01. DOOR MANUFACTURERS
   A. Amweld Building Products, Inc. - Product: 700 Series.
   B. Ceco Door Division - Product: Imperial Series.
   C. Curries Company - Product: Curries 707.
   E. Or equal as approved by the County.

2.02. DOORS AND PANELS
   A. Doors and steel accessories to be galvanized material; commercial class weighing not less
      than 0.30 oz/psf per side. Zinc applied as ductile coating to both sides, bonded tightly to
      base metal. Wipe Coat Galvanized Steel (WCGS) is not acceptable.
   B. Reinforce, drill, and tap doors to receive mortised hinges, locks, latches, flush bolts, and
      concealed closers as required. Such preparations for door hardware shall be performed by
      the door manufacturer in the factory.
   C. Doors and metal panels to be SDI Extra Heavy Duty, Grade III, Model 2, 1-3/4-inches thick
      (minimum); seamless design, stretcher leveled, no exposed joints or seams, and fully
      enclosed.
   D. No field welding permitted on factory fabricated units.

2.03. DOOR AND PANEL CONSTRUCTION
A. Face - Steel sheet 16-gauge minimum steel.
B. Core - Reinforced, stiffened, sound deadened and insulated with polyurethane or polystyrene core.
C. Core of door to resist vermin, mildew, or rot.

2.04. FRAMES
A. Frames - 14 gauge minimum thickness material for all doors.
B. Spreaders to be provided for all frames.

2.05. ACCESSORIES
A. Apply protective coating to concealed steel surfaces in contact with cementitious materials or dissimilar metals.
B. Silencers – Provide at all interior doors not equipped with weather stripping – resilient rubber, fitted into drilled hole. Glynn Johnson No. 64 or equal.
   1. Three single silencers for single doors.

2.06. FABRICATION
A. Fabricate doors with hardware reinforcement welded in place.
B. Close top and bottom edge of exterior doors with flush end closure. Seal joints watertight.
C. Fabricate frames as welded unit.
D. Anchors to be as recommended by manufacturer for use with masonry construction.
   1. UL at labeled doors.
E. Use adjustable base anchors at jambs or mullions using appropriate type.
F. Side jamb anchors at 2 feet 0 inches o.c. maximum.
G. Provide for full mortise hardware, reinforced, drilled, tapped for hinges, lock strikes and all other hardware at factory.
H. Attach fire rated label to each door frame unit as applicable.
I. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.
J. Provide mortar guard boxes as protection for mortise hardware cut-outs.

2.07. FINISH
A. Steel Sheet - Galvanized to ASTM A526; A60.
B. Primer – Baked-on rust-inhibitive type.
C. Factory Finish - Doors, panels and frames to be bonderized over galvanized surface, shop painted with baked-on rust-inhibitive primer. Finish coat in field per finish schedule and Section 09900, Painting.

D. Any damage to primed galvanized surfaces, after installation, to be cleaned and touched up with zinc-rich paint.

E. Do not paint over fire labels.

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that opening sizes and tolerances are acceptable.

B. Do not fill thermally broken frames with grout.

3.02. INSTALLATION

A. Install doors and frames in accordance with SDI Fact File.

B. Install door louvers, plumb and level.

C. Coordinate installation of doors with installation of hardware.

3.03. ERECTION TOLERANCES

A. Maximum Diagonal Distortion - 1/16-inch measured with straight edge, corner to corner.

3.04. ADJUSTING

A. Adjust door for smooth and balanced movement.

END OF SECTION
PART 1  GENERAL

1.01. DESCRIPTION OF WORK
   A. Fiberglass reinforced plastic (FRP) doors and frames.
      1. Fire-rated side-hinged flush door and frame assemblies.
      2. Non-rated side-hinged door assemblies.

1.02. REFERENCES
   A. SDI - Steel Door Institute Fact File
   B. AAMA 920 – Specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems
   C. ANSI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
   D. ASTM E84 - Surface Burning Characteristics of Building Materials
   E. NFPA 252 – Standard Methods of Fire Tests for Door Assemblies
   F. UL 10C – Standard for Positive Pressure Fire Tests of Door Assemblies

1.03. PERFORMANCE REQUIREMENTS
   A. Provide fire-rated door and frame assemblies where required by code:
      1. Tested in accordance with NFPA 252 or UL 10C, and
      2. Labeled by an Approved Agency per the Building Code for the applicable duration.
   B. Provide doors and frame combinations that, when tested as an assembly, have successfully withstood one million swing cycles when tested in accordance with ANSI A250.4 or AAMA 920.
   C. Provide doors and frames with surface burning characteristics on face sheets exposed to building interior spaces not to exceed a flame spread rating of 25 or a smoke developed rating of 450 when tested in accordance with ASTM E84.
   D. Provide doors and frames that will resisted failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering; for the required warranty period.

1.04. SUBMITTALS
   A. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes, and installation.
B. Shop Drawings: Submit manufacturer's shop drawings, including elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, and finish.

C. Samples:
   1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
   2. Color: Submit manufacturer's samples of standard colors of doors and frames.

D. Test Reports: Submit test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

E. Maintenance Instructions: Submit manufacturer's maintenance and cleaning instructions for doors.

F. Warranty: Submit warranty meeting conditions of this Section.

1.05. QUALITY ASSURANCE
A. Provide door and frame components from the same manufacturer.

1.06. WARRANTY
A. Ten years against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.

B. Lifetime against failure due to corrosion on FRP components.

PART 2 PRODUCTS
2.01. DOOR MANUFACTURERS
A. Special-Lite, Inc., Decatur, Michigan
B. CORRIM Company, Oshkosh, Wisconsin
C. Or equal.

2.02. PRODUCTS
A. Fire-Rated Flush Door and Frame Assemblies: Special-Lite FR series or CORRIM equivalent with rating duration as scheduled or required on Drawings.
B. Non-Rated Flush Door and Frame Assemblies: Special-Lite AF-200 or CORRIM equivalent.
C. Or equal.

2.03. MATERIALS
A. Doors.
1. Laid-up construction.
3. Cores.
   a. Non-Rated Doors: Polyurethane foam, center-or-door R-value no less than 9.
4. Pultruded FRP internal framing.
5. Face Sheets: FRP no less than 0.120 inches thick, factory polyurethane finish.
   a. Not gel-coated.
6. Provide factory cut-outs and glazing materials for vision lites where applicable.

B. Frames.
   1. Pultruded FRP.
   2. Profile: Double rabbet 2-inch face with 5-3/4-inch profile and 1-15/16-inch rabbet, or as shown on drawings.

2.04. FABRICATION
   A. Finished doors and frames to be strong, rigid, neat in appearance, free from defects; waves, scratches, cuts, dents, ridges, holes, warp, and buckle.

2.05. FINISH FOR DOORS AND FRAMES
   A. Factory-applied industrial, gloss polyurethane with preparation and prime coats as needed to meet performance requirements.
   B. Color as directed by the County Engineer.

PART 3 EXECUTION

3.01. EXAMINATION
   A. Verify substrate conditions before installing frames, as beginning of installation indicates acceptance.

3.02. INSTALLATION
   A. Install doors in accordance with SDI Fact File.
   B. Field alterations shall not be allowed. Modify at manufacturer’s factory.

3.03. ADJUSTING AND CLEANING
   A. Adjust door for smooth and balanced movement.
B. Remove dirt and excess sealant from exposed surfaces.

END OF SECTION
SECTION 08710
DOOR HARDWARE

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Hardware for doors, including, but not limited to, thresholds, hinges, locksets, closers, and weatherstripping/gasketing.

   1. All finish hardware necessary to complete the work, and all parts necessary to put all hardware in operating condition.

B. Locksets shall be compatible with County's existing master key and core system. Contractor shall coordinate with the County and County Engineer.

1.02. REFERENCES

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<tr>
<td>ANSI/BHMA A156.13</td>
<td>Mortise Locks and Latches</td>
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</table>

1.03. SUBMITTALS

A. Submittal shall include:

   1. Hardware Schedule – Submit in vertical format as illustrated by the DHI's “Sequence and Format for the Hardware Schedule.” Hardware schedule shall clearly indicate the hardware group and the manufacturer of each item proposed.

      a. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.

   2. Manufacturer’s product data and specifications with selections and criteria highlighted in a fashion that is visible when printed copies are made.

B. Manufacturer’s Installation Instructions - Indicate special procedures, perimeter conditions requiring special attention, and provide special tools of each size and type required for adjustment of hardware items. Turn over to Owner in good condition at project's end.
1.04. OPERATION AND MAINTENANCE DATA

A. Provide to Owner maintenance and adjustment data, templates, catalog pages for each product, special tools required for servicing hardware components that would only be available from hardware manufacturer, and name, address and phone number of a local representative for each manufacturer.

1. Provide hands-on training in maintenance, adjustment and use of special tools required and furnished by hardware supplier.

1.05. QUALITY ASSURANCE

A. Hardware supplier is responsible for providing fire-rated hardware where necessary.

B. Qualifications of Manufacturers - Products used in the work of this section shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of successful production acceptable to the County Engineer.

1.06. REGULATORY REQUIREMENTS

A. Work shall conform to 2012 IBC adopted by the State of Maryland, with Maryland Amendments.

B. Hardware supplier is responsible for providing proper hardware to meet UL requirements.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Individual hardware items to be packaged and labeled. Package individual hardware items into labeled hardware sets.

B. Deliver keys to Owner by security shipment or certified mail direct from hardware supplier. Deliver “construction keying” masters that will void construction keys at substantial completion.

1. Maintain original master and each change key in secure location.

C. Protection – Use all means necessary to protect materials of this section before, during and after installation and to protect installed work and materials of all other trades.

D. Replacements – In the event of damage, immediately make all repairs and replacements necessary to the approval of the County Engineer at no additional cost to the Owner.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Burns Manufacturing, Erie, PA.

B. Corbin Russwin, Monroe, NC.

C. Dorma Architectural Hardware, Reamstown, PA.

D. Glynn-Johnson, Indianapolis, IN.
E. Hager Companies, St. Louis, MO.
F. Ives, Indianapolis, IN.
G. National Guard Products.
H. Pemko Mfg. Co., Memphis, TN.
I. Rockwood Mfg. Co., Rockwood, PA.
J. SARGENT Manufacturing Company, New Haven, CT
K. Schlage Allegion, Dublin, Ireland
L. The Stanley Works, New Britain, CT.
M. Or equal.

2.02. PRODUCTS SUPPLIED

A. Provide all hardware, fasteners, and accessories necessary to achieve fully functioning and smoothly operating doors in compliance with the applicable codes.

B. Wherever technically feasible, all hardware of the same functional type shall be from a single manufacturer throughout the project, regardless of door material or other variables. For example, all door closers shall be from a single manufacturer. Locksets may be from a different manufacturer than door closers, but all locksets must be from a single manufacturer.

2.03. HARDWARE TYPES

A. Thresholds to be extruded aluminum with skid-resistant surface, meeting ADA requirements.
   1. Thermal barrier threshold (5 inches wide); National Guard Products 8425, Pemko 252x3AFG, or equal.
   2. Saddle threshold (5 inches wide); use with interior doors where threshold is scheduled.
      a. National Guard Products - 425
      b. Pemko - 171A.
      c. Or equal.

Thresholds and saddles are to be set in full bed of sealant, coped to frame, and secured with countersunk stainless steel screws and expansion shields.

B. Mortised Hinges - 4-1/2-inch by 4-1/2-inch for doors up to and including 38-inch wide doors; 5-inch by 5-inch for doors over 38 inches in width, up to 48 inches in width. Provide with non-removable pins on exterior reverse bevel doors. Use three hinges per leaf up to and including 7 feet 6 inches and one additional hinge for each additional 30 inches of door height. Maximum spacing of 30 inches between hinges on transom door panels.
C. Locksets, Latch Sets, and Exit Devices

1. Provide locksets, latch sets, and exit devices as shown by the table below. Locksets and latch sets to be Grade 1 per the applicable standards: ANSI/BHMA A156.2 or ANSI/BHMA A156.13.

2. Acceptable Manufacturers
   a. Corbin Russwin
   b. Sargent
   c. Schlage
   d. Dorma
   e. Or equal

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
<th>ANSI Function</th>
<th>Sargent Product</th>
<th>Corbin Russwin Product</th>
<th>Dorma Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Passage lockset, single door</td>
<td>F01</td>
<td>8215 LE2L</td>
<td>ML2010 NSP</td>
<td>ML9040 CLCM</td>
</tr>
<tr>
<td>L2</td>
<td>Privacy lock, single door</td>
<td>F02</td>
<td>8215 LE2L</td>
<td>ML2020 NSP</td>
<td>ML9040 CLCM</td>
</tr>
<tr>
<td>L3</td>
<td>Dormitory lock, single door</td>
<td>F13</td>
<td>8225 LE2L</td>
<td>ML2065 NSP</td>
<td>ML9056 CLCM</td>
</tr>
<tr>
<td>L3A</td>
<td>Storage and entrance lock, single door</td>
<td>F04</td>
<td>8878 LE2L</td>
<td>ML20834 NSP</td>
<td>--</td>
</tr>
<tr>
<td>L4</td>
<td>Exit – single door with lock, exterior lever</td>
<td>F08</td>
<td>8977 777 ETL</td>
<td>ED5200 x 9834/9MAC2</td>
<td>--</td>
</tr>
<tr>
<td>L5</td>
<td>Exit – pair of doors, with lock, Rim device active leaf, exterior lever at active leaf; vertical rod exit device inactive leaf, no exterior trim; meeting astragal.</td>
<td>F08 x F08</td>
<td>8877 777-8 ETL x 8710</td>
<td>ED5200 x 9834/9MAC2 x ED 5400 N9M55</td>
<td>--</td>
</tr>
<tr>
<td>L6</td>
<td>Exit – single door, no lock, exterior lever</td>
<td>F14</td>
<td>12-8915 x 715 ETL</td>
<td>ED5200 x 9834/9MAC2</td>
<td>9500 x YC23M</td>
</tr>
<tr>
<td>L7</td>
<td>Exit – pair of doors, no lock, exterior lever. Rim device active leaf; vertical rod exit device inactive leaf, no exterior trim; meeting astragal.</td>
<td>F14 x F14</td>
<td>8902 x ETL 8702 x ETL</td>
<td>ED5200 x 9834/9MAC2 X ED5400 N9M55</td>
<td>9500 x YC23M 9500 x YC23_</td>
</tr>
<tr>
<td>Designation</td>
<td>Description</td>
<td>ANSI Function</td>
<td>Sargent Product</td>
<td>Corbin Russwin Product</td>
<td>Dorma Product</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>L8</td>
<td>Exit – pair of doors with split upper leaves, with lock. Rim device active leaf, exterior lever at active leaf; locking of inactive leaves by automatic flush bolts w/chain activation, provide per 2.03.L</td>
<td>F08</td>
<td>8902 x ETL</td>
<td>ED5200 x 9834/9MAC2</td>
<td>--</td>
</tr>
</tbody>
</table>

3. Provide push bar fire exit hardware for labeled doors and panic hardware for non-labeled doors. Locks and latches to be mortise type. UL classify exit devices.


5. For locking hardware, provide six-pin interchangeable core lock cylinders to accept cores compatible with Owner’s existing master key system.

6. Lock trim shall be through bolted through the lockcase to assure correct alignment and proper operation.

7. All locks, trim, and cylinders shall be from one manufacturer.

8. Aluminum (interior) vestibule doors shall be push-pull only using manufacturer’s standard clear anodized devices.

D. Door closers to be sized per manufacturer’s recommendations for width of door. Parallel arm mounting with heavy duty hold-open arms at exterior, out-swinging doors. Use non-metallic, corrosion-resistant covers. Provide without hold-open on rated doors.

<table>
<thead>
<tr>
<th>Corbin Russwin</th>
<th>Sargent</th>
<th>Dorma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>DC6210</td>
<td>351</td>
</tr>
</tbody>
</table>

1. Include brackets for closers at outswinging exterior doors.

2. Devices shall be equipped with adjustable back check valves to prevent door or closer from striking adjacent wall or equipment.

E. Door Protection Plates - 0.050-inch stainless steel US32D plate, four sides beveled, 2 inches less than door width.

1. Stainless steel attachment hardware.

<table>
<thead>
<tr>
<th>Burns</th>
<th>Ives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kickplate (10-inch high)</td>
<td>KP50</td>
</tr>
<tr>
<td>Mop plate (4-inch high)</td>
<td>MP50</td>
</tr>
<tr>
<td>Armor plate (42-inch high)</td>
<td>AP50</td>
</tr>
</tbody>
</table>

F. Astragal Weatherstripping – Clear anodized aluminum retainer with silicone seal. Surface mounted center meeting (pair).
G. Head and Jamb Weatherstripping – Clear anodized aluminum retainer with silicone seal.

<table>
<thead>
<tr>
<th>National Guard Products, Inc.</th>
<th>Pemko</th>
</tr>
</thead>
<tbody>
<tr>
<td>137SA</td>
<td>303CS</td>
</tr>
</tbody>
</table>

H. Smoke and Draft Seals at Fire-Rated Doors

1. In-kerf seals at head and jamb equal to Smoke-Tech by CECO.

2. Where integral kerf is not provided, self-adhesive fire and smoke gasketing equal to S44 SiliconSeal by Pemko. Select color to match or blend with frame color.

I. Door Sweep – Stainless steel or aluminum retainer with neoprene seal: mounted on bottom of door in contact with threshold.

<table>
<thead>
<tr>
<th>National Guard Products, Inc.</th>
<th>Pemko</th>
</tr>
</thead>
<tbody>
<tr>
<td>160SA</td>
<td>303SNS</td>
</tr>
</tbody>
</table>

J. Door Silencers - Resilient rubber, fitted into drilled hole on all non-rated interior doors; three at jambs of single doors and two at head for each leaf of double doors.

<table>
<thead>
<tr>
<th>Ives</th>
<th>Rockwood</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR64</td>
<td>608</td>
</tr>
</tbody>
</table>

K. Door Stops - Locate for maximum swing, wall stop for masonry, floor stop for GWB or where wall mounting is not acceptable. Finish US26D (BHMA 626).

<table>
<thead>
<tr>
<th>Ives</th>
<th>Rockwood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masonry application (wall)</td>
<td>WS401 CVX or WS401 CCV</td>
</tr>
<tr>
<td>GWB (floor stop)</td>
<td>FS17</td>
</tr>
</tbody>
</table>

L. Flush Bolts – Where indicated on Drawings, provide extension flush bolts on inactive leaf of pairs of doors at top and bottom of door.

1. Top strike and dustproof foot strike.

2. Top bolts 12 inches long except at doors over 7 feet 6 inches high, where length provided shall permit operation from floor.

3. Top Bolts at High Hinged Transoms - Surface-mounted, chain operated, spring return.

M. Or equal.
2.04. FASTENERS
   A. Fasteners shall be 316 stainless steel of proper types, sizes, and quantities. Provide all screws, special screws, bolts, special bolts, and other devices needed for proper application of hardware.

2.05. FINISHES
   A. All hardware to be stainless steel unless noted otherwise.
   B. Visible metal components are to be US32D wherever possible.

PART 3 EXECUTION

3.01. EXAMINATION
   A. Ensure that doors and frames are ready to receive work and dimensions are as indicated on shop drawings and instructed by the manufacturer.

3.02. INSTALLATION
   A. Install hardware in accordance with manufacturer’s instructions, Steel Door Institute Standards, NFPA 80 for fire doors, and NFPA 101 for exit doors.
   B. Install hardware after doors and frames have been finished, including field painting/finishing if required.
   C. Use templates provided by hardware manufacturer.
   D. Hardware required for passage shall be mounted no higher than 48 inches above finished floor.
   E. Door protection plates shall be installed on the push side of doors.

3.03. ADJUSTING
   A. Adjust hardware for smooth operation.
   B. All door closer parameters shall be properly adjusted, including closing speed, latching speed, backcheck, and delayed action.

3.04. ACCEPTANCE OF WORK
   A. Following installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work.
   B. Demonstrate that permanent keys operate respective locks then turn over to Owner as specified in this specification.
   C. Demonstrate that door closers backcheck, delay, and close properly.
   D. Correct, repair, and finish, as directed, errors in cutting and fitting or damage to adjoining work.
3.05. PROTECTION OF FINISHED WORK

A. Protect finished work from construction activity.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION
PART 1   GENERAL

1.01.    SECTION INCLUDES

A. Insulating safety glass assemblies for exterior doors.
B. Safety glass assemblies for interior doors.

1.02.    REFERENCES

A. National Fire Protection Association (NFPA)
   1. NFPA 80: Fire Doors and Other Opening Protective
   2. NFPA 252: Standard Method of Fire Tests of Door Assemblies
   3. NFPA 257: Standard for Fire Test of Window and Glass Block Assemblies

B. Underwriters Laboratories, Inc. (UL)
   1. UL 9: Standard for Safety of Fire Tests of Window Assemblies
   2. UL 10B: Standard for Safety of Fire Tests of Door Assemblies
   3. UL 10C: Standard for Safety of Positive Pressure Fire Tests of Door Assemblies

C. Consumer Product Safety Commission (CPSC)

D. Insulating Glass Certification Council (IGCC)
   1. Certified Products listing

E. National Fenestration Rating Council, Inc. (NFRC)

F. ASTM International
   1. ASTM E2190: Standard Specification for Insulating Glass Unit Performance and Evaluation

1.03.    PERFORMANCE REQUIREMENTS
A. Provide glass, glazing materials and glass assemblies that meet the performance requirements for each glazing mark or category listed in Part 2 of this section.

B. Where fire-rated or safety glazing is required: coordinate with door or frame suppliers to provide assemblies which are listed or labeled to provide the specified fire ratings and/or safety class.

C. Size exterior glass to withstand dead loads and positive and negative live loads acting normal to plane of glass to a design pressure of 25 pounds per square foot.
   1. Limit glass deflection to 1/200 with full recovery of glazing materials, whichever is less.

D. Safety glass (fully tempered glass) shall conform to Category II per CPSC 16 CFR 1201.

1.04. DEFINITIONS

A. Sealed Insulating Glass Unit Surfaces
   2. Side 2 – Interior surface of outer pane.

1.05. SUBMITTALS

A. Submit product data for each type of glass or glass assembly proposed for use on the project. Include evidence of testing and certification by approved agencies or laboratories.

B. Submit sample copies of all manufacturers’ standard warranties.

C. Coordinate with frame or door suppliers to ensure compatibility and performance of glazing with overall window and door assemblies.

1.06. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings and instructed by the manufacturer. Start of work implies acceptance of substrates.

PART 2 PRODUCTS

2.01. INSULATING SAFETY GLASS ASSEMBLIES

A. Glazing Mark - ISG
   1. Location - Glass in exterior doors.
   2. Description - Clear, insulating: two layers of .025-inch thick tempered glass with 0.50-inch air space.
      a. Low-emissivity coating on No. 2 surface.
b. Warm edge spacer.

