# APPENDIX “D”

## SECTION 13

### SEWAGE PUMPING STATION GUIDELINE SPECIFICATIONS

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- Guide to MAWSS Piping Specifications
  - Sample Piping Specification Sheets
- Guide to MAWSS Valve Specifications
  - Sample Valve Specification Sheets
- Wet Well and Manhole Lining Systems
  - Sample Specification Sheets

### TYPICAL SEWAGE PUMPING STATION DRAWINGS AND DETAILS

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  - Connections – Plan View and Sectional Elevation
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  - Connections – Sections and Details
- PS-201 Duplex Submersible Pumping Station with Engine Driven Stand-By Pump
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- PS-202 Duplex Submersible Pumping Station with Engine Driven Stand-By Pump
  - Sections and Details
- GP-101 Cetrifugal and Semi-Positive Displacement Grinder Pumping Station Details
- SF-101 Site Fencing and Paved Access Drive Details
- SF-102 Access Drive Gate Details
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- E-102 Duplex Submersible Pumping Station with Engine Driven Stand-By Pump Typical Electrical Details

Revised 6/3/09
FORCE MAIN PRESSURE AND LEAK TEST

Project No. ______________________________ Date: __________

Project Name: ____________________________

Contractor: ______________________________ Design Eng. Inspector: __________________________

Weather: ______________________ MAWSS Inspector: _____________________________

Name of force main tested: ________________________________________________

Force main diameter and material of construction: ____________________________

Force main section tested: ________________________________________________

Test Pressure: ______ psig

Remarks:

This is to certify the test was performed in accordance with project specifications and the leakage rate is in conformance as prescribed.

Signature of Contractor:

_______________________________________________ Date: __________

Distribution: MAWSS Project Manager, Contractor, Design Engineer
**FINAL INSPECTION PUNCH LIST**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Reference Spec. Section or Dwg.</th>
<th>Description of Defect or Omission</th>
<th>Date Corrected</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Distribution: MAWSS Project Manager, Contractor, Design Engineer
Action: Contractor to correct Defect or Omission within 30 days of receipt, mark date completed and submit form to MAWSS
And design Engineer for Field Review and Final Approval for Contractor final payment.  

FIPL-101
GUIDE TO MAWSS PUMPING SPECIFICATIONS

The design engineer shall prepare a Pump Specification Sheet for each sewage pumping station based on the MAWSS Standard Pump Specification Sheets attached. The Sheet may be revised to suit special conditions or specific pumps required for an installation. The Pump Specification Sheets shall be revised upon completion of the project as part of the “Record Drawings” process to indicate only the pump(s) installed. The “Design Performance” shall be revised to indicate actual in-field performance delivered.
Tag No.: P-1 & P-2

Service: Sewage

Location: *

Type of Pump: End Suction Centrifugal - Submersible Pump

Solids Handling Capability: 3" minimum diameter spherical solid

Materials of Construction:

1. Casing - cast iron A48 Class 35C or 40
2. All Exposed Bolts & Nuts - 316 stainless steel
3. Pump Exterior Coating - Factory applied primer and finish coat to suit pumped media
4. Pump Interior Coating – All internal wetted parts including volute assembly, impeller and discharge connection shall receive a factory applied ceramic-epoxy coating a minimum of 40 mils dry film thickness.
5. Shaft & Sleeve - Stainless steel AISI 431 or 420
6. Impeller - Grey cast iron ASTM A-48 Class 35B
7. O-Rings - Nitrile rubber
8. Upper Bearing - Single row deep groove ball bearing
9. Lower Bearing - Two row angular contact ball bearing
10. Guide Rails - Type 316 stainless steel

Installation: The pump shall have a ** cast iron quick-disconnect discharge elbow permanently mounted to the wet well floor. The elbow shall include guide-rail guides to allow removal and replacement of pump without personnel entering the wet wall. The type 316 stainless steel guide rails shall be furnished by the contractor and the brackets furnished by the pump supplier.
Drive Motor:

1. * horsepower, * V, 60Hz, * phase
2. Design –squirrel-cage, induction
3. NEMA Design – Type B
4. Windings – Copper, Class F or H Insulated rated for 180 degrees C
5. Service Factor – 1.15 continuous
6. Design Temperature – 40°C ambient
7. Non-overloading at any point on pump curve
8. Explosion Proof
9. Air filled or oil motor, may have closed, integral, liquid cooling system.
10. Motor Terminal Board
11. Stator shall be heat-shrink fitted
12. Motor Winding Over temperature Thermostats
13. Seal Failure Moisture Probe

Guaranteed Performance:

<table>
<thead>
<tr>
<th>GPM</th>
<th>TDH</th>
<th>RPM</th>
<th>EFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*%</td>
</tr>
</tbody>
</table>

Warranty: The pump manufacturer shall warrant the unit being supplied to the Owner against defects in workmanship and material for a period of five (5) years or 10,000 hours.