3. Performance Requirements:
   a. Visible Light Transmittance - minimum 0.60.
   b. Winter Nighttime U of 0.30 ±0.05.
   c. Solar Heat Gain Coefficient (SHGC) - maximum of 0.50.
   d. Tested and qualified in conformance with ASTM E2190.
   e. Rated Category II in compliance with CPSC 16 CRF 1201.

4. Tempered Glass Manufacturers
   a. PPG Industries, Inc.
   b. Guardian Industries Corp.
   c. Or equal.

5. Fabricator
   a. Dlubak Corporation, Blairsville, PA.
   b. Trulite Glass & Aluminum Solutions, LLC, Cheswick, PA.
   c. Other fabricator making IGCC certified products and approved by the glass manufacturer.

2.02. SAFETY GLASS

A. Glazing Mark - SG

1. Location - Glass in interior doors.

2. Description - Single layer of clear .025-inch thick tempered glass.

3. Performance Requirements - Rated Category II in compliance with CPSC 16 CRF 1201.

4. Tempered Glass Manufacturers
   a. PPG Industries, Inc.
   b. Guardian Industries Corp.
   c. Or equal.

5. Fabricator
   a. Dlubak Corporation, Blairsville, PA.
   b. Trulite Glass & Aluminum Solutions, LLC, Cheswick, PA.
2.03. GLAZING MATERIALS AND ACCESSORIES

A. As recommended by door or framing system manufacturer for installed location.
B. As required to meet fire rating, safety rating and structural requirements.
C. Compatible with frame materials and finishes, and with spacer assemblies for insulating units.

PART 3  EXECUTION

3.01. EXAMINATION

A. Verify prepared openings at job site as prepared by others. Measure frames at job site or rely on guaranteed dimensions provided by frame supplier.
B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.02. PREPARATION

A. Clean contact surfaces with solvent and wipe dry.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant as required by glass manufacturer.

3.03. GLAZING

A. Install products using the recommendations of manufacturers for glass, sealants, gaskets, and other glazing materials except where more stringent requirements are indicated, including those in FGMA Glazing Manual.
B. Protect glass from edge damage during handling and installation.
C. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter.
D. Remove and replace glass that is broken, chipped, cracked or damaged in any way.

3.04. CLEANING

A. Remove glazing materials from finish surfaces.
B. Remove labels and clean glass and mirrors after work is complete.

END OF SECTION
PART 1   GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install a multi-coat seamless flooring system and all required accessories. The system is to be applied to all concrete walking surfaces in the Building 2 centrifuge room, electrical room, and control room. The system includes, but is not limited to the following:

1. Moisture vapor transmission testing. Corrective treatment if required to create proper application conditions.
2. Surface preparation and cleaning, including abrasive blasting.
3. VOC compliant epoxy primer and sealer.
4. VOC compliant polyaspartic or polyamine epoxy top coating, applied in two coats, with embedded broadcast silica sand to achieve a slip-resistant surface.
5. VOC compliant aliphatic urethane top coat in areas of two colors.
6. Graphics, including stripes and lettering, of the same urethane material as the top coats, in a third and contrasting color, applied to the topcoat where directed by County.
7. Joint treatments at control joints, floor/wall intersections and other interruptions in slab surface.

B. Mock-up location shall be of size and complexity as specified herein.

1.02. REFERENCES

A. ASTM D4258 – Standard Practice for Surface Cleaning Concrete for Coating
B. ASTM D4259 – Standard Practice for Abrading Concrete
C. ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
F. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
I. SSPC-SP13/NACE 6 - Concrete

1.03. SUBMITTALS

A. Initial Submittal – Provide all initial submittal information concurrently under a single submittal. Submittals shall include, but not be limited to, the following:

1. Product Data - Provide data on specified products, including test results demonstrating compliance with specified requirements. Include product literature for all accessory materials.

2. Color Chart - Submit color charts showing the manufacturer’s full range of available colors for top coat materials.

3. Manufacturer’s Installation Instructions - Indicate special procedures if required for this specific installation.

4. Shop Drawings – Provide large scale details showing control joints, expansion joints, terminations at floor drains, transitions to adjacent floor materials, cove base details, and other site-specific conditions. Show specific details of adjacent construction for this project.

5. Maintenance Data - Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

6. Installer’s Qualifications – Provide a letter from the finish system manufacturer verifying that the installing Contractor’s personnel have been trained by the manufacturer in the installation of the specified system, or a system with similar installation requirements; and stating the manufacturer’s approval of the installing Contractor for this Work.

B. Preconstruction Submittals – After approval of the specified products and selection of colors; provide the following submittals:

1. Floor Finish and Graphics Mock-Up – To demonstrate workmanship and uniformity of coating thickness: install entire system, including color changes and stripes, to a portion of the floor as directed by County. If the mock-up work is sufficiently uniform and precise to satisfy County; it may remain in place as part of the final installation. If not satisfactory, the finish in this area must be partially or wholly removed and reinstalled until it provides a satisfactory example of the standard expected for the locations scheduled to receive this finish.

2. Slabs scheduled to receive the epoxy floor finish are to be tested for humidity within the slab and moisture vapor transmission. Data for ASTM D4263, ASTM F1869, and ASTM F2170 tests are to be recorded and copies submitted to the floor finish manufacturer’s representative and to the County.

3. Letter from the floor finish manufacturer’s representative stating that s/he has reviewed the humidity and moisture vapor transmission reports, and has inspected the surface preparation for the floor finish, and certifies that these reports and observations indicate conditions that are compliant with the manufacturer’s recommended conditions.

1.04. QUALIFICATIONS
A. Manufacturer’s Representative – Individual qualified to inspect surface preparation conditions and assess the suitability of environmental conditions for successful application of the specified system. The individual must also be empowered to approve the granting of a warranty for the completed Work.

1.05. REGULATORY REQUIREMENTS

A. Floor finish shall be classified under NFPA 253 as either Class I or Class II.
B. Conform to COMAR 26.11.33 including the VOC content limits listed under 26.11.33.05.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Store finish component materials in a dry, secure area.
B. Maintain a minimum temperature of 55 degrees F.
C. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.07. ENVIRONMENTAL REQUIREMENTS

A. Do not install finish system unless substrate surface temperature, substrate moisture content, and air temperature and humidity are all within the recommended ranges specified by the system manufacturer.
B. Maintain curing conditions as recommended by the system manufacturer.

1.08. WARRANTY

A. Provide one-year warranty.
B. Warranty shall include coverage against flooring delamination from substrate and degradation of surface finish.

1.09. EXTRA MATERIALS

A. Provide 2 gallons of flooring material of each color selected.

PART 2    PRODUCTS

2.01. MANUFACTURERS

A. Entire system is to be supplied by a single manufacturer.
B. Acceptable manufacturers:
   1. Carboline Company, St. Louis, MO
   2. Tnemec Company Incorporated, Kansas City, MO
   3. Other manufacturer with product of same generic type and equal performance, as determined by County.
2.02. SYSTEMS

A. The complete coating system shall include the following components at a minimum:

1. Epoxy filler and primer.
2. Modified polyamine epoxy or high-solids polyaspartic base coat.
3. Silica aggregate applied between base and intermediate coats to attain a slip-resistant texture to the floor finish.
4. Modified polyamine epoxy or high-solids polyaspartic intermediate coat.
5. Aliphatic moisture cured urethane or aliphatic acrylic polyurethane surface coat, applied in separate colors for field and walkway areas as directed by County.

2.03. ACCESSORIES

A. Vapor Blocking Mortar or Liquid Vapor Retarder

1. To be used only if required to meet the installation requirements for humidity and moisture vapor transmission of the substrate.
2. Type recommended by the finish system manufacturer for the particular project conditions.

B. Installation Accessories for Control Joints, Movement Joints and Cove Base

1. As recommended by the system manufacturer and shown on approved shop drawings.
2. Include as needed: joint sealants, compressible backers, reinforcing fabrics and edge termination sealants or trim.
3. Special installation tools recommended by the system manufacturer.

2.04. COLORS

A. Primer – Manufacturer’s standard color.

B. Base Coat – Light, neutral color that contrasts with intermediate/surface coat so that coverage may be visually verified.

C. Surface Coat – As selected by County.

2.05. BASE

A. Base Details

1. Cant cove where floor slab abuts or passes under concrete block or drywall partitions, 6-inches tall.
2. Compatible urethane sealant over compressible filler where floating slab terminates adjacent to exterior walls.
PART 3   EXECUTION

3.01. EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 1/4 inch in 10 feet and are ready to receive work.

B. Verify concrete floors have cured a minimum 28 days, meet manufacturer’s recommendations for humidity and moisture vapor transmission, and exhibit negative alkalinity, carbonization, or dusting.

C. If moisture testing exceeds manufacturer’s limits, install manufacturer approved vapor barrier such as vapor blocking mortar. Verify that slabs with barrier meet manufacturer’s recommended limits.

D. Verify floor is free of substances that may impair adhesion of new adhesive and finish materials.

3.02. PREPARATION

A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.

B. Shot blast or mechanically abrade (scarify) to remove laitance, curing compounds, sealers, and other contaminants, and provide required surface profile per flooring manufacturer.

C. Vacuum clean substrate.

D. Conformance to ASTM D4258 and ASTM D4259, or SSPC-SP13/NACE 6, is the minimum acceptable level of preparation.

3.03. INSTALLATION - FLOORING

A. Before starting installation: verify that substrate temperature, air temperature and relative humidity are within the manufacturer’s recommended ranges and will remain stable during curing times.

B. Apply each layer of the system in accordance with manufacturer's instructions.

C. Apply each layer at the upper end of the manufacturer’s recommended thickness.

D. Broadcast silica or quartz aggregate at layer in system as recommended by the manufacturer to achieve the required slip resistance.

E. Sequence the installation of joint and base accessories as recommended by the system manufacturer to achieve the details shown by approved shop drawings.

F. Install surface coat materials where shown on drawings and as directed by County.

3.04. PROTECTION OF FINISHED WORK

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to permit uninterrupted curing.
C. Install base divider strips at all boundaries between sections of finish installed at different times.

END OF SECTION
PART 1 GENERAL

1.01. SECTION INCLUDES

A. Interior and exterior wall-mounted fiberglass signs.
B. Exterior wall-mounted or post-mounted parking space designation aluminum signs.
C. Safety warning signs.
D. Instructional signs.

1.02. SUBMITTALS

A. Manufacturer’s Data - Submit descriptive literature and specifications, including color chart.
B. Submit shop drawings depicting sign styles, lettering font, foreground and background colors, locations above finished floor and adjacent to doors, a list of all signs to be provided indicating sign location and text, and overall dimension of each sign and method of attachment.
C. Submit manufacturer’s standard warranty information.

1.03. REGULATORY REQUIREMENTS

B. Exterior wall-mounted or post-mounted signs designating accessible parking spaces shall conform to ICC/ANSI A 117.1 – 2010 - Accessible and Usable Buildings and Facilities, and shall also conform to the applicable sections of Maryland State Building Performance Standard.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. For Interior and Exterior Wall-Mounted Fiberglass Signs

1. Best Sign Systems, Inc., Montrose, CO.
   www.bestsigns.com (800) 235-2378
2. Apco Signs, Atlanta, GA.
   www.apcosigns.com (877)988-2726
3. Or equal.

B. Exterior Post-Mounted Signs
1. Emed Co. Inc., Chicago, IL.  
   www.emedco.com (800) 442-3633

2. Brimar Industries, Inc, Garfield, NJ  
   www.safetysign.com (800) 274-6271

3. Or equal.

C. Safety Warning Signs

1. Seton Identification Products, Branford, CT.  
   www.seton.com (800) 571-2596

2. Emed Co. Inc., Chicago, IL.  
   www.emedco.com (800) 442-3633

3. Or equal.

D. Instructional Signs

1. Interior and exterior wall-mounted fiberglass signs.

2. Best Sign Systems, Inc., Montrose, CO.  
   www.bestsigns.com (800) 235-2378

3. Apco Signs, Atlanta, GA.  
   www.apcosigns.com (877)988-2726

4. Or equal.

2.02. SIGNS

A. Interior Room Designation Signs

1. Etched fiberglass with non-glare, UV-resistant painted surface.

2. Base material thickness to be 0.125 inch.

3. Minimum Width - 10 inches; minimum height: 3 inches.


5. Raised white letters on black background.

6. Vinyl foam tape mounting.

7. Best Sign Systems HC300, equal series by Apco Signs, or equal.

B. Exterior Room Designation Signs

1. Etched fiberglass with non-glare, UV-resistant painted surface.

2. Base material thickness to be 0.25 inch.

3. Minimum Width - 10 inches; minimum height: 3 inches.

5. Raised white letters on black background.

6. Mounting by countersunk stainless steel screws in pre-drilled holes with expansion sleeves. Plastic spacing sleeves behind signs as required to attain plum and true alignment.

7. Best Sign Systems HC300, equal series by Apco Signs, or equal.

C. Exterior Wall-Mounted or Post-Mounted Parking Space Designation Aluminum Signs


2. Duroshield Tedlar top coat.

3. Handicapped Parking Space Designation Signs
   a. Text and graphics shall be as required by the referenced regulatory requirements, with the International Symbol of Accessibility.
   b. Width 12 inches; height 24 inches.
   c. Emed Co. Item Number 30840, equal by Mbimar Industries, Inc., or equal.
   d. White lettering against a blue background.

D. Mounting Posts for Exterior Signs


2. Stainless steel bolts for attaching the sign.

3. Minimum Length - Size so that the bottom edge of the sign is 5 feet minimum above the adjacent pavement or walking surface.

4. Minimum Post Embedment - 3 feet.

E. Safety Warning Signs/Equipment Signs

1. Where self-adhesive application is possible: flexible vinyl with a clear polyester coating or high-performance polyester.

2. Where it is necessary to mount the sign on railings or other framework near the hazard: 0.063-inch aluminum secured with stainless steel U-bolts or other appropriate stainless steel fasteners.

3. Rectangular signs are to be a minimum size of 10 inches wide by 7 inches high.

4. Chemical hazard diamonds are to be vinyl decals or rigid plastic depending on mounting conditions. 11 inches by 11 inches minimum size, with hazard numbers intended for use on the sign material. Signs shall be supplied by manufacturer of chemical.

F. Interior and Exterior Instructional Signs
1. Etched fiberglass with non-glare, UV-resistant painted surface.

2. Base material thickness to be 0.25 inch.

3. Minimum width 10 inches; minimum height 3 inches.


5. Raised white letters on black background.

6. Mounting by countersunk stainless steel screws in pre-drilled holes with expansion sleeves. Plastic spacing sleeves behind signs as required to attain plum and true alignment.

7. Best Sign Systems HC300, equal product by Apco Signs, or equal.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning installation means installer accepts existing surfaces.

3.02. INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install signs after doors and surfaces are finished.

C. Room identification signs shall be mounted:
   1. So that the baseline of characters shall be no less than 48 inches above, and no more than 60 inches above, the adjacent floor or ground surface.
   2. Outside the room on the wall next to the door on the latch side. For double doors, the sign shall be mounted to the right of the right-hand door.
   3. Where there is no wall space on the latch side of a single door, or to the right side of double doors, signs shall be mounted on the nearest adjacent wall.
   4. If wall space is not available in any of the locations designated in items 1 through 3 above, signs may be mounted on the push side of doors provided that the doors are equipped with closers but do not have hold-open devices.
   5. The same location specifications apply to signs associated with doors whether at the interior or at the exterior of buildings.

D. Parking space designation signs shall be either wall or post mounted so that the bottom edge of the sign is 5 feet above the adjacent walking surface or pavement.

E. Safety warning signs shall be mounted so as to be clearly visible to the person approaching the equipment or area referenced by the sign. Sign locations shall be in compliance with OSHA regulations. Where possible, signs are to be mounted directly on the tanks, cabinets,
or equipment referenced by the safety message. Coordinate mounting locations with County Engineer.

F. Instructional signs shall be mounted:

1. So that the baseline of characters shall be no less than 48 inches above, and no more than 60 inches above, the adjacent floor or ground surface.

2. Outside and the room on the wall next to the operating hardware of the overhead door.

3.03. REQUIRED SIGNS

A. Room Designation Signs - Provide sign with room name on doorway or entrance to each room of each building. Exterior doors are also to be labeled, on the exterior side of the wall, with the name of the room to which the door gives access.

B. Provide red “NON-POTABLE WATER - DO NOT DRINK” safety signs at the following locations:

1. Hose bibbs.

2. All other locations providing non-potable (plant water) or plant effluent water sources.

C. Provide “LIFTING CAPACITY ___ TON”; red safety signs for all lifting cranes, monorails, and beams that are intended for lifting.

*Insert capacity. The asterisk in the preceding text shall be replaced by the lifting beam capacity, or the lifting capacity stated in the approved submittal for monorails, as applicable.

D. Equipment Designation Signs - Provide wall- or handrail-mounted equipment designation sign adjacent to each major equipment item, gate or control valve. Sign shall have full name of equipment and equipment I.D. both stated.

E. Provide “CAUTION - EQUIPMENT STARTS AUTOMATICALLY” red safety signs at all equipment that can be remotely started.

F. Provide “NO SMOKING” signs inside all entrances to new or rehabilitated buildings:

G. Provide red “CONFINED SPACE” sign with wording required by OSHA at appropriate locations created by the work.

H. Fire Extinguisher – Provide identifying sign at each new unit.

I. Provide red “EXIT” signs above inside face of all exterior doors for the following locations:

1. All new exterior doors.

(continued)
PART 1   GENERAL

1.01. DESCRIPTION OF WORK

A. Design, furnish, install, and test rotary lobe pumps complete with motors, frames, upstream grinder, and all other required accessories in accordance with the Contract.

1.02. REFERENCES

A. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
B. ASTM A470/A470M – Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts
D. ANSI B16.5 – Pipe Flanges and Flange Fittings
E. SAE 1045
F. Hydraulic Institute Standards – Latest Edition

1.03. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings
   a. Provide a bill of materials for all supplied equipment and accessories.
   b. Provide operating characteristics, nameplate data, and maximum recommended starts per hour for pump motor.
   c. Submit wiring diagrams showing power and control wiring terminal connections including wiring identification and color coding.
   d. Indicate junction box sizing for power and control wiring connections.

2. Shop testing results.

3. Manufacturer’s installation certificate.

4. Certification of equipment compliance.

5. Field testing results.

6. Provide operation and maintenance manuals and data.

1.04. PERFORMANCE REQUIREMENTS

A. Pumps shall be capable of continuous, stable operation under the following conditions:
1. Centrifuge Sludge Feed Pumps

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum number of installed pumps</td>
<td>2</td>
</tr>
<tr>
<td>Location</td>
<td>Building 23</td>
</tr>
<tr>
<td>Service</td>
<td>Mix of primary sludge, waste activated sludge (WAS), and septage with upstream grit removal, 1.0-4.5% solids</td>
</tr>
<tr>
<td>Drive type</td>
<td>Variable speed</td>
</tr>
<tr>
<td>Minimum combined flow capacity with all installed pumps operating at full speed</td>
<td>Equal to combined hydraulic throughput capacity of all centrifuges supplied under Section 11360 at 2.0% feed solids</td>
</tr>
<tr>
<td>Total dynamic head</td>
<td>As required for application based on anticipated operating conditions</td>
</tr>
</tbody>
</table>

B. The grinder upstream of the rotary lobe pumps shall be capable of continuous dry or wet operation at flows up to the total combined flow capacity of the rotary lobe pumps supplied under this Section.

1.05. SPARE PARTS

A. Furnish the following spare parts, in clearly identified dust-proof containers:

1. One set of all mechanical seals, gaskets, O-rings and other expendable parts supplied.

2. One set of belts or motor couplings.

1.06. EQUIPMENT WARRANTIES AND SPECIAL GUARANTEES

A. The Supplier shall provide the following warranties and special guarantees:

1. The equipment manufacturer shall guarantee for a period of one-year starting at the time of Substantial Completion that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer’s recommendations. The manufacturer shall correct any breach in this warranty at their expense.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
</table>
| Acceptable pump manufacturers            | • Vogelsang  
• Boerger  
• Or equal                                                                                                                                                                                                                                                                 |
| Acceptable grinder manufacturers         | • Vogelsang  
• Moyno  
• JWC Environmental  
• Or equal                                                                                                                                                                                                                   |
| Or-equal manufacturer experience requirements | • Demonstrate in writing to the satisfaction of COUNTY that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the Bid Due date. |

2.02. EQUIPMENT DESIGN

A. Rotary Lobe Pumps

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
</table>
| Casing                                   | • Heavy duty cast iron.  
• Removable front cover for access to casing interior and wet end components without disconnecting suction or discharge piping, bearings, or mechanical seals.  
• Designed to minimize recesses or dead pockets where solids can accumulate.  
• Replaceable front and rear wear plates.                                                                                                                                                        |
| Rotors                                    | • Two rotors gear driven by timing gears running in oil.  
• Solid cast iron cores coated with NBR.  
• Rotor vanes designed for pulse-free operation.                                                                                                                                                         |
| Rotor shafts                              | • ASTM carbon steel with replaceable stainless steel sleeves where passing through seal areas.  
• Dynamically balanced.                                                                                                                                                                                                                                           |
| Bearings                                  | • Integral to pump.  
• Oil or grease lubricated.  
• Designed for minimum L-10 life of 100,000 hours under design operating conditions.                                                                                                                                                                                      |
| Seals                                     | • Cartridge seals with Duronite or silicon carbide faces.                                                                                                                                                                                                                      |
| Connections and Joints                    | • 125 pound flange connections to adjacent process piping.                                                                                                                                                                                                                     |
| Motors and Drives                         | • Direct-coupled or belt drive system.  
• Galvanized steel or aluminum belt/coupling guard.                                                                                                                                                                                                                           |
### Minimum Requirements

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Inverter duty motors.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum speed of 1,800 rpm.</td>
</tr>
<tr>
<td></td>
<td>NEMA Design B, continuous duty, Class F insulation, TEFC.</td>
</tr>
<tr>
<td></td>
<td>Integral motor winding thermostats.</td>
</tr>
</tbody>
</table>

Base

- Pump, motor, and accessories mounted on fabricated steel baseplate with drop pot.

### Grinder

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Cutter and drive assembly capable of removal from main housing without further disassembly, including cutters, spacers, shafts, gears, reducers, motor, bearings, and seal cartridges.</td>
</tr>
<tr>
<td>Cutters and Spacers</td>
<td>Constructed of heat treated alloy steel</td>
</tr>
<tr>
<td></td>
<td>Through-hardened to minimum 60 Rockwell C.</td>
</tr>
<tr>
<td></td>
<td>Surface ground for uniformity.</td>
</tr>
<tr>
<td></td>
<td>Minimum of two columns of cutters and spacers, overlapped to achieve sufficient maceration of debris in process flow</td>
</tr>
<tr>
<td>Shafts</td>
<td>Constructed of heat treated steel with minimum tensile strength of 149 ksi.</td>
</tr>
<tr>
<td></td>
<td>Intermediate shaft support of stainless steel collar and bushings provided for columns 24 inches or more in height.</td>
</tr>
<tr>
<td>Main housing</td>
<td>One piece, in-line configuration.</td>
</tr>
<tr>
<td></td>
<td>Solid cast iron or ductile iron construction.</td>
</tr>
<tr>
<td></td>
<td>Flanged connections.</td>
</tr>
<tr>
<td></td>
<td>Inside profile matching shape of cutters with clearance not to exceed 5/16 inch.</td>
</tr>
<tr>
<td></td>
<td>Covered access port for inspection of interior components.</td>
</tr>
<tr>
<td>Bearings and Seals</td>
<td>Sealed ball bearings at each end of cutter shafts.</td>
</tr>
<tr>
<td></td>
<td>Bearings protected by replaceable mechanical seals.</td>
</tr>
<tr>
<td></td>
<td>Bearings and seals housed in removable and replaceable cartridges which provide protection from axial loads during shaft deflection.</td>
</tr>
<tr>
<td></td>
<td>Tungsten carbide seal faces.</td>
</tr>
<tr>
<td></td>
<td>Buna-N O-rings.</td>
</tr>
<tr>
<td></td>
<td>Designed for continuous operation without lubrication or flushing.</td>
</tr>
<tr>
<td></td>
<td>Designed for continuous duty up to 90 psig operating pressure.</td>
</tr>
</tbody>
</table>
### 2.03. ACCESSORIES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure gauges</td>
<td>• Provide on suction and discharge piping for each pump.</td>
</tr>
<tr>
<td></td>
<td>• Provide with elastomer diaphragm to isolate device from process fluid.</td>
</tr>
<tr>
<td>Pressure Sensors</td>
<td>• Pressure switch and/or sensor on suction and discharge piping.</td>
</tr>
<tr>
<td>ITEM</td>
<td>MINIMUM REQUIREMENTS</td>
</tr>
<tr>
<td>------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>• Provide with elastomer diaphragm to isolate device from process fluid.</td>
</tr>
<tr>
<td></td>
<td>• Configure to automatically stop pump in the event of a high pressure/vacuum condition.</td>
</tr>
</tbody>
</table>

2.04. CONTROLS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Manufacturer-supplied control components and associated enclosures for automatic operation of the equipment supplied herein.</td>
</tr>
<tr>
<td></td>
<td>• Integrate pump and grinder controls with controls for centrifuge equipment supplied under Section 11360.</td>
</tr>
<tr>
<td></td>
<td>• Local controls shall include a Hand-Off-Automatic switch for each unit, at a minimum.</td>
</tr>
<tr>
<td></td>
<td>• Controls shall be PLC-based and contain all features necessary to provide a complete, functional installation.</td>
</tr>
<tr>
<td></td>
<td>• Any control panels supplied shall be furnished as a coordinated assembly requiring only field connections of the power and control circuits.</td>
</tr>
<tr>
<td></td>
<td>• Any control logic required shall be based on an open programming environment which allows the County to make changes after the warranty period ends. The manufacturer will be required to provide a copy of the control logic to the County following the operational testing period.</td>
</tr>
<tr>
<td></td>
<td>• All electrical components shall be mounted in NEMA 4X enclosures for wet locations and NEMA 12 enclosures for dry locations at a minimum. Provide alternate ratings for electrical enclosures if necessary based on conditions of surrounding environment.</td>
</tr>
<tr>
<td>Sequence of operations</td>
<td>• Automatic pump controls shall operate the equipment as necessary to provide the flow and pressure required for the centrifuge equipment supplied under Section 11360.</td>
</tr>
<tr>
<td></td>
<td>• Automatic grinder controls shall be coordinated with operation of the downstream pumps.</td>
</tr>
<tr>
<td></td>
<td>• Provide safety features for the grinder, including reverse cycles to clear obstructions and motor overload relays.</td>
</tr>
<tr>
<td>Communications</td>
<td>• The control devices for the pumps and grinders shall be capable of remote communication with the control system for the centrifuge equipment supplied under Section 11360 for monitoring and control of the equipment supplied herein.</td>
</tr>
</tbody>
</table>
2.05. FABRICATION REQUIREMENTS

A. Shop coat per manufacturer’s standard finish system and color.

B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

C. Welds shall be continuous unless noted otherwise.

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

E. Furnish nameplates for each piece of equipment with tag numbers as indicated on the Drawings.
   1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
   2. Nameplates shall contain the manufacturer’s name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

2.06. SHOP TESTING

A. Shop test at minimum, maximum, and average design operating conditions to ANSI/HI 14.6, Acceptance Grade 1B.

B. Submit certified copies of test results for review and approval prior to shipment of the equipment to site.

PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

A. Install in accordance with the manufacturer’s written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of County Engineer.

C. Field verify all dimensions and elevations. Notify County Engineer of specific differences.

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.

H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline, DuPont 25P Epoxy, or equal.

I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.
3.02. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of a County representative and the equipment manufacturer’s approved representative.

C. Final acceptance of the equipment will be made after the following has been demonstrated in the field:
   1. That the units have been properly installed and are in proper alignment.
   2. That the units operate without overheating or overloading of any parts and without objectionable vibration.
   3. That there are no mechanical defects in any of the parts.
   4. That the pumps can meet the performance requirements listed herein. Contractor shall provide all temporary measuring devices as necessary to demonstrate performance.
   5. That the pumps can pass the size of solids specified and the type of liquid for which the pumps are to be used.
   6. That the motors are not overloaded in normal operating conditions.

D. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

E. Submit a field testing report for review and approval.

3.03. SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. A qualified representative of the equipment manufacturer shall be on site for the following activities:
   1. Field testing and equipment startup.
   2. Training
   3. As necessary to provide submittals specified herein.

END OF SECTION
PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Design, furnish, install, and test progressive cavity pumps complete with motors, frames, upstream grinder, and all other required accessories in accordance with the Contract.

1.02. REFERENCES

A. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
B. ASTM A470/A470M – Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts
D. ANSI B16.5 – Pipe Flanges and Flange Fittings
E. SAE 1045
F. Hydraulic Institute Standards – Latest Edition

1.03. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings
   a. Provide a bill of materials for all supplied equipment and accessories.
   b. Provide operating characteristics, nameplate data, and maximum recommended starts per hour for pump motor.
   c. Submit wiring diagrams showing power and control wiring terminal connections including wiring identification and color coding.
   d. Indicate junction box sizing for power and control wiring connections.

2. Shop testing results.

3. Manufacturer’s installation certificate.

4. Certification of equipment compliance.

5. Field testing results.

6. Provide operation and maintenance manuals and data.

1.04. PERFORMANCE REQUIREMENTS

A. Pumps shall be capable of continuous, stable operation under the following conditions:
1. Centrifuge Scum Feed Pumps

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum number of installed pumps</td>
<td>2</td>
</tr>
<tr>
<td>Location</td>
<td>Building 22</td>
</tr>
<tr>
<td>Service</td>
<td>Scum from aerobic digester</td>
</tr>
<tr>
<td>Drive type</td>
<td>Variable speed</td>
</tr>
<tr>
<td>Minimum combined flow capacity with all installed pumps operating at full speed</td>
<td>400 gpm</td>
</tr>
<tr>
<td>Total dynamic head</td>
<td>As required for application based on anticipated operating conditions</td>
</tr>
</tbody>
</table>

B. The grinder upstream of the progressive pumps shall be capable of continuous dry or wet operation at flows up to the total combined flow capacity of the progressive pumps supplied under this Section.

1.05. SPARE PARTS

A. Furnish the following spare parts, in clearly identified dust-proof containers:

1. One set of all mechanical seals, gaskets, O-rings and other expendable parts supplied.
2. One rotor.
3. One stator.
4. One set of belts or motor couplings.

1.06. EQUIPMENT WARRANTIES AND SPECIAL GUARANTEES

A. The Supplier shall provide the following warranties and special guarantees:

1. The equipment manufacturer shall guarantee for a period of one-year starting at the time of Substantial Completion that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer’s recommendations. The manufacturer shall correct any breach in this warranty at their expense.
### ITEM | MINIMUM REQUIREMENTS
--- | ---
Acceptable pump manufacturers | Moyno  
| Netzsch  
| Or equal

Acceptable grinder manufacturers | Vogelsang  
| Moyno  
| JWC Environmental  
| Or equal

Or-equal manufacturer experience requirements | Demonstrate in writing to the satisfaction of COUNTY that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the Bid Due date.

#### 2.02. EQUIPMENT DESIGN

A. Progressive Cavity Pumps

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
</table>
| Casing | Heavy duty cast iron.  
| Inspection ports for access to suction assembly interior without disconnecting piping. |
| Rotors | One piece alloy steel construction with integrally machined rotor head.  
| Minimum yield strength of 55 ksi.  
| Tungsten carbide coating. |
| Stators | Removable from suction and discharge assemblies.  
| Bonded inside tube designed for mounting within pump casing.  
| Replaceable gaskets to prevent pumped fluid from contacting mounting tube. |
| Bearings | Integral to pump.  
| Oil or grease lubricated.  
| Designed for minimum L-10 life of 100,000 hours under design operating conditions.  
| Protected by bearing cover. |
| Seals | Replaceable cartridge seal or stuffing box with split packing gland.  
| Packing, if used, shall be replaceable without removing the bearings or drive shaft.  
| Include all seal and/or flushing water components necessary for operation as recommended by pump manufacturer. |
### Connections and Joints
- 125 pound flange connections to adjacent process piping.

### Motors and Drives
- Hardened steel drive shaft.
- Inverter duty motors.
- Maximum speed of 1,800 rpm.
- NEMA Design B, continuous duty, Class F insulation, TEFC.
- Integral motor winding thermostats.

### Base
- Pump, motor, and accessories mounted on fabricated steel baseplate.

### B. Grinder

<table>
<thead>
<tr>
<th>Item</th>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>- Cutter and drive assembly capable of removal from main housing without further disassembly, including cutters, spacers, shafts, gears, reducers, motor, bearings, and seal cartridges.</td>
</tr>
</tbody>
</table>
| **Cutters and Spacers** | - Constructed of heat treated alloy steel  
- Through-hardened to minimum 60 Rockwell C.  
- Surface ground for uniformity.  
- Minimum of two columns of cutters and spacers, overlapped to achieve sufficient maceration of debris in process flow |
| **Shafts**        | - Constructed of heat treated steel with minimum tensile strength of 149 ksi.  
- Intermediate shaft support of stainless steel collar and bushings provided for columns 24 inches or more in height. |
| **Main housing**  | - One piece, in-line configuration.  
- Solid cast iron or ductile iron construction.  
- Flanged connections.  
- Inside profile matching shape of cutters with clearance not to exceed 5/16 inch.  
- Covered access port for inspection of interior components. |
| **Bearings and Seals** | - Sealed ball bearings at each end of cutter shafts.  
- Bearings protected by replaceable mechanical seals.  
- Bearings and seals housed in removable and replaceable cartridges which provide protection from axial loads during shaft deflection.  
- Tungsten carbide seal faces.  
- Buna-N O-rings. |
### Minimum Requirements

- Designed for continuous operation without lubrication or flushing.
- Designed for continuous duty up to 90 psig operating pressure.

**Motors and Drives**

- Maximum motor speed of 1,800 rpm.
- NEMA Design B, continuous duty, Class F insulation, TEFC.
- 1.15 service factor.
- Integral motor winding thermostats.

**Variable frequency drives (VFDs)**

- Constant torque, heavy duty, pulse-width modulation (PWM) drives with solid-state full wave diodes and IGBT power transistors.
- Compatible with associated motor and equipment applications.
- On-board alphanumeric digital display for programming and indication of set-up operating, circuit analysis, and diagnostic data.
- Lockable input circuit breaker.
- Set-up parameters shall be stored in EPROM memory that does not require battery backup.
- UL Listed and Labeled.
- Inner loop torque control strategy with mathematical torque and flux calculation updates every 25 microseconds (40,000 times per second).
- Drive efficiency shall be 95% or higher at full speed and load.
- An internally mounted 5% line reactor shall be provided.
- Output line filter for motors 40 hp or greater and applications where the motor is 150 ft or more from the VFD.
- An automatic motor parameter ID function shall define the motor equivalent circuit in the VFD.
- Equipped with Ethernet network communication module/card or fiber optics.
- Speed regulation of 0.5% or better.
- Torque signal accuracy of +/- 5%.
- Overload rating of 150% for 1 minute.
- Adjustable torque limiting of motor torque, 0 – 200%.
- Cleanable, replaceable filters in cooling air openings.
- As manufactured by Allen-Bradley, ABB or equal.

### Accessories

**Pressure gauges**

- Provide on suction and discharge piping for each pump.
- Provide with elastomer diaphragm to isolate device from process fluid.
# Pressure Sensors

- Pressure switch and/or sensor on suction and discharge piping.
- Provide with elastomer diaphragm to isolate device from process fluid.
- Configure to automatically stop pump in the event of a high pressure/vacuum condition.

## 2.04. CONTROLS

### General

- Manufacturer-supplied control components and associated enclosures for automatic operation of the equipment supplied herein.
- Integrate pump and grinder controls with controls for centrifuge equipment supplied under Section 11360.
- Local controls shall include a Hand-Off-Automatic switch for each unit, at a minimum.
- Controls shall be PLC-based and contain all features necessary to provide a complete, functional installation.
- Any control panels supplied shall be furnished as a coordinated assembly requiring only field connections of the power and control circuits.
- Any control logic required shall be based on an open programming environment which allows the County to make changes after the warranty period ends. The manufacturer will be required to provide a copy of the control logic to the County following the operational testing period.
- All electrical components shall be mounted in NEMA 4X enclosures for wet locations and NEMA 12 enclosures for dry locations at a minimum. Provide alternate ratings for electrical enclosures if necessary based on conditions of surrounding environment.

### Sequence of operations

- Automatic pump controls shall operate the equipment as necessary to provide the flow and pressure required for the centrifuge equipment supplied under Section 11360.
- Automatic grinder controls shall be coordinated with operation of the downstream pumps.
- Provide safety features for the grinder, including reverse cycles to clear obstructions and motor overload relays.

### Communications

- The control devices for the pumps and grinders shall be capable of remote communication with the control system for the centrifuge equipment supplied under Section 11360 for monitoring and control of the equipment supplied herein.
2.05. FABRICATION REQUIREMENTS

A. Shop coat per manufacturer’s standard finish system and color.

B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

C. Welds shall be continuous unless noted otherwise.

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

E. Furnish nameplates for each piece of equipment with tag numbers as indicated on the Drawings.
   1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
   2. Nameplates shall contain the manufacturer’s name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

2.06. SHOP TESTING

A. Shop test at minimum, maximum, and average design operating conditions to ANSI/HI 14.6, Acceptance Grade 1B.

B. Submit certified copies of test results for review and approval prior to shipment of the equipment to site.

PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

A. Install in accordance with the manufacturer’s written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of County Engineer.

C. Field verify all dimensions and elevations. Notify County Engineer of specific differences

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.

H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline, DuPont 25P Epoxy, or equal.
I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.02. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of a County representative and the equipment manufacturer's approved representative.

C. Final acceptance of the equipment will be made after the following has been demonstrated in the field:

1. That the units have been properly installed and are in proper alignment.

2. That the units operate without overheating or overloading of any parts and without objectionable vibration.

3. That there are no mechanical defects in any of the parts.

4. That the pumps can meet the performance requirements listed herein. Contractor shall provide all temporary measuring devices as necessary to demonstrate performance.

5. That the pumps can pass the size of solids specified and the type of liquid for which the pumps are to be used.

6. That the motors are not overloaded in normal operating conditions.

D. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

E. Submit a field testing report for review and approval.

3.03. SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. A qualified representative of the equipment manufacturer shall be on site for the following activities:

1. Field testing and equipment startup.

2. Training

3. As necessary to provide submittals specified herein.

END OF SECTION
PART 1    GENERAL

1.01. DESCRIPTION OF WORK

A. Design, furnish, install, and test liquid polymer feed systems complete with mixing chamber, dilution water controls, neat polymer pump, controls and all other required accessories in accordance with the Contract.

1.02. REFERENCES

A. AGMA – American Gear Manufacturers Association Standards
B. ASME – American Society of Mechanical Engineers
C. ASTM – American Society for Testing and Materials
D. ANSI – American National Standards Institute
E. American Welding Society
F. OSHA – Occupational & Safety Health Administration
G. IEEE – Institute of Electrical & Electronics Engineers

1.03. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings
   a. Provide a bill of materials for all supplied equipment and accessories.
   b. Submittals shall contain the NEMA type designation and manufacturer data describing the enclosures and showing its compliance with specifications and associated standards.
   c. Control panel assembly drawings detailing panel cut-out locations and sizes, back panel and device layout and locations.
   d. Provide electrical point to point wiring diagrams showing detailed internal wiring and wiring to field devices provided under this Section. Terminal blocks and wiring numbers shall be identified on the wiring diagrams.

2. Manufacturer’s installation certificate.

3. Certification of equipment compliance.

4. Field testing results.

5. Provide operation and maintenance manuals and data.

1.04. PERFORMANCE REQUIREMENTS

Mattawoman WWTP Centrifuge Project RFP #18-25
11123532 11348-1
A. Each polymer feed system shall be designed for automatic metering, dilution, activation, and feeding of ultra-high molecular weight liquid emulsion polymer solution and shall be capable of continuous operation in accordance with the following:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum number of feed systems</td>
<td>2 (1 installed standby)</td>
</tr>
<tr>
<td>Maximum neat polymer viscosity</td>
<td>75,000 cps</td>
</tr>
<tr>
<td>Finished polymer solution strength (active polymer)</td>
<td>0.1-1.0%</td>
</tr>
<tr>
<td>Available utility water pressure (approximate)</td>
<td>45 psig</td>
</tr>
<tr>
<td>Required discharge pressure, minimum</td>
<td>20 psig</td>
</tr>
<tr>
<td>Minimum design pressure rating of components</td>
<td>75 psig</td>
</tr>
</tbody>
</table>

A. The polymer feed system shall be capable of producing a constant polymer solution concentration by automatically controlling the neat polymer feed rate with either automatic or manual control of the dilution water flow rate as required for system operation as specified herein.

B. The polymer feed system shall be capable of delivering the finished polymer solution to the selected process injection points related to the dewatering centrifuge equipment. Additional polymer feed pumps shall be provided if necessary for delivery of the finished polymer feed solution.

C. Each dewatering centrifuge specified under Section 11360 shall be provided with a dedicated polymer feed system or polymer feed pump such that the polymer delivery rate to each individual centrifuge can be controlled separately.

D. The quantity and capacity of the polymer feed systems and pumps shall be designed such that the failure of an individual polymer feed system or pump does not reduce the capacity of more than one dewatering centrifuge.

E. The capacity of the polymer feed systems and pumps shall be selected to match the active polymer demand for the dewatering centrifuges specified under Section 11360. The polymer feed system or pump dedicated to each centrifuge shall be capable of delivering the full range of active polymer doses required for successful operation of the dewatering equipment. Variable output pumps, flow control valves, and other devices shall be used to adjust the output of the polymer feed equipment to match the active polymer demand at any given time.

1.05 SPARE PARTS

A. Furnish the following spare parts, in clearly identified dust-proof containers:

1. One mixer motor shaft coupling (for mechanical mixed systems only).
2. Two mixing chamber O-rings.
3. One mixing chamber mechanical seals (for mechanical mixed systems only).
4. One polymer injection check valves.
5. One wet end repair kit for neat polymer feed pump.

6. Five fuses of each type supplied.

7. Five pilot lights of each type supplied.

1.06. EQUIPMENT WARRANTIES AND SPECIAL GUARANTEES

A. The Supplier shall provide the following warranties and special guarantees:

1. The equipment manufacturer shall guarantee for a period of one-year starting at the
time of Substantial Completion that the equipment supplied is free from defects in
materials or workmanship and will meet the specified performance requirements
when operated in accordance with the manufacturer’s recommendations. The
manufacturer shall correct any breach in this warranty at their expense.