Controls: The existing pump control panel shall be modified in accordance with the electrical specifications.

ACCEPTABLE PUMP EQUIVALENTS

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Supplier</th>
<th>Phone No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>*</td>
<td>Hydra Service, Inc.</td>
<td>251-947-5006</td>
</tr>
<tr>
<td>EMU</td>
<td>*</td>
<td>General Machinery Co., Inc.</td>
<td>251-473-1588</td>
</tr>
<tr>
<td>FLYGT</td>
<td>*</td>
<td>Jim House &amp; Associates</td>
<td>251-928-7867</td>
</tr>
<tr>
<td>KSB</td>
<td>*</td>
<td>Pump &amp; Process Equipment, Inc.</td>
<td>850-432-1336</td>
</tr>
</tbody>
</table>

* Asterics indicate information to be inserted by Design Engineer
Tag No.: X

Service: Domestic Wastewater

Location: X

Type of Pump: Engine Driven, Fully Automatic Dry Priming, Vacuum Assisted, Run Dry, Heavy Duty Solids Handling, Horizontal Self-Priming Pump

Pump Size: X" x X"

Solids Handling Capability: 3” minimum diameter spherical solid

Pump Specifications:

1. Volute Casing - cast iron ASTM48 Class 30
2. Impeller – Enclosed type, two vane, Cast Chromium Steel hardened to Brinell 220 HB, or equivalent
3. Impeller shaft – Nickel/Chromium Steel, or equivalent
4. Wear Plate – Hardened Cast Iron, ASTM A48, Class 30
5. Back Plate – ASTM A48 Class 30 Gray Iron
6. Bearing Housing – Gray Iron No. 30
7. Seal Plate – Allot Steel No. 4130
8. Shaft Seal – Alloy Steel No. 4130
9. Pump End Bearing - Open Single Row Ball
10. Drive End Bearing – Open Single Row Ball
12. Inlet Flange – ANSI B16.1 Class 125
13. Gaskets – Buna-N, Compressed Synthetic Fibers, PTFE, Vegetable Fiber, Cork, and Rubber
14. O-Rings – Buna-N
15. Hardware – Standard Plated Steel
16. Oil Level Sight Gauge
17. Seal – Mechanical, Oil-Lubricated, self-aligning, tungsten carbide or silicon carbide rotating and stationary faces. Stainless steel hardware and spring. Seal system designed for indefinite dry running.
18. Vacuum Pump – Diaphragm style, continuous vacuum, mechanically driven
19. Discharge check valve assembly, Flanged ANSI B16.1 Class 125

**Engine Drive:**

Engine drive shall be natural gas or transportation grade diesel fueled (as specified), compression ignition, liquid cooled. Engine and pump assembly shall be direct drive and mounted on a structural steel base and enclosed in a critical grade sound attenuation enclosure. Diesel fueled units shall include a sub-base fuel tank for 72 hours of pump cycle operation. Assembly shall be painted gloss battleship gray.

**Engine Specifications:**

1. Engine Manufacturer - X
2. Engine Configuration - X
3. Horse Power - X
4. Fuel Consumption – X gph

**Engine Pump Assembly Accessories:**

1. Block Heater
2. (2) 12 volt batteries (180 amp hour rating) and charger
3. Starter; 12 volt electric
4. Automatic Engine/Pump Controller: Fully programmable microprocessor engine control system allowing for inputs from level, flow, pressure transducers or float switches. Manual, automatic, and remote start functions. Programmable relays with selectable features including pump running and pump failure. RS-232 and RS-485 communications ports for communication with SCADA and alarm equipment. Provide separate dry contact discrete relay output signals for remote “on-off” monitoring of engine drive status and a run prevent signal to the electrically driven pumps during operation of the engine in accordance with MAWSS Pumping Station Standards. Unit shall be capable of auto throttling engine RPM in response to changing pressure/level/flow transducer signals. Maintains event history of all warning alarms up to 32 signals. User pre-set for engine RPM to maintain flow and head parameters when running unattended. Unit shall track oil and filter usage and alert operator when replacement is recommended. Diesel engine warm up and cool down cycle.

5. Sound Attenuation Enclosure shall be critical grade. Noise level: 69 dBA @ 30 feet.
6. Exhaust system shall include muffler and silencer

**ENGINEERING STANDARD**

<table>
<thead>
<tr>
<th>ISSUED</th>
<th>PUMP SPECIFICATION SHEET</th>
<th>Engine Driven, Stand-By</th>
</tr>
</thead>
</table>

Guaranteed Performance:

- Maximum Operating Speed = X
- Maximum Operating Temperature = X
- Maximum Working Pressure = X
- Minimum Suction Pressure = X

Design Performance Requirements:

- Working Pressure Required = X
- Working Suction Pressure Required = X
- Working Operating Speed = X

References:
See drawing plan set for pump configuration and installation details.

**ACCEPTABLE PUMP EQUIVALENTS**

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>MODEL</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Godwin Pumps</td>
<td></td>
<td></td>
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<tr>
<td>Gorman-Rupp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pioneer Pumps, Inc.</td>
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<td></td>
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</tbody>
</table>
**ENGINEERING STANDARD**

<table>
<thead>
<tr>
<th>ISSUED</th>
<th>12/28/07</th>
<th>PUMP SPECIFICATION SHEET</th>
<th>Portable, By-Pass</th>
</tr>
</thead>
</table>

**Tag No.:** X

**Service:** Domestic Wastewater

**Location:** X

**Type of Pump:** Engine Driven, Fully Automatic Dry Priming, Vacuum Assisted, Run Dry, Heavy Duty Solids Handling, Horizontal Self-Priming Pump

**Pump Size:** X" x X"

**Solids Handling Capability:** 3" minimum diameter spherical solid

**Pump Specifications:**

1. Volute Casing - cast iron ASTM48 Class 30
2. Impeller – Enclosed type, two vane, Cast Chromium Steel hardened to Brinell 220 HB, or equivalent
3. Impeller shaft – Nickel/Chromium Steel, or equivalent
4. Wear Plate – Hardened Cast Iron, ASTM A48, Class 30
5. Back Plate – ASTM A48 Class 30 Gray Iron
6. Bearing Housing – Gray Iron No. 30
7. Seal Plate – Allot Steel No. 4130
8. Shaft Seal – Alloy Steel No. 4130
9. Pump End Bearing - Open Single Row Ball
10. Drive End Bearing – Open Single Row Ball
12. Inlet Flange – ANSI B16.1 Class 125
13. Gaskets – Buna-N, Compressed Synthetic Fibers, PTFE, Vegetable Fiber, Cork, and Rubber
14. O-Rings – Buna-N
15. Hardware – Standard Plated Steel
16. Oil Level Sight Gauge
17. Seal – Mechanical, Oil-Lubricated, self-aligning, tungsten carbide or silicon carbide rotating and stationary faces. Stainless steel hardware and spring. Seal system designed for indefinite dry running.
18. Vacuum Pump – Diaphragm style, continuous vacuum, mechanically driven
19. Discharge check valve assembly, Flanged ANSI B16.1 Class 125

Engine Drive:
Engine drive shall be transportation grade diesel fueled, compression ignition, liquid cooled. Engine and pump assembly shall be direct drive and mounted on a structural steel base with axle, suspension, tires, wiring, lights, and trailer hitch assembly in accordance with D.O.T. standards and enclosed in a sound attenuation enclosure. Unit shall include a sub-base fuel tank for 24 hours of pump cycle operation.

Engine Specifications:
1. Engine Manufacturer - X
2. Engine Configuration - X
3. Horse Power - X
4. Fuel Consumption – X gph

Engine Pump Assembly Accessories:
1. Block Heater
2. 12 volt battery, 180 amp hour rating
3. Starter; 12 volt electric
4. Safety shut-down switches for low oil pressure and high temperature
5. Tachometer
6. Hour meter
7. Oil pressure gage
8. Governor shall be mechanical type. Engine speed shall be adjustable to operate pump between maximum and minimum design operating speeds.
9. Sound Attenuation Enclosure shall be critical grade. Noise level: 69 dBA @ 30 feet.
10. Exhaust system shall include muffler and silencer.
Guaranteed Performance:

- Maximum Operating Speed = X
- Maximum Operating Temperature = X
- Maximum Working Pressure = X
- Minimum Suction Pressure = X

Design Performance Requirements:

- Working Pressure Required = X
- Working Suction Pressure Required = X
- Working Operating Speed = X

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>MODEL</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Godwin Pumps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pioneer Pumps, Inc.</td>
<td></td>
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</tr>
</tbody>
</table>
GUIDE TO MAWSS PIPING SPECIFICATIONS

The Design Engineer shall select the piping system(s) most appropriate for the project and include the attached Piping Specification(s) Sheets bound into the Contract Specifications for the project.

Should a piping system be required that is not included herein, the Design Engineer shall create a new Piping Specification Sheet for that material following the guidelines of the current specifications sheets and submit it to MAWSS for approval and acceptance.

These Specification Sheets are to be used by the Contractor to ensure obtaining the materials specified for the project.