PART 2 PRODUCTS

2.01. MANUFACTURERS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
</table>
| Acceptable manufacturers | • Fluid Dynamics, DynaBlend Series  
• Velocity Dynamics, VeloBlend Series  
• Or equal |
| Or-equal manufacturer experience requirements | • Demonstrate in writing to the satisfaction of COUNTY that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the Bid Due date. |

2.02. EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
</table>
| General | • The liquid polymer feed systems shall consist of a
multi-zone mixing chamber, dilution water and polymer control systems, and neat polymer feed pump all
factory mounted on a single Type 304 or 316 stainless steel frame.  
• The polymer system shall be suitable for use with either potable or plant water supply.  
• Any components in contact with polymer or water shall be constructed of electroless nickel plated brass, Type 316 stainless steel, or an inert plastic.  
• All components shall be piped together at the factory, and shall be furnished pre-wired to the polymer system control panel. |
<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixing chamber</td>
<td>- Multi-zone hydrodynamic, hydro-mechanical or mechanical variable speed mixing technology.</td>
</tr>
<tr>
<td></td>
<td>- Mixing chamber shall be composed of at least two zones with distinct tapered energy zones.</td>
</tr>
<tr>
<td></td>
<td>- Any component of the system that requires periodic maintenance shall be readily accessible.</td>
</tr>
<tr>
<td></td>
<td>- The system shall be capable of producing its mixing energy with inlet utility water pressure as specified herein.</td>
</tr>
<tr>
<td></td>
<td>- The system shall be capable of producing high mixing energy without damage to the polymer’s molecular structure.</td>
</tr>
<tr>
<td></td>
<td>- If mechanical mixing is used it shall be achieved through a variable intensity stainless steel mechanical mixer. The mixer drive shaft shall have an integral seal flushing valve. A drain port shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. All bearings shall be external from the mixing chamber.</td>
</tr>
<tr>
<td></td>
<td>- The mixing chamber shall be provided with a clear section of discharge piping or clear polycarbonate cover to view the mixing action and blending effectiveness. The mixing chamber shall be constructed of PVC or Type 304 stainless steel.</td>
</tr>
<tr>
<td></td>
<td>- Provide a pressure relief on the mixing chamber, adjustable between 25% and 100% of the specified design pressure rating.</td>
</tr>
<tr>
<td>Dilution water</td>
<td>- All polymer systems shall be provided with dilution water connection and electric solenoid valve at the dilution water inlet for on/off control. Water connection and solenoid valve shall be stainless steel or brass construction.</td>
</tr>
<tr>
<td></td>
<td>- Provide a check valve at dilution water inlet connection.</td>
</tr>
<tr>
<td></td>
<td>- The dilution water line shall be provided with an electronic flow meter to measure the total water flow through the unit.</td>
</tr>
<tr>
<td></td>
<td>- Each polymer system shall be equipped with manual or automatic dilution water control valves as required for system operation.</td>
</tr>
<tr>
<td>Neat polymer pumps</td>
<td>- All systems shall be provided with an electronically-driven diaphragm or progressive cavity pump for volumetrically metering neat polymer from the raw polymer supply to the feed system.</td>
</tr>
<tr>
<td></td>
<td>- Pump materials shall be inert to all polymers and carrier materials and shall be capable of handling all liquid emulsion and dispersion polymers.</td>
</tr>
<tr>
<td></td>
<td>- Pump shall be self-priming with sufficient suction lift capacity.</td>
</tr>
<tr>
<td></td>
<td>- Pump shall be controlled by a microprocessor controller provided by pump manufacturer and integrated into polymer system controls.</td>
</tr>
<tr>
<td></td>
<td>- Pump shall have a minimum 100:1 turndown ratio.</td>
</tr>
</tbody>
</table>
2.03. ACCESSORIES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration columns</td>
<td>• A calibration column shall be supplied for each neat polymer feed pump. The column shall have sufficient capacity to provide 30-second drawdown at full capacity.</td>
</tr>
<tr>
<td></td>
<td>• Column shall be mounted to the feed system frame and provided with isolation ball valves.</td>
</tr>
<tr>
<td>Inlet connections</td>
<td>• Isolation valves, quick connect fittings and suction hoses shall be supplied between each polymer supply and polymer feed system. Hoses shall be 8 feet long minimum.</td>
</tr>
<tr>
<td></td>
<td>• Provide a pressure reducing valve for the utility water inlet pipe as necessary for system operation.</td>
</tr>
<tr>
<td>Flow monitoring</td>
<td>• Each polymer feed system shall contain flow meters to quantify the amount of polymer fed to the systems.</td>
</tr>
<tr>
<td></td>
<td>• Each polymer feed system shall include a flow switch to detect the use of utility water.</td>
</tr>
<tr>
<td></td>
<td>• Provide additional flow and/or pressure monitoring devices as necessary for system operation.</td>
</tr>
<tr>
<td>Frame</td>
<td>• Each polymer feed system shall be provided with a welded fiberglass or stainless steel frame assembly for mounting of the equipment and devices supplied under this Section.</td>
</tr>
</tbody>
</table>

2.04. MOTORS AND DRIVES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motors</td>
<td>• Motor type to be selected by polymer feed system manufacturer.</td>
</tr>
<tr>
<td></td>
<td>• Continuous duty.</td>
</tr>
<tr>
<td></td>
<td>• Variable speed.</td>
</tr>
<tr>
<td></td>
<td>• NEMA 4X enclosure.</td>
</tr>
<tr>
<td></td>
<td>• Integral motor winding thermostat (1 per phase winding) for all motors over 1 hp.</td>
</tr>
<tr>
<td>ITEM</td>
<td>MINIMUM REQUIREMENTS</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>General</td>
<td>• The control panels shall be PLC based and contain all controls and devices necessary to provide a complete, functional polymer feed system.</td>
</tr>
<tr>
<td></td>
<td>• Control panel shall be integral to the system frame including all control devices required for a complete operable system.</td>
</tr>
<tr>
<td></td>
<td>• The control panel shall be furnished as a coordinated assembly requiring only field connections of the power and control circuits for a complete operating installation.</td>
</tr>
<tr>
<td></td>
<td>• The controls shall be based on an open programming environment which allows the County to make changes after the warranty period ends. The manufacturer will be required to provide a copy of the control logic to the County following the operational testing period.</td>
</tr>
<tr>
<td></td>
<td>• Local control panel shall include an HMI display showing operating parameters, including speeds and flows, and a keypad to adjust the polymer feed rate to the system.</td>
</tr>
<tr>
<td></td>
<td>• All electrical components mounted on the polymer feed system frame, including junction boxes and instrumentation, shall be of NEMA 4X construction.</td>
</tr>
<tr>
<td>System control panel</td>
<td>• Main circuit breaker with external, flange mounted, lockable disconnect switch.</td>
</tr>
<tr>
<td></td>
<td>• Branch circuit breakers for all motors and external loads.</td>
</tr>
<tr>
<td></td>
<td>• NEMA 4X rated enclosure.</td>
</tr>
<tr>
<td></td>
<td>• Include separately labelled terminal strips for connection of equipment status indications, alarm and control connections of external control devices for each unit.</td>
</tr>
<tr>
<td></td>
<td>• All manufacturer’s power and control wiring shall be installed in liquid-tight flexible metallic conduit with PVC coated fittings and connections. Conduit shall be factory installed on the skid and wired back to a common junction box or the main control panel. Junction box shall be provided with terminal blocks for connection of field wiring back to the main control panel.</td>
</tr>
<tr>
<td>Sequence of operations</td>
<td>• The system shall detect loss of dilution water flow or pressure and shall respond by automatically placing the polymer pump and mix chamber on standby and will restart it automatically when flow/pressure is restored.</td>
</tr>
<tr>
<td></td>
<td>• The system shall detect loss of polymer flow and, sensing that polymer flow has been interrupted for any reason, will place the polymer pump and mix chamber on standby and will restart it automatically when flow is restored.</td>
</tr>
<tr>
<td>Communications</td>
<td>• At a minimum the following signals should be available</td>
</tr>
</tbody>
</table>
### Minimum Requirements

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
</table>

- to the plant PCS for each polymer feed system:
  - Local/Remote switch position, run status, common alarm, feed pump speed control, feed pump speed indication, pump fail alarm.
  - Additional signals shall be transmitted to the control system for the dewatering centrifuges supplied under Section 11360 as necessary for successful system operation.

### 2.06. FABRICATION REQUIREMENTS

A. Shop coat per manufacturer’s standard finish system and color.

B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

C. Welds shall be continuous unless noted otherwise.

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

E. Furnish nameplates for each piece of equipment with tag numbers as indicated on the Drawings.

1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.

2. Nameplates shall contain the manufacturer’s name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

### PART 3 EXECUTION

#### 3.01. EQUIPMENT INSTALLATION

A. Install in accordance with the manufacturer’s written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of County Engineer.

C. Field verify all dimensions and elevations. Notify County Engineer of specific differences.

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.
H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline, DuPont 25P Epoxy, or equal.

I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.02. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of a County representative and the equipment manufacturer’s approved representative.

C. Performance Testing shall be conducted during Startup using emulsion polymer.

D. Final acceptance of the equipment will be made after the polymer system has been demonstrated in the field to meet the performance requirements stated in this specification under all normal operating conditions and verification that the motors are not overloaded in normal operating conditions.

1. The polymer feed system, including pump and mixing chamber, shall be checked for abnormal noise and vibration while the system is running throughout the normal range of motor speeds. Abnormal noise or excessive vibration will constitute failure of the system.

2. Demonstrate that each unit is able to detect loss of water flow and place the polymer pump and mix chamber on standby, then restart it automatically when flow is restored.

3. Demonstrate that each unit is able to detect loss of polymer flow and energize contacts indicating alarm after 15 seconds of continuous loss.

4. Demonstrate capability of all systems to operate in Local and Remote modes as specified herein.

5. Demonstrate that each unit is capable of providing the specified flow rates of neat polymer feed and dilution water by collecting volumetric samples in graduated cylinders or other suitable vessels.

6. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

3.03. SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. A qualified representative of the equipment manufacturer shall be on site for the following activities:

1. Field testing and equipment startup.

2. Training

3. As necessary to provide submittals specified herein.
SECTION 11360
CENTRIFUGES

PART 1   GENERAL

1.01.   DESCRIPTION OF WORK

A.   Design, furnish, install, and test three (3) dewatering centrifuges complete with support frame, drive system, control panels and all other required accessories in accordance with the Contract.

B.   Contractor shall be responsible for providing a complete, integrated, fully functional equipment system with all components and materials required for operation and performance as specified and shown in the Contract.

1.02.   REFERENCES

A.   AGMA – American Gear Manufacturers Association Standards

B.   ASME – American Society of Mechanical Engineers

C.   ASTM – American Society for Testing and Materials

D.   ANSI – American National Standards Institute

E.   American Welding Society

F.   OSHA – Occupational & Safety Health Administration

G.   IEEE – Institute of Electrical & Electronics Engineers

1.03.   DEFINITIONS

A.   Centrifuge System

1.   The dewatering centrifuges and all other equipment and materials supplied by the centrifuge manufacturer to comply with this Specification shall be collectively referred to as the centrifuge system.

1.04.   SUBMITTALS

A.   Submittals shall include, but not be limited to, the following:

1.   Shop Drawings

   a.   Submit piping and instrumentation diagram (P&ID) drawings and block diagrams indicating all necessary process and electrical connections, including connections between system components and connections with the system control panel.

   b.   Provide a bill of materials for all control system hardware, software and spare parts. Include manufacturer’s catalog information for all control system equipment, instrumentation, control components and accessories.
c. Indicate NEMA type designation and manufacturer data describing all control enclosures and showing compliance with the Specifications and associated standards. Control panel assembly drawings shall detail panel cut-out locations and sizes, back panel and device layout and locations. Include a list of control panel and control station nameplate titles.

d. Submit project-specific electrical point-to-point wiring diagrams showing detailed internal wiring and wiring to field devices, with device tag numbers and terminal blocks and wiring numbers identified on the wiring diagrams.

2. Process Control System Information

a. Input/output matrix for all programmed registers and corresponding system parameters which shall be made available through the Ethernet communications network.

b. Operator Interface Terminal (OIT) graphic displays (screen shots) for each OIT graphic display for the completed program. Submit four sets of color screen shots.

c. Complete written and electronic form of completed PLC program, for coordination with plant process control system.

d. Detailed “sequence of operation” controls narrative which completely describes the operation of the control system. Written narrative shall be provided with sufficient detail to demonstrate complete operation of the system in compliance with the Specifications. Control narratives shall be project-specific and include the following at a minimum:

1) System manual operation
2) System automatic operation
3) Control sequencing
4) Instrumentation loop controls
5) Alternation and fail-over sequencing
6) System alarm monitoring
7) System alarm alarm/acknowledge/reset procedures
8) Power outage shutdown and power restoration sequencing
9) System diagnostics

3. Manufacturer’s Operation and Maintenance Manual

4. Manufacturer’s Installation Certificate

5. Certification of Equipment Compliance

6. Field Testing Results

7. Training Plan
8. Recording of Training Sessions
9. Training Report
10. Manufacturer’s Warranty
11. PLC Programming Record Documents
   a. Submit a fully documented hard copy and disc copy of final debugged PLC program and programming software for use by the COUNTY.

1.05. PERFORMANCE REQUIREMENTS

A. The centrifuge system shall be capable of continuously dewatering a mixture of primary sludge, waste activated sludge (WAS), and septage with the characteristics specified herein up to 22 hours per day, seven days per week. Sludge shall be fed to the centrifuges by the Centrifuge Feed Pumps. The centrifuge shall effectively accomplish solids-liquids separation to produce a dewatered sludge cake. Dewatered sludge shall be discharged from the centrifuges to screw conveyors. Centrate and wash water drainage shall be collected and routed to a single drain line connection.

B. The centrifuges shall be capable of operation under all of the following conditions:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of installed centrifuges</td>
<td>3 (equally sized)</td>
</tr>
<tr>
<td>Feed sludge</td>
<td>Mix of primary sludge, waste activated sludge (WAS), and septage with upstream grit removal</td>
</tr>
<tr>
<td>Design feed sludge characteristics</td>
<td></td>
</tr>
<tr>
<td>Dry solids concentration</td>
<td>1.0-4.5% by weight</td>
</tr>
<tr>
<td>Volatile solids concentration</td>
<td>60-80% of total solids</td>
</tr>
<tr>
<td>Minimum internal bowl diameter</td>
<td>29 inches (nominal)</td>
</tr>
<tr>
<td>Minimum bowl length (cylindrical portion)</td>
<td>108 inches</td>
</tr>
<tr>
<td>Maximum beach angle</td>
<td>15 degrees</td>
</tr>
<tr>
<td>Minimum centrifugal force at wall</td>
<td>3,000 G</td>
</tr>
<tr>
<td>Solids throughput capacity per unit</td>
<td>4,000 dry lbs./hour</td>
</tr>
<tr>
<td>Hydraulic throughput capacity per unit</td>
<td></td>
</tr>
<tr>
<td>Feed sludge solids concentration</td>
<td>2.0%</td>
</tr>
<tr>
<td>Gyration</td>
<td>400 gpm</td>
</tr>
<tr>
<td>Minimum discharge (cake) dry solids concentration</td>
<td></td>
</tr>
<tr>
<td>Volatile solids &lt; 66.0% of total solids</td>
<td>21.0%</td>
</tr>
<tr>
<td>PARAMETER</td>
<td>VALUE</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Volatile solids 66.0-72.0% of total solids</td>
<td>23.0%</td>
</tr>
<tr>
<td>Volatile solids &gt; 72.0% of total solids</td>
<td>25.0%</td>
</tr>
<tr>
<td>Minimum solids capture</td>
<td>95%</td>
</tr>
<tr>
<td>Maximum polymer usage</td>
<td>30 active lbs./dry ton of solids</td>
</tr>
<tr>
<td>Maximum vibration level</td>
<td>0.26 inch/sec</td>
</tr>
<tr>
<td>Maximum noise level at 3 feet from unit (operating)</td>
<td>85 dBA</td>
</tr>
<tr>
<td>Maximum wash water demand per unit (total)</td>
<td>80 gpm continuous</td>
</tr>
<tr>
<td></td>
<td>250 gpm instantaneous (&lt; 15 min)</td>
</tr>
<tr>
<td>Available utility water pressure (approximate)</td>
<td>45 psig</td>
</tr>
</tbody>
</table>

C. Sludge conditioning will be provided by the polymer feed system. The centrifuges shall be capable of using polymer solution as diluted and fed from the liquid polymer feed system provided by Contractor. The maximum polymer dosage rate indicated is based on pounds of active polymer. No other chemical addition shall be required to meet the performance requirements listed herein. Polymer injection points (minimum of 2) shall be located as recommended by the centrifuge system manufacturer for adequate mixing prior to the units.

D. The available utility water pressure represents the approximate pressure of the utility water supply at the Dewatering Building. Contractor shall be responsible for connecting to the existing utility water distribution system to provide sufficient flow and pressure of utility water to the centrifuge system.

1.06. SPARE PARTS

A. Furnish the following spare parts, in clearly identified dust-proof containers:

1. One set of O-rings and seals for centrifuge unit.
2. One set of drive belts.
3. Two sets of plate dams as selected by the centrifuge Manufacturer.
4. One set of all supplied bearings.
5. One set of lubricants.
6. One cable to connect the programming port of each PLC to the serial port of an IBM-compatible PC.
7. Additional spare parts as recommended by the centrifuge Manufacturer.

1.07. EQUIPMENT WARRANTIES AND SPECIAL GUARANTEES

A. The Supplier shall provide the following warranties and special guarantees:
1. The equipment manufacturer shall guarantee for a period of one-year starting at the time of Substantial Completion that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer’s recommendations. The manufacturer shall correct any breach in this warranty at their expense.

2. Contractor shall provide COUNTY with an extended maintenance guarantee from the centrifuge Manufacturer. This maintenance guarantee shall be in force for a period of three years from the date of initial startup of the centrifuges.
   a. This extended maintenance guarantee shall guarantee the mechanical performance of the entire unit including the frame and casings, frame coatings, bowl, scroll conveyor, gear box, feed tube, and drive system. It shall further guarantee repair (parts and labor) and correction or replacement of any defect in these components which may become evident at any time during the three-year period, at no cost to the COUNTY. This guarantee specifically excludes normal wear items such as seals, bearings, wear protection, and consumable wear items.

PART 2 PRODUCTS

2.01. MANUFACTURERS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable manufacturers</td>
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<tr>
<td></td>
<td>• Alfa Laval</td>
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<tr>
<td></td>
<td>• Centrisys Centrifuge Systems</td>
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<tr>
<td></td>
<td>• GEA Westfalia Separator</td>
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<tr>
<td></td>
<td>• Or equal</td>
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<td>Or-equal manufacturer</td>
<td></td>
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<tr>
<td>experience requirements</td>
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<tr>
<td></td>
<td>• Demonstrate in writing to the satisfaction of COUNTY that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the Bid Due date.</td>
</tr>
</tbody>
</table>

2.02. EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>• Centrifuge system shall be specifically designed for the intended conditions of service.</td>
</tr>
<tr>
<td></td>
<td>• Centrifuges shall be counter-current design, horizontal, solid bowl type.</td>
</tr>
<tr>
<td></td>
<td>• Individual parts manufactured to standard sizes and gauges.</td>
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<td></td>
<td>• All castings shall be inspected for cracks, shrinkage, porosity, or other defects by means of a liquid dye penetrant test or other suitable means of quality control.</td>
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<tr>
<td>ITEM</td>
<td>MINIMUM REQUIREMENTS</td>
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<td></td>
<td>Contractor is responsible for coordinating necessary process piping with the manufacturer’s equipment.</td>
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<td></td>
<td>Centrifuges shall be provided with the following components at a minimum: vibration isolators, drive motor, back drive and/or speed reducer assembly to infinitely vary the differential speed of the conveyors, belt guards, vibration and temperature monitoring devices, and control system.</td>
</tr>
<tr>
<td></td>
<td>No disassembled component shall individually weigh more than 4,000 pounds.</td>
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<tr>
<td></td>
<td>Lifting lugs, rigs, slings or other assemblies shall be provided as necessary for system installation and to allow lifting of the centrifuge bowl in and out of the centrifuge unit by the bridge crane.</td>
</tr>
<tr>
<td></td>
<td>All wetted parts shall be Type 316 or Type 317 stainless steel or nitrile rubber unless otherwise noted.</td>
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<tr>
<td></td>
<td>Allow for ease of access to components requiring regular service or lubrication.</td>
</tr>
<tr>
<td></td>
<td>All wiring supplied by the centrifuge manufacturer shall be contained in PVC-coated galvanized steel conduit, fittings and enclosures.</td>
</tr>
<tr>
<td></td>
<td>All components shall be rated in accordance with NFPA 820 for installation and operation in hazardous locations.</td>
</tr>
<tr>
<td>Structural frame and casings</td>
<td>Centrifuge rotating assembly and bearings will rest on a steel frame designed for rigidity and noise reduction. The entire steel frame assembly shall be galvanized or provided with a fusion bonded powder coating. The frame shall be fabricated from structural tubular steel and shall contain no weighted aggregate.</td>
</tr>
<tr>
<td></td>
<td>The steel frame shall be provided with lifting hooks, lifting bars, or other provisions to allow lifting by a crane or hoist.</td>
</tr>
<tr>
<td></td>
<td>Conduit boxes for all centrifuge mounted electrical devices, except those specifically related to the main drive motor, shall be mounted on the frame.</td>
</tr>
<tr>
<td></td>
<td>The casing shall be stainless steel and provide a complete, sound-insulating, sealed enclosure around the rotating assembly for solids, liquid, and odor containment and operator safety. The casing top shall be hinged or otherwise removable. Removable tops shall be provided with lifting hooks.</td>
</tr>
<tr>
<td></td>
<td>Flexible splashguard for cake discharge.</td>
</tr>
<tr>
<td></td>
<td>Include flexible transition fittings and adapters for all necessary connections to adjacent equipment or piping.</td>
</tr>
<tr>
<td>Bowl</td>
<td>Manufactured from centrifugally cast castings of Type 316, 317, or duplex stainless steel. Rolled and welded bowls shall not be allowed.</td>
</tr>
<tr>
<td></td>
<td>Nominal thickness of the cylindrical and conical sections of the bowl shall be a minimum of 0.5 inches.</td>
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</table>
|      | Flow shall be counter current such that there are no
<table>
<thead>
<tr>
<th>Item</th>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centrifuge</td>
<td>Concentrate tubes to maintain. Pool depth shall be readily adjustable via weir plates located at the large diameter (cylindrical) end of the bowl without needing to remove the rotating assembly from the frame. Solids shall be discharged at the small diameter (conical) end of the bowl.</td>
</tr>
<tr>
<td></td>
<td>- Dynamically and independently balanced to allow for the complete exchange of the bowl with a remanufactured or replacement unit of the same model without further balancing or adjustment.</td>
</tr>
<tr>
<td></td>
<td>- Type 316 or 317 stainless steel sludge feed tube designed to minimize turbulence.</td>
</tr>
<tr>
<td>Scroll conveyor</td>
<td>- Type 316 or 317 stainless steel horizontal conical-cylindrical scroll conveyor with helical flights.</td>
</tr>
<tr>
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<td>- Independently mounted concentrically within the bowl.</td>
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<tr>
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<td>- Feed material leaving the conveyor hub will pass through hard surfaced feed ports. The feed shall be evenly discharged into the bowl in a way which minimizes disturbance of the settled solids.</td>
</tr>
<tr>
<td></td>
<td>- Flights shall allow for minimum disturbance to the pool and maximum settling of fine particles.</td>
</tr>
<tr>
<td></td>
<td>- Dynamically and independently balanced to allow for the exchange of the scroll conveyor with a remanufactured or replacement unit of the same model without further balancing or adjustment.</td>
</tr>
<tr>
<td></td>
<td>- Edge and face of conveyor flights shall be protected from wear with abrasion resistant materials.</td>
</tr>
<tr>
<td>Main drive system</td>
<td>- Consist of an electric motor and a belt drive system.</td>
</tr>
<tr>
<td></td>
<td>- Shall use a single motor for the main bowl drive and a separate back drive for differential adjustment.</td>
</tr>
<tr>
<td>Back drive system</td>
<td>- Allow control of differential speed between the scroll conveyor and the bowl.</td>
</tr>
<tr>
<td></td>
<td>- Provide an infinitely adjustable differential speed variation over its range of operation.</td>
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<tr>
<td></td>
<td>- Consist of a secondary motor, gear box and/or hydraulic system per manufacturer’s standard design.</td>
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<tr>
<td></td>
<td>- Capable of operating in either a manual or automatic mode. In the manual mode it shall provide for operation at a specific, adjustable scroll differential speed with internal torque allowed to vary. In the automatic mode it shall continuously monitor changes in internal torque and automatically maintain a preset torque input to the scroll by allowing the differential speed to vary. The net effect of this system, when operated in the automatic mode, shall be to maximize the time that cake solids are under the influence of accelerated gravitational force without plugging the centrifuge.</td>
</tr>
<tr>
<td></td>
<td>- Torque-based adjustment shall be a function of input to the driven unit. The maximum torque input and rate of change of scroll differential speed shall be adjustable.</td>
</tr>
<tr>
<td><strong>ITEM</strong></td>
<td><strong>MINIMUM REQUIREMENTS</strong></td>
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<tr>
<td></td>
<td>• Full differential speed and maximum torque must be achievable while the centrifuge bowl is at a standstill.</td>
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<tr>
<td></td>
<td>• Hydraulic back drive systems, if used, shall use a hydraulic pumping group and hydraulic motor. The hydraulic motor shall have a minimum torque of 3,500 Nm.</td>
</tr>
<tr>
<td>Gear box (if applicable)</td>
<td>• Planetary speed reducer, cyclogear speed inducer, radial piston motor or rotodiff as necessary to provide control of the differential speed between the centrifuge bowl and conveyor.</td>
</tr>
<tr>
<td></td>
<td>• Lubrication for the gear box shall be self-contained and shall be high performance gear oil or grease filled.</td>
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<td></td>
<td>• Independently balanced from the centrifuge, and interchangeable.</td>
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<tr>
<td></td>
<td>• Each gear unit shall be protected from damage due to high torque overload with a monitoring device to initiate centrifuge shutdown in the event of overload. A thermal overload protection device shall not be considered as providing for sufficient protection for the gear unit.</td>
</tr>
<tr>
<td>Bearings</td>
<td>• Bowl shall be supported by roller bearings mounted in pillow blocks and fitted for convenient external lubrication.</td>
</tr>
<tr>
<td></td>
<td>• Main bearings shall have a calculated life of at least 100,000 hours at standard operating speeds in accordance with DIN ISO 281 requirements.</td>
</tr>
<tr>
<td></td>
<td>• Scroll conveyor shall be supported on grease lubricated anti-friction ball or roller bearings sealed from process contamination.</td>
</tr>
<tr>
<td>Bowl and belt guards</td>
<td>• Constructed of painted steel and/or fiberglass.</td>
</tr>
<tr>
<td></td>
<td>• Shall not come into contact with the sludge or centrate under normal operating conditions.</td>
</tr>
<tr>
<td>Abrasion protection</td>
<td>• Replaceable hard surfacing shall be provided at all points where the abrasive action of the sludge will cause wear on the metal parts of the centrifuge.</td>
</tr>
<tr>
<td></td>
<td>• The bowl wall and conical extensions shall be protected with welded ribs or wear strips designed to trap a protective layer of solids between the bowl wall and the conveyor.</td>
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<tr>
<td></td>
<td>• The scroll conveyor feed ports shall be protected by field replaceable solid sintered tungsten carbide elements.</td>
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<tr>
<td></td>
<td>• The solids discharge ports shall be protected by field replaceable wear saddles or raised inserts with tungsten carbide or silicon carbide surface.</td>
</tr>
<tr>
<td></td>
<td>• A replaceable stainless steel or urethane insert shall protect the solids discharge casing.</td>
</tr>
<tr>
<td></td>
<td>• The edge and face of the conveyor flights shall be protected by a series of welded-on sintered tungsten carbide tile assemblies from within two flights (wraps)</td>
</tr>
</tbody>
</table>
ITEM | MINIMUM REQUIREMENTS
---|---
of the feed zone through to the solids discharge end. Each tile assembly shall be weight correct, and consist of a solid sintered tungsten carbide wear part braised to a stainless steel back-up holder. Each assembly shall be individually replaceable and shall include the ability to monitor wear by visual inspection. The tile assemblies must extend 3/8 inch beyond the radial edge of the conveyor flight. The remaining scroll conveyor edge and face shall be protected by flame sprayed hard-surfacing material containing minimum 40% tungsten carbide particles.

Noise and Vibration
- Centrifuge shall be equipped with noise suppression devices.
- Ambient noise levels at the facility will be measured prior to testing and the noise levels measured for the centrifuge will be adjusted accordingly.
- The centrifuge shall be measured when running without feed for vibration at the manufacturing facility. The vibration shall be less than the maximum vibration level specified.

Lubrication
- All bearings and gear boxes shall be grease or high performance oil lubricated.
- All lubrication points shall be easily accessible from the operating floor or access platform.

2.03. ACCESSORIES
ITEM | MINIMUM REQUIREMENTS
---|---
Vibration isolators
- The centrifuge shall be mounted on rubber-type vibration isolators.
- There shall be no rigid connections to the centrifuge assembly.
- Flexible connectors shall be constructed of 1/8 inch minimum thickness black neoprene.
- All hardware shall be constructed of Type 304 stainless steel.

Anchoring
- Sized by the centrifuge manufacturer.
- Anchor bolts shall be Type 304 stainless steel.

Special tools
- Lifting tools to lift equipment, including the bowl and scroll conveyor, from the installed position to the building floor.
- Provide any other special tools required to assemble or disassemble the centrifuge.
2.04. MOTORS AND DRIVES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash water valves</td>
<td>• Provide solenoid valves and isolation ball valves on all required centrifuge wash water supply lines.</td>
</tr>
<tr>
<td>Sample taps</td>
<td>• Provide a centrate sample tap at the discharge point of the centrate line from the underside of the centrifuge. Tap shall be accessible from the operations floor.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
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</thead>
<tbody>
<tr>
<td>Motors</td>
<td>• 1800 maximum speed.</td>
</tr>
<tr>
<td></td>
<td>• NEMA design B.</td>
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<tr>
<td></td>
<td>• Continuous duty.</td>
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<td></td>
<td>• Premium efficiency.</td>
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<tr>
<td></td>
<td>• Inverter duty rated for variable speed applications.</td>
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<td></td>
<td>• Class F insulation.</td>
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<td>• TEFC enclosure.</td>
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<td></td>
<td>• Integral motor winding thermostat (1 per phase winding).</td>
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<tr>
<td></td>
<td>• Standard long shaft for v-belt drive and terminal box capable of rotation in 180 degree increments.</td>
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<tr>
<td></td>
<td>• Capable of making two complete starts per hour in succession with coasting to rest between starts.</td>
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<tr>
<td></td>
<td>• Capable of an immediate restart after any shutdown except motor overload.</td>
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<tr>
<td></td>
<td>• Shall not take longer than five minutes (each start) to accelerate to full rated motor speed at 90% nameplate voltage while maintaining operation below nameplate full load amps.</td>
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<tr>
<td></td>
<td>• Motor bearings shall have a minimum life rating of 40,000 hours of operation.</td>
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<tr>
<td></td>
<td>• Each AC motor and contactor shall be protected by a properly-sized motor starter protector and overload relays.</td>
</tr>
<tr>
<td>Variable frequency drives</td>
<td>• Flux vector controlled, sine coded, pulse-width modulation (PWM) drives.</td>
</tr>
<tr>
<td></td>
<td>• IGBT (Insulated Gate Bipolar Transistor) power module.</td>
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<td></td>
<td>• On-board alphanumeric digital display for programming and indication of set-up operating, circuit analysis, and diagnostic data.</td>
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<td></td>
<td>• Set-up parameters shall be stored in EPROM memory that does not require battery backup.</td>
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<td></td>
<td>• UL Labels.</td>
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<tr>
<td></td>
<td>• Inner loop torque control strategy with mathematical torque and flux calculation updates every 25 microseconds (40,000 times per second).</td>
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## 2.05. CONTROLS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
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</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>All equipment and devices necessary for proper operation of the centrifuge system shall be controlled by the control system supplied by the centrifuge manufacturer, including, but not limited to, the sludge conveyors, centrifuge sludge feed pumps, centrifuge scum feed pumps, and polymer feed system.</td>
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<tr>
<td></td>
<td>Provide all power distribution, instrumentation and control components including PLC system, Operator Interface Terminal (OIT), operator controls, control relays, timing relays, switches, lights, timers and other features as necessary for a fully operational system.</td>
</tr>
<tr>
<td></td>
<td>Panel assemblies shall be UL Listed and Labeled. Panels shall conform to the requirements of UL 508/508A, manufactured and assembled in a UL registered shop.</td>
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<td>Nameplates shall be provided to identify panel components, including each component mounted on the panel face.</td>
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<td></td>
<td>Control panels shall have a minimum 10,000A short circuit rating.</td>
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<td>Power and control points for field wiring shall be wired to terminal blocks located inside the panel enclosures. Terminal blocks shall be easily accessible.</td>
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<td>Control wire shall be #14 AWG minimum.</td>
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<td>A ground lug shall be supplied on each panel.</td>
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<td>All interface contacts shall be provided through isolated 10 amp interposing relays.</td>
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<td>Each wire segment shall be colored, bundled, and numbered at each end. The wire numbers shall correspond to those on the system wiring diagram.</td>
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</table>
| | Wiring within panels shall be bound with plastic slip.
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<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
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</table>
|      | lock straps and/or wireway, and terminated on numbered and labeled terminals strips.  
|      | • All electrical components mounted on the centrifuge frame, including junction boxes and instrumentation, shall be of NEMA 4X construction.  
|      | • PLCs shall be Modicon M340H. |
| Local control components | • Provide an emergency stop pushbutton station for each centrifuge.  
| | • Provide a NEMA 4X HMI terminal at each centrifuge near the centrate discharge port, to allow access to the system control screens. |
| Remote control components | • The system main control panel shall be PLC-based and shall include VFD controls, transformers, motor starters, relays, switches, lights, timers, interlocks, alarms, operator controls, terminal boxes, circuit breakers, wiring and all other necessary equipment and accessories required for a functional system.  
| | • The enclosure shall house a flange-mounted dead front main disconnect.  
| | • Supplied PLCs shall be capable of communicating with the plant SCADA system through native in-rack communications modules manufactured by the PLC manufacturer.  
| | • Mounted in a free standing NEMA 12 enclosure.  
| | • Hinged doors shall be provided across the front of the panel. Doors shall be of pan-type construction, gasketed and with locking handle and three-point latch. Door handles shall be keyed alike.  
| | • Subpanels shall be provided for terminal boards and rear-mounted components.  
| | • One 100-watt-equivalent light and fixture shall be installed in the panel.  
| | • Provided with a panel mounted, color display, touch screen Operator Interface Terminal (OIT) for monitoring and control of the centrifuge system.  
| | • Furnish one licensed copy of the associated OIT configuration software to the COUNTY.  
| | • At a minimum, the following control devices shall be located on the front of the control panel: OIT screen, System Reset pushbutton, Alarm indicator, Alarm Silence pushbutton, Emergency Stop pushbutton and indicator, and alarm horn.  
| | • Each individual component powered from the control panel shall have an overload and an overcurrent protection.  
| | • All 24 VDC power supplies must provide short circuit fold back protection.  
| | • One duplex 120 VAC utility outlet for use up to 3 amps shall be installed in the panel.  
| | • Provided with battery backup capability so all programs and settings are retained if a power supply failure occurs. The battery backup shall be capable of...
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<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
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<td>powering the control panel PLC, OIT, and any other essential components for a minimum of one hour.</td>
</tr>
</tbody>
</table>

Control programming
- PLC-based controls based on an open programming environment which allows the COUNTY to make changes after the warranty period ends.
- Provide a copy of the final control logic to the COUNTY following the operational testing period.
- Control logic shall reside in the PLC in the main control panel and its associated OIT.
- All operator functions shall be provided through menus and function keys on the control panel OIT.
- The PLC-based system shall include standard control functions and any specific requirements required by the Contract.
- The control system shall allow for the following, at a minimum: automatic or manual start/stop and process control, display of all available operating data, display and adjustment of control set points and parameters, and system alarms (active and alarm history).
- Allocate a minimum of 40 hours of additional programming services, at the request of the COUNTY, subsequent to initial startup and testing. Additional programming may consist of control logic changes, annunciation, and/or graphic displays. The additional programming will be a maximum of two trips.

Sequence of operations
- Allow for manual and automatic control of the centrifuge system components in accordance with manufacturer’s standard operating procedures and as supplemented herein.
- Upon stopping the centrifuge, the centrifuge feed pumps and polymer feed system interlock contacts shall stop automatically. An auto-flush valve will also be opened for a pre-determined time during shutdown.
- A Clean-In-Place (CIP) system shall be provided. The CIP run cycle can be started anytime the main drive motor is at rest as determined by the shutdown timer. Before initiation of the CIP start sequence, all faults must be cleared. Operator shall also be capable of starting a CIP cycle manually. The centrifuge drive systems shall operator to produce a water “sloshing” effect within the centrifuge bowl and conveyor. The CIP will control the flush water by actuating the solenoid valves on the utility water supply lines. The process will continue until the predetermined overall time ends, a “CIP Stop” key is depressed, or a fault occurs. Any shutdown fault will terminate the CIP cycle.
- In the event that a fault condition occurs, the sounding of an alarm horn will take place, and an alarm text fault message will be displayed on the OIT. An Alarm Acknowledge push-button, mounted on the front panel, will flash when a fault condition occurs. When pressed,
2.06. FABRICATION REQUIREMENTS

A. Shop coat per manufacturer’s standard finish system and color. Shop coatings shall be compatible with finish coatings specified in Division 9. Notify Engineer if proposed shop coating is not compatible with specified finish coating.

B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

C. Welds shall be continuous unless noted otherwise.

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

Communications

- The centrifuge control system shall be suitable for integration with the Plant Control System (PCS) through Ethernet network communications. The control system and associated panels shall be provided with Ethernet communications module/cards as required to provide network communications. All status, control and alarm functions shall be accessible through the PCS.
- Provide a complete listing of all analog, discrete, and virtual points, including alarm points and set point values, used in the proposed controller, including Tag ID, description, and register address.
- Controls shall allow for alarm acknowledgement through the PCS.
E. Furnish nameplates for each piece of equipment with tag numbers as indicated on the Drawings.

1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.

2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

PART 3  EXECUTION

3.01. GENERAL

A. All equipment specified herein shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings and specifications, engineering data, instructions and recommendations of the equipment manufacturer.

B. The equipment shall be shipped in a minimum number of components; and they will typically be comprised of the centrifuge skid assembly with drive and backdrive, control panel, and other parts.

3.02. EQUIPMENT INSTALLATION

A. Install in accordance with the manufacturer’s written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of County Engineer.

C. Field verify all dimensions and elevations. Notify County Engineer of specific differences.

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.

H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline, DuPont 25P Epoxy, or equal.

I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.03. TESTING AND STARTUP

A. Testing and Startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
C. Furnish all polymer to perform the specified field testing and for the period of initial operation in accordance with Section 01660. Contractor shall also furnish all oil and grease necessary for initial operation.

D. Preliminary Field Test

1. Verify that the centrifuges, drives, instrumentation, and all accessories and controls are installed in accordance with the Contract and with the Manufacturer’s recommendations.

2. Verify the equipment has been properly lubricated, aligned and adjusted in accordance with the Manufacturer’s instructions and is ready for operation.

E. Functional Test

1. A Functional Test shall be conducted prior to final acceptance to demonstrate that the system can meet the performance requirements specified herein. This testing shall be conducted by Contractor.

2. Prior to the initiation of the test, initial testing and operation of the equipment shall have been completed to the centrifuge supplier’s satisfaction. The centrifuge equipment supplier shall give written notice when they feel the equipment is ready for performance testing.

3. Dewatered sludge cake produced during the performance test will be collected and disposed of properly by the Contractor.

4. During testing, a representative of the decanter centrifuge supplier will direct a person assigned by the Contractor to make all adjustments to the decanter centrifuge system and record them in a log book. No adjustments will be made within 20 minutes before sampling. For each test run, the decanter centrifuge supplier will record the decanter centrifuge system conditions including sludge flow rate (gpm), pond depth, operating bowl speed, polymer dosage (lbs./dry ton) and take samples of the sludge feed, cake sludge, and centrate. The decanter centrifuge supplier shall label each sample with the run number and required analysis. The samples will be tested for those properties required by the specification by a certified laboratory, as detailed below. No composite samples shall be taken. The decanter centrifuge system supplier may take unofficial, duplicate samples for their own purposes.

5. All tests to determine compliance with the Contract shall be performed by an independent commercial certified laboratory accepted by the Engineer unless otherwise noted. Cost for the testing and analysis shall be the responsibility of the decanter centrifuge supplier.

6. The performance test shall consist of two tests that shall last six hours each. Sludge samples shall be collected at the end of every hour (for a total of 12 samples). Both tests shall be averaged and the installed equipment shall demonstrate that it can meet or exceed the specified performance requirements specified herein.

7. The following tests shall be performed on the equipment:

   a. Demonstrate that each drive operates properly through the entire operating speed range.

   b. Demonstrate that the decanter centrifuge system will condition and dewater the specified pounds per hour of solids specified of the type specified. The
Centrifuge Feed Pumps, Centrifuge Polymer Feed System and Centrifuge Polymer Feed Pumps shall be fully installed and operational before this test is run. Sludge shall be fed to the centrifuge by the Centrifuge Feed Pumps.

c. Demonstrate that all controls at the centrifuge control panel operate properly.

d. Demonstrate the lifting and removal of the bowl and scroll using manufacturer-provided lifting tools, and bridge crane (not furnished by centrifuge supplier).

8. A performance test report shall be submitted after completion of the performance test with laboratory test results. The report should include field notes, laboratory test results, calculations, and any other documentation necessary to indicate conformance to the specified performance test requirements. All test data shall be signed by the Contractor, approved manufacturer’s representative, and approved Engineer’s representative. The report shall include the following information for each sample at a minimum:

a. Date/time of sample

b. Pump operating

c. Feed solids flow rate (gpm)

d. Feed solids concentration (percent)

e. Sludge pump discharge pressure (psi)

f. Polymer type

g. Polymer dosage (lb./ton)

h. Polymer water flow rate (gph)

i. Polymer flow rate (gph)

j. Polymer make-up solution concentration

k. Polymer discharge solution concentration

l. Cake solids concentration (percent)

m. Centrate solids concentration (percent)

n. Estimated centrate flow (gpm)

o. Solids capture (percent)

p. Backdrive speed (percent)

9. In the event that the decanter centrifuge system does not meet the requirements of the Specifications during field testing and Startup, the decanter centrifuge supplier will be permitted to make changes to the equipment and methods of operation at the decanter centrifuge supplier's sole expense. The readjustments shall be made as soon as practicable within a period not to exceed 30 days. Following the readjustments, the incomplete testing and startup activities shall be re-started at no
additional cost to the COUNTY. Additional testing of any equipment that has been repaired, modified or replaced shall be conducted in accordance with the procedure for initial acceptance testing described above. Conformance with the Specifications, including the equipment performance requirements, must be achieved before the decanter centrifuge will be accepted.

3.04. SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. A qualified representative of the equipment manufacturer shall be on site for the following activities:

1. Installation
2. Preliminary Field Testing
3. Functional Testing
4. System Demonstration Testing
5. Startup
6. Training
7. As necessary to provide submittals listed herein.

B. Provide the following additional services:

1. The manufacturer shall provide follow-up field service visits at no additional cost 6 months and again 12 months after successful completion of the performance testing requirements to review routine maintenance with the COUNTY and to make adjustments to the operating parameters for the equipment to optimize performance. Each follow-up field service visit shall be a minimum of one day with eight hours minimum on-site time. The field service visits shall be conducted by qualified field technicians with experience in training and troubleshooting on the supplied equipment.

END OF SECTION
SECTION 11450
SHAFTLESS SCREW CONVEYORS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK
   A. Design, furnish, install, and test shaftless screw conveyors complete with motors, speed reducers, supports, and all other required accessories in accordance with the Contract.

1.02. REFERENCES
   B. ASTM A322 – Standard Specification for Steel Bars, Alloy, Standard Grade
   C. ANSI B20.1 – Safety Standards for Conveyors, Cableways and Related Equipment
   D. ANSI B105.1 – Specifications for Welded Steel Conveyor Pulleys with Compression Type Hubs
   E. AISI 1045 – Medium Carbon Steel
   F. SAE 4140
   G. AWS D1.1 – Welding In Building Construction
   H. AISC – American Institute of Steel Construction
   I. NEC – National Electrical Code
   J. OSHA – Operations Safety and Health Association
   K. CEMA – Conveyor Equipment Manufacturer’s Association

1.03. SUBMITTALS
   A. Submittals shall include, but not be limited to, the following:
      1. Shop Drawings
         a. Detailed drawings and calculations for the conveyors and associated structural supports, signed by a Professional Engineer licensed in the State of Maryland, shall be submitted for review and comment prior to fabrication.
         b. Provide operating characteristics, nameplate data, and maximum recommended starts per hour for each conveyor motor.
         c. Submit wiring diagrams showing power and control wiring terminal connections including wiring identification and color coding.
         d. Indicate junction box sizing for power and control wiring connections.
      2. Manufacturer’s installation certificate.
3. Certification of equipment compliance.
4. Field testing results.
5. Provide operation and maintenance manuals and data.

1.04. PERFORMANCE REQUIREMENTS

A. Screw conveyors shall be designed for conveying dewatered sludge up to the design maximum quantities specified herein without sustaining structural or mechanical damage. The screw conveyors shall be capable of transporting sludge that has thixotropic characteristics and tendencies to plug, ball and bridge during transport.

B. Conveyors shall be capable of stable operation with either continuous or intermittent loading under the following conditions:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor type</td>
<td>Shaftless screw</td>
</tr>
<tr>
<td>Drive type</td>
<td>Reversible</td>
</tr>
<tr>
<td>Configuration</td>
<td>As required for application</td>
</tr>
<tr>
<td>Conveyed material</td>
<td>Dewatered sludge with 12-30% solids (by weight)</td>
</tr>
<tr>
<td>Bulk density of conveyed material (approx.)</td>
<td>60-70 lbs/cf</td>
</tr>
<tr>
<td>Throughput capacity</td>
<td>Equal to or greater than the maximum rated dewatered sludge output of the centrifuge equipment discharging to the corresponding conveyor unit (total combined output for conveyors receiving material from multiple centrifuges)</td>
</tr>
<tr>
<td>Maximum conveyor speed</td>
<td>20 rpm</td>
</tr>
</tbody>
</table>

C. The conveyance equipment supplied under this Section shall be capable of transferring the dewatered sludge discharged from each centrifuge to the intake point of the downstream solids processing facilities. Coordinate the discharge locations with County.

1.05. SPARE PARTS

A. Furnish the following spare parts, in clearly identified dust-proof containers:

1. One set of all mechanical seals, gaskets, packing, O-rings and other expendable parts supplied.

2. 10% of the total installed length of wear liner.

1.06. EQUIPMENT WARRANTIES AND SPECIAL GUARANTEES

A. The Supplier shall provide the following warranties and special guarantees:
1. The equipment manufacturer shall guarantee for a period of one-year starting at the time of Substantial Completion that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer’s recommendations. The manufacturer shall correct any breach in this warranty at their expense.