<table>
<thead>
<tr>
<th>Letter Designation</th>
<th>Piping Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>B</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>C</td>
<td>Cast Iron</td>
</tr>
<tr>
<td>D</td>
<td>Ductile Iron</td>
</tr>
<tr>
<td>G</td>
<td>Plastic (PVC, CPVC, HDPE, Fiberglass, etc.)</td>
</tr>
<tr>
<td>U</td>
<td>Concrete</td>
</tr>
</tbody>
</table>
## Sample piping specification sheets attached:

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-2</td>
<td>Galvanized carbon steel.</td>
</tr>
<tr>
<td>A-4</td>
<td>Carbon steel</td>
</tr>
<tr>
<td>B-1</td>
<td>Type 304 stainless steel</td>
</tr>
<tr>
<td>B-5</td>
<td>Type 316 stainless steel</td>
</tr>
<tr>
<td>C-1</td>
<td>Cast iron soil pipe</td>
</tr>
<tr>
<td>D-2A</td>
<td>Ductile Iron – Fastite Joints– Cement Mortar Lined</td>
</tr>
<tr>
<td>D-3B</td>
<td>Ductile Iron – Flanged – Epoxy Coated, Cement Mortar Lined</td>
</tr>
<tr>
<td>D-3C</td>
<td>Ductile Iron – Flanged – Epoxy Coated, Ceramic Epoxy Lined</td>
</tr>
<tr>
<td>G-1A</td>
<td>PVC Type 1, Grade 1, Schedule 80</td>
</tr>
<tr>
<td>G-1B</td>
<td>PVC Type 1, Grade 1, Schedule 40</td>
</tr>
<tr>
<td>G-2</td>
<td>High Density Polyethylene (HDPE)</td>
</tr>
<tr>
<td>G-4</td>
<td>PVC 4&quot; - 12&quot; diameter – DR.18, C-900</td>
</tr>
<tr>
<td>G-9</td>
<td>PVDF Sch. 80, IPS, Chemical Systems</td>
</tr>
<tr>
<td>G-12</td>
<td>High Density Polyethylene (HDPE), DIPS Force Main</td>
</tr>
<tr>
<td>U-1</td>
<td>Concrete Drainage Pipe</td>
</tr>
</tbody>
</table>
Service: 150 psig to 450°F corrosive atmosphere

Pipe:
1/8" to 4" dia. : Schedule 40 galvanized welded carbon steel. ASTM A-53, Grade B, threaded ANSI B1.20.1 STPT

2 1/2" dia. and larger: Schedule 40 galvanized carbon steel seamless. ASTM A106, Grade B. threaded ASME B1.20.1.

Fittings: 150# rating in accordance with ANSI B16.3, Class 150 galvanized malleable iron threaded ANSI B1.20.1 Standard Tapered Pipe Thread.

Pipe Connections: 150 lb. rated threaded coupling in accordance with ANSI B16.3 galvanized malleable iron with ANSI B1.20.1 Standard Tapered Pipe Threads.

Connections at Valves and Pumps: 1" to 4" - 125 psi cast iron flanges meeting ASTM A-126, and ANSI B16.1 threaded ANSI B1.20.1 Standard Tapered Pipe Threads.

Gaskets To suit service


Remarks: Specification A-2 is:

Normally used in areas of specific corrosion conditions in the outside environment in compressed air service.

Underground piping shall be coated and wrapped in accordance with the latest revision of AWWA C203.

Unless otherwise noted, all above grade exterior piping shall be insulated and protected in accordance with the contract specifications
<table>
<thead>
<tr>
<th>Service:</th>
<th>200 psig max. at 100°F.</th>
</tr>
</thead>
</table>
| Pipe: | 2" and smaller - Schedule 80, carbon steel, threaded and coupled, seamless, ASTM A106, Grade B.  
2 1/2" through 10" - Schedule 40, carbon steel, bevel end, seamless, ASTM A106, Grade B.  
12" and larger - Standard weight, carbon steel, bevel end, seamless, ASTM A106, Grade B. |
| Fittings: | 2" and smaller - elbows, tees, etc. - 150 lb., malleable iron, black, threaded, banded, ASTM A197.  
Unions - 300 lb., malleable iron, threaded, ground joint, brass to iron seat.  
Threadolets, elbolets - 3000 lb., forged steel.  
Reductions - extra heavy, seamless, carbon steel, swagged nipple.  
Nipples - extra heavy, seamless, carbon steel.  
Couplings - 3,000 lb., forged steel, threaded.  
2 1/2" and larger - forged carbon steel, standard weight, buttweld, ASTM A234, Grade WB. |
| Flanges: | 2" and smaller - 150 lb. ANSI standard, forged steel, raised face, threaded, ASTM A181, Grade I.  
2 1/2" and larger - ANSI B 16.1, Class 125 standard, forged steel, raised face, slip-on, ASTM A181, Grade I.  
Weld neck flanges may be used at buttweld fittings. |
| Gaskets: | To suit service. |
| Gaskets - Underground: | 1/8" thick, 150 lb. ANSI standard, red rubber, full face. |
| NOTES: | Underground piping shall be coated and wrapped in accordance with the latest revision of AWWA C203 |
Service: 150 psi at 200°F corrosive atmosphere.

Pipe:
2" and smaller - Schedule 40, Type 304L stainless steel, ASTM A312, threaded.
2 1/2" and larger - Schedule 10S, Type 304L stainless steel, ASTM A312, butt-welded.

Fittings:
2" and smaller - Type 304L stainless steel, 150 lb. screwed fittings and MSS flanges:
Elbows, tee, and crosses = MSS SP-114, ASTM A351, and ASTM B16.3
Locknuts = ASTM A351
Other fittings = ASTM A182, and ASTM B16.3
2 1/2" and larger - Type 304L stainless steel, Schedule 10S, butt welded fittings - ANSI B16.9 ASTM A403, and ASME SA 403/SA-403M, Class WP-W

Flanges:
2" and larger - Type 304L stainless steel, class 150, forged, raised face, slip-on or welding neck flanges.

Pipe Couplings
2" – 16" – Dresser Style 253, or equal, ASTM A-536 modular ductile iron coupling, NSF-61 fusion bonded powder coated middle ring and followers.

Gaskets:
1/8" red rubber flat ring type per ANSI B16.21.

Remarks:
Service: 150 psi at 200°F corrosive atmosphere.

Pipe:
- 1 1/2" and smaller - Schedule 40, Type 316 stainless steel, ASTM A312, threaded.
- 2" and larger - Schedule 10S, Type 316L stainless steel, ASTM A312, butt-welded.

Fittings:
- 1 1/2" and smaller - Type 316 stainless steel, 150 lb. screwed fittings and MSS flanges:
  - Elbows, tee, and crosses = MSS SP-114, ASTM A351, and ASTM B16.3
  - Locknuts = ASTM A351
  - Other fittings = ASTM A182, and ASTM B16.3
- 2" and larger - Type 316L stainless steel, Schedule 10S, butt welded fittings - ANSI B16.9 ASTM A403, and ASME SA 403/SA-403M, Class WP-W

Flanges:
- 2" and larger - Type 316L stainless steel, class 150, forged, raised face, slip-on or welding neck flanges.

Pipe Couplings
- 2" – 16" – Dresser Style 253, or equal, ASTM A-536 modular ductile iron coupling, NSF-61 fusion bonded powder coated middle ring and followers.

Gaskets:
- 1/8" red rubber flat ring type per ANSI B16.21.

Remarks:
For use within sewage manholes, wet wells, or other submerged applications.

Pipe: (below grade) 2”–15”, SV, ASA Group 021, Cast iron soil pipe, ASTM A74, hub x plain end, with ring joint gaskets.

Pipe: (above grade) 2”–15”, No-Hub, ASA Group 022, cast iron pipe and fittings in accordance with ASTM A 888 with stainless steel banded and protected elastomeric sleeve type couplings in accordance with ASTM C 1277 and CISPI 301

Fittings: (below grade) 2”–15” SV, ASA Group 021, Cast Iron, ASTM A74, with ring joint gaskets.

Joints: (below grade) Hub x plain end; with elastomeric ring joint rubber gasket. Special fittings with spigot end; neoprene sealing sleeve with stainless steel sleeve and stainless steel clamps. Screwed; joint cement or lubricant shall be used only on male threads.
**Service:** Collection or Distribution – water, wastewater or other liquids - 200 psig to 150°F maximum. *Below Grade Piping Installations*

**Pipe:**
- 4" dia. and smaller - ductile iron - minimum thickness Class 52.
- 6" through 54" dia. - ductile iron - minimum thickness Class 52, Grade - 60,000 psi tensile, 42,000 psi yield, 10% elongation, ANSI/AWWA C151/21.51 (see Note 2 - Remarks).

**Pipe Joints:** Gasketed push-on bell and spigot in accordance with AWWA C111/A21.11

**Fittings:**
- 4" - 48" = ductile iron - mechanical joint, grade 70-50-05, 250 PSI pressure rated in accordance with ANSI/AWWA C110/A21.10 or 4" - 24" 350 PSI pressure rated in accordance with ANSI/AWWA C153/A21.53 ductile iron compact fittings. All fittings shall be complete with gaskets, follower glands, alloy steel tee bolts and hex nuts.

- 54" - 64" ductile iron Fastite* bell and spigot joint-grade 70-50-05, 150 PSI pressure rated in accordance with ANSI/AWWA C153/A21.53.