PART 2 PRODUCTS

2.01. MANUFACTURERS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable pump manufacturers</td>
<td>• Spirac</td>
</tr>
<tr>
<td></td>
<td>• JDV Equipment</td>
</tr>
<tr>
<td></td>
<td>• Or equal</td>
</tr>
<tr>
<td>Or-equal manufacturer experience requirements</td>
<td>• Demonstrate in writing to the satisfaction of COUNTY that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the Bid Due date.</td>
</tr>
</tbody>
</table>

2.02. EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>• Equipment shall be designed for both continuous and intermittent operation.</td>
</tr>
<tr>
<td></td>
<td>• All supports required for conveyors shall be provided by the conveyor manufacturer and coordinate with the conveyor framing and adjacent facilities.</td>
</tr>
<tr>
<td></td>
<td>• Minimum thickness of 3/16” for all steel members.</td>
</tr>
<tr>
<td></td>
<td>• Provide safety equipment and guards to meet OSHA and ANSI B15.1 standards.</td>
</tr>
<tr>
<td>Trough and Liner</td>
<td>• Troughs fabricated from stainless steel.</td>
</tr>
<tr>
<td></td>
<td>• Stiffeners spaced across top of trough to maintain shape and provide sealing face for covers.</td>
</tr>
<tr>
<td></td>
<td>• Flanged drain outlet to facilitate cleaning.</td>
</tr>
<tr>
<td></td>
<td>• Bolted stainless steel cover fabricated in segments with maximum length of 5 feet each.</td>
</tr>
<tr>
<td></td>
<td>• Continuous Buna-N rubber gasket to seal between trough and cover, minimum 1/2” wide and 1/8” thick.</td>
</tr>
<tr>
<td></td>
<td>• Replaceable UHMWPE wear liner to protect interior surface of trough, minimum 3/8” thick and in segments with maximum length of 5 feet each.</td>
</tr>
<tr>
<td></td>
<td>• Wear liner material impregnated with lubricant to reduce liner wear.</td>
</tr>
<tr>
<td></td>
<td>• Wear liner held in place by welded clips at ends and center of each segment.</td>
</tr>
</tbody>
</table>
### SHAFTLESS SCREW CONVEYORS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear liners for trough sizes 16 inches or greater shall be provided with visual indication of excess wear.</td>
<td></td>
</tr>
<tr>
<td>Grease ports located to provide convenient access within five feet of the operating floor level.</td>
<td></td>
</tr>
<tr>
<td>Spiral Flighting</td>
<td></td>
</tr>
<tr>
<td>Designed to convey material without center shaft.</td>
<td></td>
</tr>
<tr>
<td>Inner and outer flight for increased axial strength.</td>
<td></td>
</tr>
<tr>
<td>Coupled to draft shaft by flanged and bolted connection plate welded to flights.</td>
<td></td>
</tr>
<tr>
<td>Fabricated from high strength alloy steel with minimum 80 ksi yield strength.</td>
<td></td>
</tr>
<tr>
<td>Concentric to within 2 mm.</td>
<td></td>
</tr>
<tr>
<td>Flight diameter not less than 85% of trough diameter.</td>
<td></td>
</tr>
<tr>
<td>Minimum weight of 15 lbs/ft.</td>
<td></td>
</tr>
<tr>
<td>Linear compression (&quot;spring effect&quot;) of flights not to exceed 0.7 mm per 100 mm at maximum design loads.</td>
<td></td>
</tr>
<tr>
<td>Drive Shaft</td>
<td></td>
</tr>
<tr>
<td>Fabricated from AISI 1045 steel.</td>
<td></td>
</tr>
<tr>
<td>Flange for mating to connection plate of flighting.</td>
<td></td>
</tr>
<tr>
<td>Gland packing ring and lubricated labyrinth seal to seal penetration through end plate of trough.</td>
<td></td>
</tr>
<tr>
<td>Conveyor Supports</td>
<td></td>
</tr>
<tr>
<td>Fabricated from stainless steel.</td>
<td></td>
</tr>
<tr>
<td>Ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member (of angles about Z-Z axis).</td>
<td></td>
</tr>
<tr>
<td>Unit stresses shall not exceed the American Institute of Steel Construction allowable stresses by more than 1/3 when subject to loading of twice the maximum design operating torque of the screw conveyor drive motors.</td>
<td></td>
</tr>
<tr>
<td>Motors and Drives</td>
<td></td>
</tr>
<tr>
<td>AGMA Class II gear reducers.</td>
<td></td>
</tr>
<tr>
<td>High capacity roller bearings with minimum B-10 life of 30,000 hours at maximum operating conditions.</td>
<td></td>
</tr>
<tr>
<td>Inverter duty motors.</td>
<td></td>
</tr>
<tr>
<td>Maximum speed of 1,800 rpm.</td>
<td></td>
</tr>
<tr>
<td>NEMA Design B, continuous duty, Class F insulation, TEFC.</td>
<td></td>
</tr>
<tr>
<td>Integral motor winding thermostats.</td>
<td></td>
</tr>
</tbody>
</table>

2.03. ACCESSORIES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Switch System</td>
<td></td>
</tr>
<tr>
<td>Cable operated emergency pull cord type.</td>
<td></td>
</tr>
<tr>
<td>Cord shall run full length of conveyor.</td>
<td></td>
</tr>
<tr>
<td>Cord coated with orange vinyl or mylar.</td>
<td></td>
</tr>
<tr>
<td>Actuating force shall be field-adjustable.</td>
<td></td>
</tr>
<tr>
<td>Type 316 stainless steel eyebolts for cord support spaced at 10-feet maximum intervals.</td>
<td></td>
</tr>
</tbody>
</table>
### Minimum Requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual reset flag arm</td>
<td>Manual reset flag arm with positive safety lock to prevent accidental reset.</td>
</tr>
<tr>
<td>Switch in NEMA 4X enclosure.</td>
<td>Switch in NEMA 4X enclosure.</td>
</tr>
<tr>
<td>Flushing Connections</td>
<td>Provide flushing connections at each end of conveyors for connection to utility water piping.</td>
</tr>
<tr>
<td>Motion Failure Alarm</td>
<td>Non-contacting type with NEMA 4X enclosure.</td>
</tr>
<tr>
<td>Motor Overload Relay</td>
<td>Adjustable load current, overload duration, and trip delay settings.</td>
</tr>
<tr>
<td></td>
<td>Automatically shut down unit in the event of an overload condition.</td>
</tr>
</tbody>
</table>

2.04. CONTROLS

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Manufacturer-supplied control components and associated enclosures for automatic operation of the equipment supplied herein.</td>
</tr>
<tr>
<td></td>
<td>Integrate conveyor controls with controls for centrifuge equipment supplied under Section 11360.</td>
</tr>
<tr>
<td></td>
<td>Local controls shall include a Hand-Off-Automatic switch and Forward-Reverse switch for each unit, at a minimum.</td>
</tr>
<tr>
<td></td>
<td>Controls shall contain all features necessary to provide a complete, functional installation.</td>
</tr>
<tr>
<td></td>
<td>Any control panels supplied shall be furnished as a coordinated assembly requiring only field connections of the power and control circuits.</td>
</tr>
<tr>
<td></td>
<td>Any control logic required shall be based on an open programming environment which allows the County to make changes after the warranty period ends. The manufacturer will be required to provide a copy of the control logic to the County following the operational testing period.</td>
</tr>
<tr>
<td></td>
<td>All electrical components shall be mounted in NEMA 4X enclosures for wet locations and NEMA 12 enclosures for dry locations at a minimum. Provide alternate ratings for electrical enclosures if necessary based on conditions of surrounding environment.</td>
</tr>
<tr>
<td>Sequence of operations</td>
<td>Automatic conveyor controls shall operate the equipment as necessary to transfer the dewatered sludge from each conveyor to the selected discharge point and shall be coordinated with operation of the centrifuge equipment supplied under Section 11360.</td>
</tr>
<tr>
<td>Communications</td>
<td>The control devices for the conveyors shall be capable of remote communication with the control system for</td>
</tr>
</tbody>
</table>
ITEM | MINIMUM REQUIREMENTS
--- | ---
the centrifuge equipment supplied under Section 11360 for monitoring and control of the equipment supplied herein.

2.05. FABRICATION REQUIREMENTS

A. Shop coat per manufacturer’s standard finish system and color.

B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

C. Welds shall be continuous unless noted otherwise.

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

E. Furnish nameplates for each piece of equipment with tag numbers as indicated on the Drawings.
   1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
   2. Nameplates shall contain the manufacturer’s name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

A. Install in accordance with the manufacturer’s written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of County Engineer.

C. Field verify all dimensions and elevations. Notify County Engineer of specific differences.

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.

H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline, DuPont 25P Epoxy, or equal.

I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.
3.02. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of a County representative and the equipment manufacturer’s approved representative.

C. Final acceptance of the equipment will be made after the following has been demonstrated in the field for a minimum of 8 consecutive hours:

1. That the units have been properly installed and are in proper alignment.

2. That the units operate without overheating or overloading of any parts and without objectionable vibration or noise.

3. That there are no mechanical defects in any of the parts.

4. That there is proper and equal spacing of spiral flights.

5. That the units achieve proper solids collection and discharge during the test period.

D. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

E. Submit a field testing report for review and approval.

3.03. SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. A qualified representative of the equipment manufacturer shall be on site for the following activities:

1. Field testing and equipment startup.

2. Training

3. As necessary to provide submittals specified herein.

END OF SECTION
SECTION 14602
HOISTS AND CRANES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK
   A. Furnish and installation of hoists, monorail systems, bridge cranes, and related equipment.

1.02. REFERENCES
   A. Specifications for underhung cranes and monorail systems, published by the Monorail Manufacturers Association, Pittsburgh, Pennsylvania.
   B. ANSI C1 National Electric Code.
   D. ASTM-A759 Crane Rails, Carbon Steel
   E. American Institute of Steel Construction (AISC).
   F. Hoist Manufacturer’s Institute (HMI).
   G. American Society of Mechanical Engineers (ASME).

1.03. DESIGN REQUIREMENTS
   A. Manufacturer-furnished design for bridge cranes including runway crane rails.
   B. Calculations and shop drawings shall be prepared, sealed, and signed by a professional engineer registered in the State of Maryland for monorail frames/tracks.
   C. The manufacturer shall have 10 years of demonstrated experience in the manufacture and installation of similar equipment.

1.04. SUBMITTALS
   A. Submit single-page catalog cuts clearly indicating items to be furnished, including maintenance and electrical requirements.
   B. The shop drawings shall show project specific cross sections with clearance indication, hook height, lift range, trolley travel range, hoist and trolley type, travel and lift speeds, horsepower and voltage of all motors, type and mounting details of electrification, bridge, end trucks, track switches, rail stops, and other relevant information.

   1. The drawings shall be prepared specifically for this project.
   2. Include catalog cuts for all hoists, trolleys, pendants/rollers, conductor (bus) bars, flat cable festooning systems, electrification, end stops, bridge crane, crane rails, and other accessories.
   3. Provide manufacturer’s data for galvanizing and paint systems proposed.
1.05. EQUIPMENT WARRANTIES AND SPECIAL GUARANTEES

A. The Supplier shall provide the following warranties and special guarantees:

1. The equipment manufacturer shall guarantee for a period of one-year starting at the time of Substantial Completion that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer’s recommendations. The manufacturer shall correct any breach in this warranty at their expense.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Supplier of all project hoisting equipment, including the bridge cranes, shall be a full service company with the responsibility to provide design, engineering, installation, and startup of all hoisting systems for this project. Hoisting equipment shall be supplied by Freeland Hoist & Crane, Inc., Baltimore, MD; American Crane and Equipment Corp., Douglassville, PA or equal.

B. Examples of acceptable hoist manufacturers include Yale, Acco-Wright, CM, Budget, Harrington, or equal.

2.02. EQUIPMENT DESIGN

A. Capacity

1. Hoist capacity and duty rating shall be suitable for the intended application, with sufficient safety factor.

2. The capacity of all crane and hoist systems shall be permanently marked in a conspicuous manner on the hoist, crane, and monorail tracks.

3. The hoists shall lift their rated capacities with a smooth and continuous operation without speed changes or vibration throughout the entire lifting height.

4. All fittings shall be designed to a 5 to 1 load safety factor.

5. Beams shall be designed so that the maximum deflection does not exceed 1/600 of the span under live load (excluding impact).

B. Durability

1. Bridge crane and accessories shall meet moderate duty Class “C” specifications. All hoists and trolleys shall have an H-4 heavy duty service rating.

C. Features

1. Hoist features shall be selected to provide ease of operation and maintenance, protect operators and adjacent facilities, and allow for compatibility with the equipment and materials to be lifted. Examples include, but are not limited to, the following:

   a. Rail ends with suitable safety stops fitted with rubber shock absorbing bumpers.
b. Web couplings on all track joints.

c. Angle bracing.

d. Components epoxy painted, hot dip galvanized, zinc plated, or stainless steel for corrosion resistance.

e. Rigging to provide a true vertical lift.

f. Mechanical load brake capable of supporting the full load and shall be easily accessible for external adjustment by removing cover plates.

g. Grease-lubricated or oil bath-lubricated gears and bearings.

h. All electrical components sealed for corrosion resistance and usage in damp environments.

i. Drums with machine cut grooves and guarded flanges and capacity to take the entire run of cable in one layer without overlapping.

j. Drum mechanism with an upper and lower limit switch to prevent reverse reeving.

k. Chain collector baskets.

l. Load block containing a ball bearing sheave and a high-grade forged steel swivel hook with anti-friction bearings.

m. Two-speed or variable speed hoist motors where practical.

n. Hooks with safety clips.

o. Chain of sufficient length to hang 4 feet above the operating floor.

p. Pull required to lift the rated load less than 85 pounds.

D. Controls

1. Bridge cranes are fully electrified with variable speed operation of hoist, trolley, and crane travel. Provide wireless remote controllers plus an independent pushbutton pendant as backup. The backup pushbutton pendants shall be coiled and hung from the bridge cranes for emergency use. Provide a primary and spare wireless control unit at each bridge crane (4 units total).

2. All controllers shall have labeled, color-coded pushbuttons to control all hoist and/or crane functions.

3. All controls shall be fully magnetic with overload protection and be made from tough indestructible materials rated NEMA 4X for use in outdoor and/or corrosive environments.

E. Electrification

1. Power feed to the crane/hoist systems shall be from a wall-mounted master on/off switch box provided, installed, and wired by the crane supplier. Contractor will bring power up to the feeds from the associated disconnect.
2. Electrification shall be by rigid, flexible, track-mounted, festooning, or alternative design to accommodate operation of the associated hoisting system. Coordinate electrification with manufacturer’s recommendations. Accessories such as hangers, clamps, bolts, etc. shall be stainless steel.

PART 3 EXECUTION

3.01. PAINTING

A. All steel components and accessories shall be abrasive blasted and epoxy painted for an exterior and/or corrosive environments.

B. After complete installation and preliminary testing, provide touch-up or repainting of all components.

3.02. EQUIPMENT INSTALLATION

A. Field Measurements and Dimensions - All measurements and dimensions shall be based on verified field conditions. Verification shall include examination of adjoining work.

B. Erection - The equipment shall be erected in accordance with the instructions of the manufacturer, coordinated with the Owner, and verified as adequate and positioned properly to perform as intended.

1. All bolts shall be furnished, installed, and shall be of ample size and strength for the purpose intended.

2. All parts of the equipment shall be amply proportioned for all stresses that may occur during fabrication, erection, and intermittent or continuous operation.

3.03. INSTALLATION AND TESTING

A. Equipment shall be shop assembled and shop tested to the fullest extent possible prior to shipment to the job site.

B. Installation shall include all necessary oil and grease for initial operation.

C. Prior to turning any installation over to the Owner, each system shall be tested for the following conditions:

1. No-load operation in all moving stages for a period of 30 minutes.

2. Operate and load test at 125 percent of field rated load capacity for at least 20 minutes, demonstrating starting hoisting, lowering, travel speed and lifting speeds.

3. Suspend the rated load from the hook, held solely by the hoist brake, for a period of 10 minutes without change of position.

4. The equipment shall demonstrate compliance with pertinent codes and specifications, that it has been properly erected and adjusted, and that it is ready for service.

5. Should any defects develop during the tests, they shall be corrected at the Contractor’s expense.

3.04. SERVICES OF MANUFACTURER’S REPRESENTATIVE
A. Manufacturer’s representative services shall include the following:

1. To take responsible charge of the initial installation, startup, and testing, the equipment manufacturer shall be on site to provide assistance and/or complete the initial installation.

2. After initial startup and toward the end of the first year of operation, a representative of the manufacturer shall make at least one visit to the plant for not less than four hours.

3. The purpose of this visit shall be to review operation of all hoisting equipment and systems and to assist plant operators. Manufacturer’s representative shall inspect all equipment installations.

4. Should any system or any component fail to operate satisfactorily for any reason other than proven Owner negligence, the Manufacturer shall make such repairs, replacements, or other modifications as required to render the system satisfactory.

END OF SECTION
PART 1  GENERAL

1.01.  DESCRIPTION OF WORK

A. Furnish, install, and test process piping complete with all fittings, appurtenances and all other required accessories in accordance with the Contract.

1.02.  REFERENCES

A. Ductile Iron and Gray Iron Pipe

<table>
<thead>
<tr>
<th>TITLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIPRA Handbook of Cast Iron Pipe</td>
<td>Standard for Flanged Pipe With Threaded Flanges</td>
</tr>
<tr>
<td>ANSI 21.4/ AWWA C104</td>
<td>Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water</td>
</tr>
<tr>
<td>ANSI 21.10/ AWWA C110</td>
<td>Ductile-Iron and Gray-Iron Fittings</td>
</tr>
<tr>
<td>ANSI 21.11/ AWWA C111</td>
<td>Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings</td>
</tr>
<tr>
<td>ANSI 21.15/ AWWA C115</td>
<td>Flanged Ductile Iron and Gray Iron Pipe With Threaded Flanges</td>
</tr>
<tr>
<td>ANSI 21.50/ AWWA C150</td>
<td>Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges</td>
</tr>
<tr>
<td>ANSI 21.51/ AWWA C151</td>
<td>Ductile-Iron Pipe, Centrifugally Cast, for Water</td>
</tr>
<tr>
<td>ANSI/AWWA C153/A21.53</td>
<td>Ductile-Iron Compact Fittings</td>
</tr>
<tr>
<td>ANSI/AWWA C606</td>
<td>Grooved and Shouldered Joints</td>
</tr>
<tr>
<td>ASME B16.1</td>
<td>Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250</td>
</tr>
<tr>
<td>ASTM A183</td>
<td>Standard Specification for Carbon Steel Track Bolts and Nuts</td>
</tr>
<tr>
<td>ASTM A536</td>
<td>Standard Specification for Ductile Iron Castings</td>
</tr>
<tr>
<td>ASTM C283</td>
<td>Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid</td>
</tr>
</tbody>
</table>
### B. Plastic Pipe and Fittings

<table>
<thead>
<tr>
<th>ORGANIZATION ID</th>
<th>TITLE OF STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWWA C900</td>
<td>Poly Vinyl Chloride (PVC) Pressure Pipe 4-inch through 12-inch for Water</td>
</tr>
<tr>
<td>AWWA C901</td>
<td>Polyethylene (PE) Pressure Pipe and Tubing ½-inch through 3-inch for Water Service</td>
</tr>
<tr>
<td>AWWA C902</td>
<td>Polybutylene (PB) Pressure Pipe, Tubing and Fittings, ½-inch through 3-inch for Water</td>
</tr>
<tr>
<td>AWWA C905</td>
<td>Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. for Water Transmission and Distribution</td>
</tr>
<tr>
<td>AWWA C906</td>
<td>Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,575 mm), for Water Distribution and Transmission</td>
</tr>
<tr>
<td>ASTM D1248</td>
<td>Polyethylene Plastics Molding and Extension Materials (High Density Type III Black Polyethylene Pipe)</td>
</tr>
<tr>
<td>ASTM D1784</td>
<td>Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (PVC) Plastic Pipe Schedule 80</td>
</tr>
<tr>
<td>ASTM D1785</td>
<td>Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120</td>
</tr>
<tr>
<td>ASTM D2241</td>
<td>Poly Vinyl Chloride (PVC) Pressure Rated Pipe (SDR Series)</td>
</tr>
<tr>
<td>ASTM D2464</td>
<td>Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80</td>
</tr>
<tr>
<td>ASTM D2467</td>
<td>Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80</td>
</tr>
<tr>
<td>ASTM D2564</td>
<td>Solvents Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings</td>
</tr>
<tr>
<td>ASTM D2581</td>
<td>Polybutylene (PB) Plastics Molding and Extrusions Materials</td>
</tr>
<tr>
<td>ASTM D2657</td>
<td>Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings</td>
</tr>
<tr>
<td>ASTM D2672</td>
<td>Solvent Cement Joint Sockets or Belled PVC Pressure Pipe</td>
</tr>
<tr>
<td>ASTM D2774</td>
<td>Underground Installation of Thermoplastic Pressure Piping</td>
</tr>
<tr>
<td>ASTM D3035</td>
<td>Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter</td>
</tr>
<tr>
<td>ASTM D3139</td>
<td>Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals</td>
</tr>
<tr>
<td>ASTM D3350</td>
<td>Polyethylene Plastics Pipe and Fittings Materials</td>
</tr>
<tr>
<td>ASTM F441</td>
<td>Standard Specification for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80</td>
</tr>
<tr>
<td>ASTM F477</td>
<td>Elastomeric Seals, (Gaskets) for Joining Plastic Pipe</td>
</tr>
<tr>
<td>ASTM F714</td>
<td>Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter</td>
</tr>
</tbody>
</table>
C. Copper Pipe and Fittings

<table>
<thead>
<tr>
<th>ORGANIZATION ID</th>
<th>TITLE OF STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM B32</td>
<td>Standard Specification for Solder Metal</td>
</tr>
<tr>
<td>ASTM B88</td>
<td>Standard Specification for Seamless Copper Water Tube</td>
</tr>
<tr>
<td>ASME/ANSI B16.18</td>
<td>Cast Copper Alloy Solder Joint Pressure Fittings</td>
</tr>
<tr>
<td>AWWA C800</td>
<td>Underground Service Line Valves and Fittings</td>
</tr>
</tbody>
</table>

D. Other

<table>
<thead>
<tr>
<th>ORGANIZATION ID</th>
<th>TITLE OF STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME B31.3</td>
<td>Process Piping</td>
</tr>
<tr>
<td>ASTM A47</td>
<td>Standard Specification for Ferritic Malleable Iron Castings</td>
</tr>
<tr>
<td>ASTM A338</td>
<td>Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures Up to 650 °F (345 °C)</td>
</tr>
<tr>
<td>NSF/ANSI 61</td>
<td>NSF 61 Drinking water system components - health effects</td>
</tr>
</tbody>
</table>

1.03. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings
   a. Include chemical compatibility data for pipe, gaskets, solvent welding cements, and other parts of the piping system. This submittal is required for all chemical feed systems.
   b. Show complete piping layout, including materials, sizes, classes, locations, dimensions, supports, adapters, couplings, expansion joints, and hanger details.
   c. Certification of UV inhibitors in plastic (CPVC, PVC, HDPE, etc.) piping for piping that will be outdoors and aboveground or inside process tanks.

2. Record Documents
   a. Provide in accordance with the Contract.
   b. Submit revised record plans including record location of pipe connections, valves, cleanouts, bends, tees, and elevations.

1.04. TEST REQUIREMENTS

A. Test all process piping in accordance with the Contract Specifications.
1.05. COORDINATION

A. Coordinate the work with County Engineer and Owner where operation of existing structures and treatment facilities are affected.