**Gaskets:** The gasket shall be manufactured from styrene butadiene copolymer (SBR) and shall be a product of the pipe manufacturer and supplied with the pipe along with joint lubricant. The gasket shall meet all requirements of ANSI/AWWA C111/A21.11.

**Bolting:** To be of type recommended by pipe supplier of material with minimum 45,000 psi tensile, with semi-finished heavy nuts in accordance with ANSI/AWWA C111/A21.11.

**Coating:** The exterior surfaces of all pipe and fittings shall receive a shop applied, one mil thick, asphaltic coating in accordance with AWWA C151, AWWA C115, AWWA C110 and AWWA C153.

**Lining:** The interior surfaces of all pipe and fittings shall receive a shop applied cement-mortar lining in accordance with ANSI/AWWA C104/A21.4.

**Plastic Encasing:**

Unless noted otherwise on the drawings or indicated in the specifications, the prescribed pipe and fittings shall be installed within polyethylene encasement. The encasement shall be in accordance with ANSI/AWWA C105/A21.5 and in conjunction with the Ductile Iron Pipe Research Association brochure "Polyethylene Encasement."

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**ENGINEERING STANDARD**
Marking: Each piece of pipe and all fittings shall be marked with the weight, class or nominal thickness, mark identifying year of manufacture, the letter "D.I." and manufacturers name.

Laying Conditions: Unless otherwise indicated, this piping shall be installed utilizing Type 2 laying condition in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. For cover depths greater than 10'-0" refer to ANSI/AWWA C151/A21.5.

Accessories: All piping accessories required to complete the project, including tapping saddles, sleeves, bosses, retainer glands, etc., shall be the product of the pipe manufacturer or meet the approval of the pipe manufacturer for installation as part of this project.
Service: Process Facilities - Water, sewage or other liquids - 200 psig at 150°F maximum. Below Grade Piping Installations.

Pipe: Ductile Iron - Grade 60-42-10 in accordance with ANSI/AWWA C151/A21.51, latest revision

4" - 12" = AWWA C150/A21.50 and C151/A21.51 pressure class 350
14" - 24" = AWWA C150/A21.50 and C151/A21.51 Pressure class 250
30" - 64" = AWWA C150/A21.50 and C151/A21.51 Pressure class 200

Pipe Joints: 4" - 64" = American Cast Iron Pipe Company, Fastite*, bell and spigot, compression - type, push-on in accordance with the requirements of ANSI/AWWA C111/A21.11.

Gaskets: The gasket shall be manufactured from styrene butadiene copolymer (SBR) and shall be a product of the pipe manufacturer and supplied with the pipe along with joint lubricant. The gasket shall meet all requirements of ANSI/AWWA C111/A21.11.

Restrained Pipe Joints: 4" - 16" = Fastite* joint with Fast-Grip* gaskets rated for 250 PSI working pressure
18" - 24" = Flex-Ring* joint rated for 350 PSI working pressure
30" - 36" = Flex-Ring* joint rated for 250 PSI working pressure
42" - 64" = Lok-Ring* joint rated for 250 PSI working pressure

Pipe Line Couplings: Plain-end to plain-end pipe couplings shall utilize a steel cylindrical middle ring, two resilient gaskets, two follower rings and a set of trackhead bolts. The couplings shall be specifically coated for underground service. The couplings shall be Dresser* style 38 or equal.

Fittings: 4" - 48" = ductile iron - mechanical joint, grade 70-50-05, 250 PSI pressure rated in accordance with ANSI/AWWA C110/A21.10 or 4" - 24" 350 PSI pressure rated in accordance with ANSI/AWWA C153/A21.53 ductile iron compact fittings. All fittings shall be complete with gaskets, follower glands, alloy steel tee bolts and hex nuts.

54" - 64" ductile iron Fastite* bell and spigot joint-grade 70-50-05, 150 PSI pressure rated in accordance with ANSI/AWWA C153/A21.53.
Restrained Fittings: 4” - 48” mechanical joint fittings, to be restrained, shall utilize Series 1100 Megalug* retainer glands, 250 PSI pressure rated, as manufactured by EBBA Iron Sales, Inc.*, or equal.

54" - 64" Fastite* joint fittings, to be restrained, shall utilize American Lok-Ring* assemblies.

Wall Pipe: Wall pipes shall be integrally cast with wall collars or shall be shop fabricated with full length penetration weld-on collars. All wall pipes shall be designed for use in thrust and load bearing conditions.

Bolting: Shall be of type and materials recommended by pipe supplier as suitable for buried services and shall have a minimum of 45,000 PSI tensile strength with semi-finished heavy hex nuts in accordance with ANSI/AWWA C111/A21.11.

Coating: The exterior surfaces of all pipe and fittings shall receive a shop applied, one mil thick, asphaltic coating in accordance with AWWA C151, AWWA C115, AWWA C110 and AWWA C153.

Lining: The interior surfaces of all pipe and fittings shall receive a shop applied cement-mortar lining in accordance with ANSI/AWWA C104/A21.4.

Plastic Encasing: When noted on the drawings or indicated in the specifications, the prescribed pipe and fittings shall be installed within polyethylene encasement. The encasement shall be in accordance with ANSI/AWWA C105/A21.5 and in conjunction with the Ductile Iron Pipe Research Association brochure "Polyethylene Encasement."

Marking: Each piece of pipe and all fittings shall be marked with the weight, class or nominal thickness, mark identifying year of manufacture, the letter “D.I.” and manufacturers name.

Laying Conditions: Unless otherwise indicated, this piping shall be installed utilizing Type 2 laying condition in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. For cover depths greater than 10’ - 0” refer to ANSI/AWWA C151/A21.5.

Accessories: All piping accessories required to complete the project, including tapping saddles, sleeves, bosses, retainer glands, etc., shall be the product of the pipe manufacturer or meet the approval of the pipe manufacturer for installation as part of this project.
Service: Process Facilities - Water, sewage or other liquids - 200 psig at 150°F maximum. Above Grade Piping Installations.

Pipe: Ductile Iron - Grade 60-42-10 in accordance with ANSI/AWWA C151/A21.51, latest revision

4" - 12" = AWWA C150/A21.50 and C151/A21.51 pressure class 350
14" - 24" = AWWA C150/A21.50 and C151/A21.51 Pressure class 250
30" - 64" = AWWA C150/A21.50 and C151/A21.51 Pressure class 200

Pipe Joints: Ductile Iron Cast-On-Flange in accordance with ANSI/AWWA C110/A21.10 and/or threaded-on-flange in accordance with ANSI/AWWA C115/A21.15. Bolt holes and bolt circles shall match those of ANSI B16.1 Class 125 flanges and ANSI B16.5 Class 150 flanges.

Gaskets: 1/8" thick red rubber ring gaskets or American Cast Iron Pipe Company, Toruseal* gaskets designed for AWWA C110 or C115 flanges.

Pipe Line Couplings: Plain-end to plain-end pipe couplings shall utilize a steel cylindrical middle ring, two resilient gaskets, two grip rings and two follower rings. The bolts and nuts shall be type 316 stainless steel (CONTRACTOR shall replace the bolts if required in order to meet this specification). The couplings shall be epoxy coated on all surfaces. The couplings shall be Dresser* style 711 or approved equal.

3" to 12" plain-end pipe to flanged valve connections and plain-end to flange pipe connections shall utilize EBBA Iron Series 2100 Megaflange restrained flange adapters, or approved equal. These units shall be coated with fusion bonded epoxy.

Other field made flanged connections shall utilize cast/ductile iron set screw type flange adapters will not be approved.

Fittings: Fittings shall be 250 PSI pressure rated, Ductile Iron flanged in accordance with ANSI/AWWA C110/A21.1 or ANSI/AWWA C153/A21.53. Flanges shall have facing and drilling to match AWWA C115 and ANSI B16.1 Class 125 flanges. The fittings shall be Ductile Iron Grade 70-50-05, with a minimum tensile strength of 70,000 PSI and minimum yield strength of 50,000 PSI per AWWA C110 or C153.

Wall Pipe: Wall pipes shall be integrally cast with wall collars or shall be shop fabricated with full length penetration weld-on collars. All wall pipes shall be designed for use in thrust and load bearing conditions.
**Bolting:**
Fasteners shall be hex head machine bolts with hex nuts. Studs with one hex nut each are required for tapped flanges. Bolts, studs and nuts are low carbon steel per ASTM A307. Threads shall be ANSI B1.1 Coarse Thread series, Class 2A external and Class 2B internal. Recommended studs are same length as corresponding bolt length with "tap end" threaded approximately the same length as flange thickness.

**Coating:**
The exterior surfaces of all pipe and fittings shall receive a pipe manufacturer applied coating of high solids epoxy primer. The finish coating shall be applied by the CONTRACTOR in accordance with specification Section 09900, Painting.

**Lining:**
The interior surfaces of all pipe and fittings shall receive a shop applied cement-mortar lining in accordance with ANSI/AWWA C104/A21.4.

**Marking:**
Each piece of pipe and all fittings shall be marked with the weight, class or nominal thickness, mark identifying year of manufacture, the letter "D.I." and manufacturer’s name.

**Laying Conditions:**
All above grade piping shall have hangers and/or supports spaced not less than one per pipe joint or as indicated on drawings.