PART 2 PRODUCTS

2.01. PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductile iron</td>
<td>- Provide in compliance with ANSI/AWWA C151/A21.51.</td>
</tr>
<tr>
<td></td>
<td>- Fittings shall conform to ANSI/AWWA C110/A21.10.</td>
</tr>
<tr>
<td></td>
<td>- Class 52 unless otherwise approved.</td>
</tr>
<tr>
<td></td>
<td>- 125-pound flanged joints.</td>
</tr>
<tr>
<td></td>
<td>- Fittings shall be of standard lengths given under the ANSI Specification B16.1, unless otherwise noted.</td>
</tr>
<tr>
<td></td>
<td>- Pipe and fittings shall be double cement lined and seal coated inside and out in accordance with ANSI 21.4/AWWA C104</td>
</tr>
<tr>
<td></td>
<td>- Rated for minimum cold water pressure of 150 psig.</td>
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<tr>
<td></td>
<td>- All interior ductile iron and steel pipe and fittings shall be factory primed and field coated with an epoxy-based coating system with total dry film thickness of at least 12 mils.</td>
</tr>
<tr>
<td></td>
<td>- As manufactured by American Cast Iron Pipe Company, Griffin Pipe Products, U.S. Pipe, EBBA Iron, or equal.</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC)</td>
<td>- ASTM D1785, Type 1, Grade 1 pressure pipe material conforming to ASTM D1784, Class Schedule 80.</td>
</tr>
<tr>
<td></td>
<td>- Joint sockets for belled PVC pressure pipe to conform to ASTM D2672 and ASTM D2564 (solvent cements).</td>
</tr>
<tr>
<td></td>
<td>- Socket type fittings for Schedule 80 PVC pipe to conform to ASTM D2467.</td>
</tr>
<tr>
<td></td>
<td>- Plastic pipe unions shall be provided at all connections to equipment, tanks and valves; and at all wall and floor penetrations.</td>
</tr>
<tr>
<td>Copper</td>
<td>- Pipe shall conform to ASTM B-88, Type L material.</td>
</tr>
<tr>
<td></td>
<td>- Fitting shall be socket-type in conformance with ASME/ANSI B16.18.</td>
</tr>
<tr>
<td></td>
<td>- Joints shall be soldered with a lead free solder conforming to ASTM B32.</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>- Piping for air service shall be Schedule 10S Type 304L stainless steel and be manufactured from materials conforming to ASTM A-240 and manufactured in accordance with ASTM A-778.</td>
</tr>
<tr>
<td></td>
<td>- Piping for liquid service shall be Schedule 40S Type 304L stainless steel and in accordance with ASTM-A312.</td>
</tr>
<tr>
<td></td>
<td>- Fittings shall be of the same grade type and thickness.</td>
</tr>
<tr>
<td>ITEM</td>
<td>MINIMUM REQUIREMENTS</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>as the pipe and in accordance with ASTM-A182.</td>
</tr>
<tr>
<td></td>
<td>• Threaded joint connections.</td>
</tr>
<tr>
<td></td>
<td>• Finish on the completed pipe and fittings shall be as specified in ASTM A-778 and A-774, respectively.</td>
</tr>
</tbody>
</table>

### 2.02. JOINTS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flanged</td>
<td>• Shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places.</td>
</tr>
<tr>
<td></td>
<td>• Bolts or studs shall be uniformly tightened around the joints.</td>
</tr>
<tr>
<td></td>
<td>• Gaskets shall be ring type, minimum 1/8-inch thick. Material shall be neoprene rubber for general liquid service or EPDM for general air service.</td>
</tr>
<tr>
<td></td>
<td>• Conform to AWWA Standard C115 (ANSI A21.15) with bolts provided in the size and number called for and in accordance with the American Standard with hexagonal nuts.</td>
</tr>
<tr>
<td></td>
<td>• Bolt sizes and lengths in accordance with the “Handbook of Cast Iron Pipe”.</td>
</tr>
<tr>
<td></td>
<td>• Bolts and fasteners shall be standard A36 steel. Steel bolts shall be field primed and painted with the same coating system the adjacent piping receives.</td>
</tr>
<tr>
<td>Threaded</td>
<td>• All threaded joints shall have threads conforming to ANSI B2.1, made with the appropriate paste of jointing compound, depending on the intended pipe service.</td>
</tr>
<tr>
<td></td>
<td>• All pipe up to and including 1-1/2 inches diameter shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt.</td>
</tr>
<tr>
<td></td>
<td>• Pipe in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.</td>
</tr>
<tr>
<td>Solvent welded</td>
<td>• Shall be accomplished in strict accordance with the pipe manufacturer’s recommendations, including necessary field cutting, sanding of pipe ends, joint support during setting period, etc.</td>
</tr>
<tr>
<td></td>
<td>• Solvent material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer.</td>
</tr>
<tr>
<td></td>
<td>• Solvent cement for PVC piping shall be resistant to the chemicals carried by the PVC piping for which it is being used and shall conform to ASTM Specification D2564.</td>
</tr>
</tbody>
</table>

### 2.03. ACCESSORIES
<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification</td>
<td>• Each pipe length and fitting shall be clearly marked with the manufacturer’s name, nominal pipe size and class, and material designation.</td>
</tr>
</tbody>
</table>
| Sleeves              | • All piping passing through walls and floors shall be installed in steel sleeves (or castings).  
• Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise approved.  
• Water-stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall, and on all sleeves penetrating walls of areas designed as “gastight.”  
• All steel wall and floor sleeves shall receive a commercial sandblast cleaning, and all surfaces shall be painted in accordance with Section 09900, Painting.  
• The annular space between the installed piping and sleeve shall be completely sealed with a modular mechanical seal consisting of interlocking synthetic rubber links connected by stainless steel bolts and nuts as manufactured by Thunderline Corp., or equal.  
• Sleeves through fire/smoke walls and floors shall be installed per NFPA. Seal all cracks and voids with fireproof sealant. |
| Pipe taps            | • Provide at least one flushing tap on the upstream end of each sludge and drain pipe.  
• Each flushing connection shall consist of a 1-1/2-inch IPS tap, a 1-1/2-inch short nipple, and a 1-1/2-inch ball valve. All nipples and fittings shall be Schedule 80, Type 316 stainless steel.  
• Ball valves for flushing connections shall be provided with a 1-1/2-inch IPS to 1-1/2-inch stainless steel quick disconnect female hose coupler.  
• Drain taps shall be provided at all new and existing pump suction and discharge piping. Drain taps shall be 1-1/2-inches IPS, with a 1-1/2-inch short nipple and a 1-1/2-inch ball valve. |
| Couplings and adapters | • Flanged coupling adapters shall be used to join process piping to all pump flanges  
• Adapters shall be restrained to process piping by the use of stainless steel tie rods.  
• All new to existing connections shall be restrained.  
• Unions shall be provided adjacent to all pumps, tanks, valves and other pieces of equipment where soldered, cement welded, or screwed joints are utilized.  
• Type 316 stainless steel bolts shall be used on all pipe adapters.  
• Flanged couplings adapters shall be Dresser Style 128W, Smith-Blair 913, or equal.  
• Dismantling joints shall be Romac Style DJ400, Smith-Blair 975, or equal. |
<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Mechanical couplings shall be Dresser Style 38, Smith-Blair 411, or equal.</td>
</tr>
<tr>
<td></td>
<td>• Reducer couplings shall be Dresser Style 62, or equal.</td>
</tr>
<tr>
<td></td>
<td>Structural expansion joints</td>
</tr>
<tr>
<td></td>
<td>• Install on all piping and conduit wherever such piping crosses a structural expansion joint.</td>
</tr>
<tr>
<td></td>
<td>• A 1/8-inch gap shall be left between adjacent lengths of pipe with a Dresser Style 38, Smith-Blair 411, or equal coupling joining the piping.</td>
</tr>
<tr>
<td></td>
<td>• Provide permanent restraints for all mechanical couplings installed on piping at structural expansion joints.</td>
</tr>
</tbody>
</table>

PART 3 EXECUTION

3.01. PIPING EXAMINATION

A. All pipe, fittings, and accessories which have been damaged in transit or which are obviously deformed or refinished in any way shall be rejected, marked and removed from the site of the work.

1. Any materials which the CONTRACTING OFFICER suspects is improper for the job shall be temporarily rejected, marked and set aside for subsequent investigation to determine its conformity with the specifications.

3.02. PIPING INSTALLATION

A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation.

1. Great care shall be taken to prevent any pipe coating from being damaged on the inside of the pipe and fittings.

2. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work.

3. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or surrounding structures or equipment.

4. All piping shall be erected to accurate lines and grades and shall be supported and braced against movement temporary or permanent.

B. Piping connections to equipment shall be in accordance with the following:

1. Mating piping/equipment flanges shall be concentric to within a tolerance of 1/8" unbolted.

2. Mating flange faces shall be parallel to within a tolerance of ½ the normal gasket thickness or 1/8", whichever is less, unbolted.

3. Flange face separation shall be no more than 1/8" beyond the normal gasket thickness or relaxed expansion joint length unbolted; nor less than the relaxed expansion joint length by more than 1/16".
C. Piping assemblies under 4-inch size shall be essentially supported on walls and ceilings, unless otherwise shown on the Contract Drawings, being kept clear of openings and positioned above “head-room” space.

1. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.

D. Install in accordance with the manufacturer’s written instructions.

E. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for installation and testing.

F. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

G. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

H. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.03. TESTING AND STARTUP

A. All pipes and fittings shall be leak tested in accordance with the Contract Specifications.

3.04. PIPING STERILIZATION

A. All pipe and fittings connected to and forming part of a potable water supply system shall be sterilized in accordance with the Contract Specifications.

END OF SECTION
SECTION 15100
PROCESS VALVES

PART 1  GENERAL

1.01.  DESCRIPTION OF WORK
A. Furnish, install, and test above ground process valves and backflow preventers complete with operators and all other required accessories in accordance with the Contract.

1.02.  REFERENCES
A. ANSI/AWWA C500 – Metal-Seated Gate Valves for Water Supply Service
B. ANSI/AWWA C504 – Rubber Seated Butterfly Valves 3 inches through 72 inches
C. ANSI/AWWA C507 – Ball Valves 6 inches through 48 inches
D. ANSI/AWWA C508 – Swing Check Valves for Waterworks Service 2 inches through 24 inches NPS
E. ANSI/AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
F. ANSI/AWWA C510 – Double Check Valve Backflow Prevention Assembly
G. ANSI/AWWA C511 – Reduced Pressure Principle Backflow Prevention Assembly
H. ANSI/AWWA C512 - Air-Release, Air/Vacuum and Combination Air Valves for Waterworks
I. ANSI/AWWA C517 – Resilient-Seated Cast-Iron Eccentric Plug Valves
J. ANSI/AWWA C520 – Knife Gate Valves 2 inches through 96 inches
K. ANSI/AWWA C542 – Electric Motor Actuators for Valves and Slide Gates
L. ANSI/AWWA C550 – Protective Interior Coatings for Valves and Hydrants
M. ASTM A126 – Gray Iron Castings
N. ASTM A48 – Gray Iron Castings for Valves, Flanges and Pipe Fittings

1.03.  SUBMITTALS
A. Submittals shall include, but not be limited to, the following:
   1. Shop Drawings
      a. Shop drawings shall indicate conformance to ANSI/AWWA codes.
      b. For those valves with motors and actuators, submittals shall include dimensions and orientation of motors and actuators, size and quantity of conduit taps, complete wiring diagrams showing all provided options and inputs/outputs from the actuator assembly, input/output matrix of all available
registers and corresponding system parameters that will be made available over the actuator’s communication module.

c. Certification that all valve components that will come in contact with the liquid are fully compatible with the liquid inside of the valve and outside the valve.

PART 2 PRODUCTS

2.01. VALVES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Design working pressure shall be 200 psig for valves 12 inches NPS in diameter and smaller, and 150 psig for valves 16 inches NPS in diameter and larger. Manufacturer's name and catalog numbers monogrammed or initialed on product. Conform to the latest edition of applicable AWWA standards. Valves 2 inches in nominal diameter and smaller shall be all brass or bronze unless otherwise noted. Valves over 2 inches in nominal diameter shall be iron bodied, fully brass or bronze mounted, unless otherwise noted. All valves with non-rising stems shall have valve position indicators. Valves shall open counterclockwise (left) unless otherwise specified. Ferrous metal valves shall be painted in accordance with the Division 09 Specifications. All new motorized actuators on motorized valves shall be of the same manufacturer.</td>
</tr>
<tr>
<td>Gate valves</td>
<td>Gate valves 2 inches and smaller shall be bronze gate valves with rising stem, double wedge disc, screwed bonnet, screwed ends, 125-pound rating and shall be repackable under pressure in full open position. Stockham Figure 107; Lunkenheimer Figure 2127; or equal. All gate valves larger than 2 inches shall conform to AWWA Standard C500 and shall be of iron body, bronze mounted, double-disc type with outside screws and yokes and have 125-pound ANSI flanged ends. Kennedy Valve Manufacturing, Mueller, or equal. All gate valves for potable water and non-potable water service larger than 2 inches shall be resilient seated gate valves in accordance with AWWA C509. Kennedy Valve Manufacturing, Mueller, or equal. Stems shall be fabricated of brass or bronze with the lath-cut, half-V pattern threads. Equipped with handwheel or chain and wheel operators.</td>
</tr>
<tr>
<td>Butterfly valves</td>
<td>Butterfly valves for liquid service shall have cast iron bodies, cast iron vanes, stainless steel or mechanically</td>
</tr>
<tr>
<td><strong>ITEM</strong></td>
<td><strong>MINIMUM REQUIREMENTS</strong></td>
</tr>
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</tr>
<tr>
<td></td>
<td>secured rubber seating edge, Type 316 stainless steel valve shafts, permanently-lubricated nylon or teflon bearings, resilient rubber seats, in accordance with AWWA C504 and as manufactured by Dresser, DeZurik, Pratt, or equal.</td>
</tr>
<tr>
<td></td>
<td>• Butterfly valves for air service shall have Type 316 stainless steel bodies and discs, single piece Type 316 stainless steel shafts, wafer body, single or double offset disc design, PTFE or RTFE for non-metallic components, as manufactured by Dresser, DeZurik, Tyco, or equal.</td>
</tr>
<tr>
<td></td>
<td>• Lever actuators for valves 8 inches and smaller, self-locking traveling nut actuators with handwheel operators for valves 10-inch through 16-inch in size, and worm gear actuators with handwheel operators for valve 18 inches and larger.</td>
</tr>
<tr>
<td><strong>Plug valves</strong></td>
<td>• Non-lubricated, eccentric type.</td>
</tr>
<tr>
<td></td>
<td>• Port areas shall be 80 percent of the full pipe area to provide clog-free operation.</td>
</tr>
<tr>
<td></td>
<td>• Valve bodies shall be constructed of cast iron in accordance with AWWA C517.</td>
</tr>
<tr>
<td></td>
<td>• All exposed nuts, bolt springs and washers shall be stainless steel.</td>
</tr>
<tr>
<td></td>
<td>• Welded-in-place nickel seats, except where rubber lining is required. Seats shall be raised 1/4-inch to prevent the plug from being in contact with the valve body when the plug is closed.</td>
</tr>
<tr>
<td></td>
<td>• Plug shall be monolithic cast iron with synthetic EPDM rubber facing.</td>
</tr>
<tr>
<td></td>
<td>• Replaceable, sleeve-type journal bearings shall be provided at each end of the plug and shall be of the wetted type to prevent binding.</td>
</tr>
<tr>
<td></td>
<td>• Bearings shall be fabricated from sintered oil impregnated 316 stainless steel to allow the plug to operate freely after long periods of inactivity.</td>
</tr>
<tr>
<td></td>
<td>• The plug shaft seal shall be adjustable or completely replaceable without removing the operator, bonnet or plug from the valve.</td>
</tr>
<tr>
<td></td>
<td>• All valves 6 inches or larger shall be provided with gear actuators and handwheels. Inside valves smaller than 6 inches shall have lever operators. Valves installed 6 feet above the floor or higher shall be provided with chainwheel operators.</td>
</tr>
<tr>
<td></td>
<td>• Valves shall be installed so that when closed, the plug is at the upstream end of the valve.</td>
</tr>
<tr>
<td></td>
<td>• Plug valves shall be as manufactured by DeZurik, or equal.</td>
</tr>
<tr>
<td><strong>Check valves</strong></td>
<td>• Horizontal single disc swing type shall have screwed or bolted covers for access to the disc, and shall be in accordance with AWWA C508 as manufactured by GA Industries, Crispin, Clow Corporation, or equal.</td>
</tr>
<tr>
<td></td>
<td>• Rubber flapper type check valves shall be Series 100 as manufactured by Apco, Darling, Crispin or equal.</td>
</tr>
<tr>
<td><strong>ITEM</strong></td>
<td><strong>MINIMUM REQUIREMENTS</strong></td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>• Ball check valves shall be ASTM D1784 PVC, with Viton seat and seal, as manufactured by Nibco; Chemtrol Tru Union, ASAHI/America, Spears; True Union, or equal.</td>
<td></td>
</tr>
<tr>
<td>• Check valves for backflow prevention on gravity flow lines shall be EPDM elastomeric Tideflex-style check valves by Red Valve Company, or equal.</td>
<td></td>
</tr>
<tr>
<td>• Check valves for air service shall be wafer style and dual-disc design, Techno Corporation Model 5051-316 or equal.</td>
<td></td>
</tr>
<tr>
<td>• Check valves shall be located in horizontal piping runs.</td>
<td></td>
</tr>
<tr>
<td>Thermoplastic ball valves</td>
<td>• True union-full bore design and manufactured of PVC (to match pipe system) with Teflon seats and Viton seals.</td>
</tr>
<tr>
<td></td>
<td>• Valves for sodium hydroxide service shall be manufactured of polypropylene with Teflon seats and EPDM seals.</td>
</tr>
<tr>
<td></td>
<td>• Valves used in sodium hypochlorite piping shall have a factory installed 1/8 – inch diameter hole with chamfered edges on the upstream side of the ball to alleviate pressure build-up due to degassing.</td>
</tr>
<tr>
<td></td>
<td>• Valves shall be equipped with snap on, snap off handles.</td>
</tr>
<tr>
<td></td>
<td>• Cabot; Hayward; NIBCO, Inc.; Asahi/America; or equal.</td>
</tr>
<tr>
<td>Metallic ball valves</td>
<td>• Valves shall be Type 316 stainless steel with Teflon seats, stainless steel levers, and lockout devices.</td>
</tr>
<tr>
<td></td>
<td>• Apollo, Marpac, Ladish or equal.</td>
</tr>
<tr>
<td>Pressure reducing/ regulating/release valves</td>
<td>• Each valve shall be provided with “Y” strainer.</td>
</tr>
<tr>
<td></td>
<td>• Valves on metallic piping shall have cast iron bodies and covers, with bronze trim, with valve opening to be at least as large as the size of valve, as manufactured by G.A. Industries, Inc.; Cla-Val Company; the Ross Valve Manufacturing Company; or equal.</td>
</tr>
<tr>
<td></td>
<td>• Valves on plastic piping shall have PVC bodies and covers with valve opening to be at least as large as the size of the valve, as manufactured by Plast-O-Matic, Hayward, or equal.</td>
</tr>
<tr>
<td>Air/vacuum release valves</td>
<td>• APCO Valve, or equal.</td>
</tr>
<tr>
<td>Solenoid valves</td>
<td>• Valves in hazardous areas shall be rated explosion-proof, and all others shall be waterproof.</td>
</tr>
<tr>
<td></td>
<td>• Metallic solenoid valves shall be Model WP 8210 (water-proof) or Model 8211 (explosion-proof) as manufactured by ASCO; Skinner; or equal, and shall be preceded with a bronze-bodied Monel metal element strainer.</td>
</tr>
<tr>
<td></td>
<td>• Thermoplastic solenoid valves shall be Series “PS” pilot with Teflon pipe bellows as manufactured by Plast-O-Matic or equal, preceded by a PVC-bodied...</td>
</tr>
<tr>
<td><strong>ITEM</strong></td>
<td><strong>MINIMUM REQUIREMENTS</strong></td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Wall hydrants</td>
<td>• Wall hydrants shall be Zurn Model Z-1315, or equal.</td>
</tr>
<tr>
<td>Others</td>
<td>• Valves not specifically listed herein shall match the general quality and construction of the listed products.</td>
</tr>
</tbody>
</table>

2.02. ACCESSORIES

<table>
<thead>
<tr>
<th><strong>ITEM</strong></th>
<th><strong>MINIMUM REQUIREMENTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure gauges</td>
<td>• Liquid service gauges shall be of the bourdon tube type with 4 1/2 inch diameter and diaphragm seals.</td>
</tr>
<tr>
<td></td>
<td>• Air service gauges shall be stem mounted with 4-inch liquid filled dial face and polished brass stopcock.</td>
</tr>
<tr>
<td></td>
<td>• Suction (vacuum) gauges shall be of the compound type to indicate both pressure and vacuum; they shall be calibrated to read 25 feet of water for liquid service or 15 psig for air service above and below zero.</td>
</tr>
<tr>
<td></td>
<td>• Discharge (pressure) gauges shall be calibrated to read from 0 feet to a minimum of 5 feet of water pressure for liquid service or 10 psig for air service above the maximum operating pressure for the associated process pipe.</td>
</tr>
<tr>
<td></td>
<td>• Each liquid service pressure gauge and diaphragm seal unit shall be connected with the necessary brass pipe fittings and a brass stopcock.</td>
</tr>
<tr>
<td></td>
<td>• All pressure gauges and diaphragm seals shall be supplied by the same manufacturer. Manufacturer shall be Ashcroft, U.S. Gauge, or equal.</td>
</tr>
<tr>
<td>Backflow preventers</td>
<td>• Backflow preventers shall be inspected by a Master Plumber, who has backflow preventer testing certification.</td>
</tr>
<tr>
<td></td>
<td>• As manufactured by Cla-Val, Watts, Wilkins, or equal.</td>
</tr>
<tr>
<td>Chain operators</td>
<td>• All valves located with center of shaft 6 feet or higher from the operating floor shall be equipped with chainwheel operators.</td>
</tr>
<tr>
<td></td>
<td>• Chainwheel operators shall have a straight or a beveled gear reducer type operator as recommended by the manufacturer.</td>
</tr>
<tr>
<td></td>
<td>• Chain in wet or corrosive areas shall be stainless steel.</td>
</tr>
<tr>
<td>Valve tags</td>
<td>• Provide valve tags for all valves.</td>
</tr>
<tr>
<td></td>
<td>• Tags shall be made from metal or heavy plastic and shall be engraved or printed with the valve number and fluid in the pipe.</td>
</tr>
<tr>
<td></td>
<td>• Tags to be made by Seton Name Plate Company; W.H. Brady Company; or equal.</td>
</tr>
</tbody>
</table>
### 2.03. ELECTRIC VALVE ACTUATORS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
</tbody>
</table>
| • Control for electric valve operators shall be furnished as a complete package by the valve manufacturer. 
| • Shall be furnished with AWWA gear box and be direct mount. 
| • Electric actuators shall comply with the latest revision of AWWA Standard C540. 
| • As manufactured by Rotork, Limitorque, or equal. |
| **Operators** | 
| • Operator housing shall be a cast aluminum or cast iron, NEMA 4X, watertight closure. 
| • Operator shall include integral control station to contain a local/remote selector switch with pushbutton open-close operation in the manual mode, valve position indicator lights (open-closed), and valve position indicator. 
| • A seized or inoperable motor shall not prevent manual operation. Return from manual to electric operation will be automatic upon motor operation. 
| • Operators for “modulating” service shall be rated for minimum 1200 starts per hour and shall have opening and closing times of 2 minutes (120 seconds), minimum. 
| • Operators for “open/closed” service shall be rated for 60 starts per hour and shall have opening and closing times of one minute (60 seconds). |
| **Position indicator** | 
| • Provide a local display of the position of the valve, even when the power supply is not present. 
| • The position of the actuator and valve must be updated contemporaneously, even when the power supply is not present. 
| • The actuator shall be able to ensure correct remote indication should the actuator be moved manually when the power supply is interrupted. |
| **Features** | 
| • Integral reversing starter and controller. 
| • Thermal overload relays. 
| • Terminal strips. 
| • Local-Off-Remote selection switch, padlockable, provided with extra contact for remote monitoring of auto status. 
| • Three-position selector switch (open, stop, close). 
| • Limit and torque switches. 
| • Open and close position NO/NC contacts. 
| • Metallic handwheel and declutch lever for manual operation. |
PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

A. All valves, deck hydrants and appurtenances shall be carefully inspected in the field.
   1. Cracked, broken, warped, out-of-round, damaged joints, including damaged linings or coatings, or otherwise defective valves, hydrants and stops, as determined by the CONTRACTING OFFICER, shall be culled out and not installed.
   2. Rejected material shall be clearly tagged in such manner as not to deface or damage it, and the material shall then be removed from the job site by the Contractor at his own expense.

B. For tapping sleeve and valve connections, the Contractor, prior to making any connections, shall verify the material and outside diameter of existing pipe.

C. The valves shall be so located that they are accessible for operating purposes and shall bear no stresses due to loads from the adjacent pipe.

D. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

E. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

F. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.

G. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series N69-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.

H. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.02. TESTING AND STARTUP

A. All pipes and fittings shall be leak tested and demonstrated in accordance with the Contract Specifications.

3.03. PIPING STERILIZATION

A. All pipe and fittings connected to and forming part of a potable water supply system shall be sterilized in accordance with the Contract Specifications.

END OF SECTION
SECTION 15810
MINIMUM REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. This Section describes minimum requirements for new heating, ventilation, and air conditioning (HVAC) facilities provided under the Contract.

B. Design, furnish, install, and test all materials and equipment necessary for a new, complete, and functional industrial HVAC system for existing Building 2 in accordance with the scope of work for the Contract, which may include the following:

1. Air conditioning units.
2. Heat transfer units.
3. Air handling units.
4. Ventilation units.
5. Duct work and insulation.
6. Air inlets and outlets.
7. Controls and accessories.
8. Labeling, signs and nameplates.
9. Mounting and support systems.
11. Contract closeout information to include record drawings, operation and maintenance manuals, final testing, inspection certificates, calibration reports, guarantees, and warranties.

1.02. REFERENCES

A. All electrical work shall be in accordance with the minimum requirements of the following:

1. 2015 International Mechanical Code
2. 2015 International Energy Conservation Code
3. SMACNA – HVAC Duct Construction Standards
4. NFPA 90A – Installation of Air Conditioning and Ventilating Systems
5. 2014 Recommended Standards for Wastewater Facilities (“10 State Standards”)
6. ASHRAE 62.1-2016 Ventilation for Acceptable Indoor Air Quality
7. 2017 ASHRAE Handbook – Fundamentals (Climate Data)
B. In the case of a discrepancy between the requirements of the Contract and other applicable regulating groups or agencies, the stricter requirements shall apply.

C. All material and equipment shall be listed by Underwriters’ Laboratories if available and shall be so labeled. All equipment labeling shall indicate the intended application of the equipment.

1. Equipment and material not covered by UL Standards will be accepted provided equipment and material are listed, labeled, certified or otherwise determined to meet safety requirements by a nationally recognized third-party testing laboratory such as ETL, FM, or CSA. Equipment of a class not listed, labeled, certified or approved by any acceptable reviewing body will be considered only if inspected or tested in accordance with national industrial standards, such as NEMA or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

1.03. SUBMITTALS

A. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

B. The shop drawing submittals shall include the following:

1. Information that confirms compliance with applicable requirements, the manufacturer’s name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports.

2. Elementary and interconnection diagrams for power and controls, equipment assemblies, and other external components. All terminal points and wiring shall be identified on wiring diagrams.

3. Parts list which shall include those replacement parts recommended by the equipment manufacturer.

1.04. PERFORMANCE REQUIREMENTS

A. Design HVAC systems to provide code required ventilation rates, provide occupant thermal comfort and provide safe working atmosphere for the operators. All control strategies shall incorporate energy savings whenever practical.

B. Design of HVAC systems shall be based on the following criteria:

1. Outside Design Temperatures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter design dry-bulb temperature</td>
<td>18°F</td>
</tr>
<tr>
<td>Summer design dry-bulb temperature</td>
<td>95°F</td>
</tr>
<tr>
<td>Summer design wet-bulb temperature</td>
<td>76°F</td>
</tr>
</tbody>
</table>

2. Inside Design Conditions

<table>
<thead>
<tr>
<th>Space Description</th>
<th>Winter Design Temperature</th>
<th>Summer Design Temperature</th>
<th>Minimum Total Ventilation Rate<a href="%5E2">^1</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical and control rooms</td>
<td>72°F</td>
<td>75°F</td>
<td>0.6 cfm/sf<a href="%5E2">^2</a></td>
</tr>
<tr>
<td>Polymer storage area</td>
<td>65°F</td>
<td>Ambient</td>
<td>6 ACPH<a href="%5E3">^3</a></td>
</tr>
<tr>
<td>Rest rooms</td>
<td>65°F</td>
<td>Ambient</td>
<td>75 cfm</td>
</tr>
<tr>
<td>Other (including centrifuge room)</td>
<td>60°F</td>
<td>Ambient</td>
<td>6 ACPH<a href="%5E3">^3</a></td>
</tr>
</tbody>
</table>

[^1]: Notes:
1. Minimum total ventilation rates refer to the outside air requirement.
2. Ventilation rate is based on surface area of floor.
3. ACPH = air changes per hour.

C. Electrical and control rooms with equipment emitting large quantities of heat shall be provided with sufficient air conditioning equipment (such as a ductless split system) to assist in maintaining the design room temperatures.

D. Rooms with dewatering equipment such as centrifuges are considered hazardous and corrosive areas. These rooms shall have both supply and exhaust fans providing continuous ventilation and will require corrosion resistant materials such as fiberglass reinforced plastic (FRP) or Type 316 stainless steel.

1.05. COORDINATION

A. Coordinate the work with County where operation of existing facilities are affected.

PART 2 PRODUCTS

2.01. GENERAL

A. HVAC materials and equipment furnished for this project shall be generally consistent with the design and configuration of the existing facilities at a minimum where additional detail is not provided in the Contract.

B. Materials and equipment furnished shall be current products of manufacturers regularly engaged in the manufacture of such items and for which replacement parts are available.

C. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.

D. All factory wiring shall be labeled and identified on or within the equipment being furnished and on all elementary, schematic and wiring diagrams.

E. Equipment and material shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed (e.g., hazardous, wet or corrosive areas/locations). Provide NEMA 12 enclosures for interior locations and NEMA 4X enclosures for exterior locations at a minimum.

2.02. MATERIAL REQUIREMENTS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
</table>
| Packaged Terminal Air Conditioning Units  | • Heat pump, outside air damper/vent control, outside air filter, and unit controls.  
|                                           | • Condensate drain to building exterior.  
|                                           | • Bottom of compressor coated for corrosion-resistance.  
|                                           | • Condenser section painted with cathodic electroplating process.  
|                                           | • Control settings for occupied and unoccupied modes.  
|                                           | • Daikin Applied, or equal.  |
| Split System Air Conditioning Units       | • Provide with low ambient kit and crankcase heater.  
<p>|                                           | • Self-diagnostics, current and temperature overload protection, high pressure switch, low pressure.  |</p>
<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td> </td>
<td>protection, and fusible refrigerant plug.</td>
</tr>
<tr>
<td> </td>
<td>- Microprocessor based, temperature sensing controls.</td>
</tr>
<tr>
<td> </td>
<td>- Automatic re-start after power failure.</td>
</tr>
<tr>
<td> </td>
<td>- Automatic heating to cooling changeover.</td>
</tr>
<tr>
<td> </td>
<td>- Dehumidification mode.</td>
</tr>
<tr>
<td> </td>
<td>- Carrier Toshiba RAV Models, or equal.</td>
</tr>
<tr>
<td>Exterior Wall-Mounted Air Conditioning Units</td>
<td>* Outside air damper.</td>
</tr>
<tr>
<td> </td>
<td>* Alarms for high and low pressure, high temperature, and loss of indoor air flow.</td>
</tr>
<tr>
<td> </td>
<td>* Economizer controls with thermostat.</td>
</tr>
<tr>
<td> </td>
<td>* Marvair ComPac II, or equal.</td>
</tr>
<tr>
<td>Terminal Heat Transfer Units</td>
<td>* Integral controls with thermostat, wall-mounted where necessary for ease of access.</td>
</tr>
<tr>
<td> </td>
<td>* Chromalox, or equal.</td>
</tr>
<tr>
<td>Air Handling Units</td>
<td>* Access door for inspection and maintenance of fan, motor, and drive components.</td>
</tr>
<tr>
<td> </td>
<td>* Coil removable through side panel without need for further disassembly on unit.</td>
</tr>
<tr>
<td> </td>
<td>* Mixing box/economizer.</td>
</tr>
<tr>
<td> </td>
<td>* Modulating hot gas re-heat for dehumidification.</td>
</tr>
<tr>
<td> </td>
<td>* Microprocessor based controls with remote-mounted programmable control station.</td>
</tr>
<tr>
<td> </td>
<td>* AAON Series H3/V3, or equal.</td>
</tr>
<tr>
<td>Axial Fans</td>
<td>* Hartzell, or equal.</td>
</tr>
<tr>
<td>Power Ventilators</td>
<td>* Conform to AMCA 210, 301, and 99 where applicable.</td>
</tr>
<tr>
<td> </td>
<td>* Greenheck, or equal.</td>
</tr>
</tbody>
</table>

2.03. CONTROLS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Systems</td>
<td>* Provided by single manufacturer.</td>
</tr>
<tr>
<td> </td>
<td>* Contain all necessary switches, control pushbuttons, relays, interlock switches, indicator lights, selector switches, motor starters, contactors, transformers, contacts, instruments, terminal strips, and associated circuitry to monitor and control the operation of the HVAC systems.</td>
</tr>
<tr>
<td> </td>
<td>* Honeywell, Johnson Controls, or equal.</td>
</tr>
<tr>
<td>Sequence of Operations</td>
<td>* Develop and implement to achieve desired conditions for each space in an energy efficient manner.</td>
</tr>
</tbody>
</table>
3.01. GENERAL

A. All work shall be completed in a neat, workmanlike and professional manner in accordance with general industry standards.

B. Coordinate location of equipment and supports with other trades to minimize interferences.

C. Repair or restore new and existing building components damaged or left open or bare as a result of the work.

D. It is the intent of the Contract that only new, unused, current production equipment and supplies be used unless specifically shown otherwise.

E. Contractor shall be responsible to store equipment and protect against damage, theft, dirt, moisture and temperature extremes.

3.02. EQUIPMENT INSTALLATION

A. Install in accordance with the manufacturer's written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of County Engineer.

C. Field verify all dimensions and elevations. Notify County Engineer of specific differences.

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.

H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline, DuPont 25P Epoxy, or equal.

I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.03. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of a County representative and the equipment manufacturer's approved representative.

C. Final acceptance of the equipment will be made after the following has been demonstrated in the field:

1. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

2. Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area of duct.
3. Measure air quantities at air inlets and outlets.

4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

5. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

6. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

7. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

10. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

11. Where modulating dampers are provided, take measurements and balance at extreme conditions.

12. Permanently mark settings of dampers and other adjustment devices allowing initial settings to be restored. Set and lock memory stops.

13. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Provide testing, adjusting, and balancing of all air handling units, fans, air inlets and outlets, and ductwork systems at a minimum.

E. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

F. Submit a field testing report for review and approval.

3.04. SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. A qualified representative of the equipment manufacturer shall be on site for the following activities:

1. Field testing and equipment startup.

2. Training

3. As necessary to provide submittals specified herein.

END OF SECTION
PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. This Section describes minimum requirements for new electrical facilities provided under the Contract.

B. Design, furnish, install, and test all materials and equipment necessary for successful operation of the new facilities included in the scope of work for the Contract, including, but not limited to, the following:

1. Power distribution equipment.
2. Communications systems.
3. Control and instrumentation systems.
4. Conduits and conductors.
5. Lighting systems.
6. Grounding systems.
7. Coordination with utility service providers.
8. Labeling, signs and nameplates.
9. Mounting and support systems.
10. Testing and startup of all supplied materials and equipment.
11. Contract closeout information to include record drawings, operation and maintenance manuals, final testing, inspection certificates, calibration reports, guarantees, and warranties.

1.02. REFERENCES

A. All electrical work shall be in accordance with NFPA 70 (National Electrical Code) and ANSI C2 (National Electrical Safety Code) and shall conform to all applicable codes and regulations.

B. In the case of a discrepancy between the requirements of the Contract and other applicable regulating groups or agencies, the stricter requirements shall apply.

C. All material and equipment shall be listed by Underwriters' Laboratories if available and shall be so labeled. All equipment labeling shall indicate the intended application of the equipment.

1. Equipment and material not covered by UL Standards will be accepted provided equipment and material are listed, labeled, certified or otherwise determined to meet safety requirements by a nationally recognized third-party testing laboratory such as ETL, FM, or CSA. Equipment of a class not listed, labeled, certified or approved by any acceptable reviewing body will be considered only if inspected or tested in
accordance with national industrial standards, such as NEMA or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

1.03. SUBMITTALS

A. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

B. The shop drawing submittals shall include the following:

1. Information that confirms compliance with applicable requirements, the manufacturer’s name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports.

2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.

3. Parts list which shall include those replacement parts recommended by the equipment manufacturer.

1.04. COORDINATION

A. Coordinate the work with County where operation of existing facilities are affected.

PART 2 PRODUCTS

2.01. GENERAL

A. Electrical materials and equipment furnished for this project shall be generally consistent with the design and configuration of the existing facilities at a minimum where additional detail is not provided in the Contract.

B. Materials and equipment furnished shall be current products of manufacturers regularly engaged in the manufacture of such items and for which replacement parts are available.

C. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.

D. All factory wiring shall be labeled and identified on or within the equipment being furnished and on all elementary, schematic and wiring diagrams.

E. Equipment and material shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed (e.g., hazardous, wet or corrosive areas/locations). Provide NEMA 12 enclosures for interior locations and NEMA 4X enclosures for exterior locations at a minimum.

F. Perform the equipment manufacturer’s standard factory testing at a minimum.

2.02. MATERIAL REQUIREMENTS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MINIMUM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grounding</td>
<td>• Grounding conductor shall be run with all branch</td>
</tr>
<tr>
<td>ITEM</td>
<td>MINIMUM REQUIREMENTS</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>circuits, feeder circuits, and control circuits sized in accordance with NEC 250.122.</td>
</tr>
<tr>
<td>Transformers</td>
<td>• Dry-type, energy efficient design.</td>
</tr>
<tr>
<td></td>
<td>• 5.0% minimum impedance at self-cooled rating.</td>
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<td></td>
<td>• Conform to NEMA TR1 sound level standards.</td>
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<tr>
<td></td>
<td>• General Electric, Square D, Siemens, or equal.</td>
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<tr>
<td>Motor Control Centers</td>
<td>• Main-tie-main, Class IIB configuration.</td>
</tr>
<tr>
<td></td>
<td>• Industrial duty.</td>
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<td></td>
<td>• Tin-plated copper bus conductors.</td>
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<td></td>
<td>• Main bus continuous current rating of 800A minimum.</td>
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<tr>
<td></td>
<td>• Ground bus for entire length of MCC and a fully rated neutral isolated for each side.</td>
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<tr>
<td></td>
<td>• Bus barriers/covers with plastic closing plates over unused openings.</td>
</tr>
<tr>
<td></td>
<td>• UL 1449 3rd Edition surge protection devices and digital power monitor for each incoming main.</td>
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<tr>
<td></td>
<td>• Integral magnetic and solid state molded case main and tie circuit breakers with limit switches for remote monitoring of breaker status.</td>
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<tr>
<td></td>
<td>• Standard rated full size thermal-magnetic molded case plug on circuit breakers for each branch/feeder unit.</td>
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<tr>
<td></td>
<td>• 20-inch minimum depth.</td>
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<tr>
<td></td>
<td>• Main circuit breaker section shall have 25-inch minimum width.</td>
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<tr>
<td></td>
<td>• Comply with NEMA ICS 2 where applicable.</td>
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<tr>
<td></td>
<td>• Integral transient voltage surge suppressor with disconnect switch and normally open dry contact for remote monitoring of device status.</td>
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<tr>
<td></td>
<td>• Oversized compartments with FVNR/FVR starters or VFDs with circuit breakers and motor overloads.</td>
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<tr>
<td></td>
<td>• Wireways with barrier plates, cable supports, reusable wire ties, and rubber grommet protectors around openings.</td>
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<tr>
<td></td>
<td>• LED push-to-test pilot lights.</td>
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<tr>
<td></td>
<td>• Include recommended spare parts.</td>
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<tr>
<td></td>
<td>• Eaton Freedom, or equal.</td>
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<tr>
<td>Panelboards</td>
<td>• 42 poles minimum.</td>
</tr>
<tr>
<td></td>
<td>• Integral main circuit breaker.</td>
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<tr>
<td></td>
<td>• 15AT/1P minimum circuit breakers for spare branch/feeder units.</td>
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<tr>
<td></td>
<td>• Locking doors.</td>
</tr>
<tr>
<td></td>
<td>• Square D Model NF, or equal.</td>
</tr>
<tr>
<td>Conduits</td>
<td>• PVC-coated rigid steel, except for connections.</td>
</tr>
<tr>
<td>Conductors</td>
<td>• Copper conductor.</td>
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<tr>
<td></td>
<td>• Insulation for main power distribution (MCC feeders, panelboard mains, transformers, etc.) shall be RHW-2, rated 90°C minimum.</td>
</tr>
<tr>
<td></td>
<td>• Insulation for general purpose applications shall be</td>
</tr>
</tbody>
</table>
## Minimum Requirements

**Mattawoman WWTP Centrifuge Project RFP #18-25**

**FOR ELECTRICAL EQUIPMENT**

### Minimum Requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THWN-2 up to #6 AWG, XHHW-2 for larger sizes, rated 90°C minimum.</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **Variable Frequency Drives** | • Provide with UL 508A label.  
  • Provide with 5% line reactor.  
  • Provide load reactors for branch circuit conductors greater than 150 feet in length. |
| **Lighting** | • High efficiency LED lighting where available.  
  • 50 foot-candles minimum for electrical/control rooms.  
  • 30 foot-candles minimum for process equipment rooms.  
  • 1 foot-candle minimum for outdoors above egress doors.  
  • Provide additional exit and emergency lighting as required by applicable codes. |

### Accessories

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
</tr>
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</table>
| **Rubber Mats** | • Provide in front of all electrical equipment supplied under this Contract, including panelboards, motor starter enclosures, motor control centers, variable frequency drives, equipment control panels, instrument control panels, disconnect switches, automatic transfer switches and switchboard and switchgear assemblies.  
  • Conform to ASTM D-178 Type I, Class I.  
  • At least 30” wide and shall have a length at least equal to the equipment before which they are to be placed. |
| **Nameplates** | • Electrical enclosures and panels shall be labelled with black nameplates with white lettering. |

### PART 3 EXECUTION

#### 3.01 GENERAL

A. Obtain permits, and request inspections as required from local authority having jurisdiction, or other County approved inspecting agency. Contractor shall provide a final inspection certificate to the County from the inspecting agency. Separate inspection certificates shall be submitted as required to accommodate phasing of the electrical work.

B. All work shall be completed in a neat, workmanlike and professional manner in accordance with general industry standards.

C. Coordinate location of equipment and conduit with other trades to minimize interferences.

D. Repair or restore new and existing building components damaged or left open or bare as a result of the work.
E. It is the intent of the Contract that only new, unused, current production equipment and supplies be used unless specifically shown otherwise.

F. Contractor shall be responsible to store equipment and protect against damage, theft, dirt, moisture and temperature extremes.

3.02. EQUIPMENT INSTALLATION

A. Install in accordance with the manufacturer’s written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of County Engineer.

C. Field verify all dimensions and elevations. Notify County Engineer of specific differences

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Division 9 Specifications.

F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.

H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline, DuPont 25P Epoxy, or equal.

I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.03. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of a County representative and the equipment manufacturer’s approved representative.

C. Final acceptance of the equipment will be made after the following has been demonstrated in the field:

1. All electrical circuits are tested to insure circuit continuity, insulation resistance, proper splicing, and freedom from improper grounds.

2. Perform megohmmeter testing of conductors operating at 600V or less for power distribution feeders down to the panelboards and for all motor power and control wiring down to equipment terminations. The results will be accepted when the megger shows the insulation resistance to be not less than 50 megohms at 20 degrees C using either a 500-volt or 1,000-volt megger. Wait 1 minute between each test for all conductors in the same enclosure and each conductor and ground.

3. Perform direct current high potential test for all conductors over 600V. The direct current high potential test shall be recorded at one minute intervals over a ten minute period between each conductor and each conductor to ground.
4. Check all single and three phase motor amperage while the unit is running at as close to operating load as possible. Record voltage on each line and the amp draw for each leg.

5. Check the load current in each phase of each distribution, lighting and receptacle panelboard feeder and make modifications to the circuit loading to correct load unbalance to within 1 kVA phase to phase for each panelboard.

6. Test all grounding conductors and grounding systems for continuity.

7. Perform infrared thermograph testing by an independent firm of MCC, panelboard, and motor connections while the unit is operational and address any excessive temperatures observed.

8. Inspect MCCs to NEMA ICS 2.


10. Electrically test all circuit breakers.

D. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

E. Submit a field testing report for review and approval.

3.04. SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. A qualified representative of the equipment manufacturer shall be on site for the following activities:

1. Field testing and equipment startup.

2. Training

3. As necessary to provide submittals specified herein.

END OF SECTION