**Accessories:**
All piping accessories required to complete the project, including tapping saddles, sleeves, bosses, etc., shall be the product of the pipe manufacturer or meet the approval of the pipe manufacturer for installation as part of this project.

* The use of manufacture and/or brand name products within this specification is done only to provide the reviewer with a known product meeting this specification and not to limit the application of other products meeting this specification.
**Service:** Process Facilities - Water, sewage or other liquids - 200 psig at 150°F maximum. Above Grade Piping Installations.

**Pipe:** Ductile Iron - Grade 60-42-10 in accordance with ANSI/AWWA C151/A21.51, latest revision

- 4" - 12" = AWWA C150/A21.50 and C151/A21.51 pressure class 350
- 14" - 24" = AWWA C150/A21.50 and C151/A21.51 Pressure class 250
- 30" - 64" = AWWA C150/A21.50 and C151/A21.51 Pressure class 200

**Pipe Joints:** Ductile Iron Cast-On-Flange in accordance with ANSI/AWWA C110/A21.10 and/or threaded-on-flange in accordance with ANSI/AWWA C115/A21.15. Bolt holes and bolt circles shall match those of ANSI B16.1 Class 125 flanges and ANSI B16.5 Class 150 flanges.

**Gaskets:** 1/8" thick red rubber ring gaskets or American Cast Iron Pipe Company, Toruseal* gaskets designed for AWWA C110 or C115 flanges.

**Pipe Line Couplings:** Plain-end to plain-end pipe couplings shall utilize a steel cylindrical middle ring, two resilient gaskets, two grip rings and two follower rings. The bolts and nuts shall be type 316 stainless steel (CONTRACTOR shall replace the bolts if required in order to meet this specification). The couplings shall be epoxy coated on all surfaces. The couplings shall be Dresser* style 711 or approved equal.

3" to 12" plain-end pipe to flanged valve connections and plain-end to flange pipe connections shall utilize EBBA Iron Series 2100 Megaflange restrained flange adapters, or approved equal. These units shall be coated with fusion bonded epoxy.

Other field made flanged connections shall utilize cast/ductile iron set screw type flange adapters will not be approved.

**Fittings:** Fittings shall be 250 PSI pressure rated, Ductile Iron flanged in accordance with ANSI/AWWA C110/A21.1 or ANSI/AWWA C153/A21.53. Flanges shall have facing and drilling to match AWWA C115 and ANSI B16.1 Class 125 flanges. The fittings shall be Ductile Iron Grade 70-50-05, with a minimum tensile strength of 70,000 PSI and minimum yield strength of 50,000 PSI per AWWA C110 or C153.

**Wall Pipe:** Wall pipes shall be integrally cast with wall collars or shall be shop fabricated with full length penetration weld-on collars. All wall pipes shall be designed for use in thrust and load bearing conditions.
**Bolting:**

Fasteners shall be hex head machine bolts with hex nuts. Studs with one hex nut each are required for tapped flanges. Bolts, studs and nuts are low carbon steel per ASTM A307. Threads shall be ANSI B1.1 Coarse Thread series, Class 2A external and Class 2B internal. Recommended studs are same length as corresponding bolt length with "tap end" threaded approximately the same length as flange thickness.

**Coating:**

The exterior surfaces of all pipe and fittings shall receive a pipe manufacturer applied coating of high solids epoxy primer. The finish coating shall be applied by the CONTRACTOR in accordance with specification Section 09900, Painting.

**Lining:**

The interior surfaces of all pipe and fittings shall receive a shop applied ceramic-epoxy lining similar to Protecto 401 in accordance with ASTM E-96, G-95, B-117, G-14, D-174 and D-1308.

**Marking:**

Each piece of pipe and all fittings shall be marked with the weight, class or nominal thickness, mark identifying year of manufacture, the letter "D.I." and manufacturer's name.

**Laying Conditions:**

All above grade piping shall have hangers and/or supports spaced not less than one per pipe joint or as indicated on drawings.

**Accessories:**

All piping accessories required to complete the project, including tapping saddles, sleeves, bosses, etc., shall be the product of the pipe manufacturer or meet the approval of the pipe manufacturer for installation as part of this project.

* The use of manufacture and/or brand name products within this specification is done only to provide the reviewer with a known product meeting this specification and not to limit the application of other products meeting this specification.
Service: 150 psig to 73°F

Pipe: Polyvinyl Chloride Type 1, Grade 1, 1120, Cell Classification 12454-B as outlined in ASTM D1784

1/4" dia. through 12" dia. - Schedule 80 in accordance with ASTM D1785

Fittings: 150 psi rating, Socket Type PVC 1120 in accordance with ASTM D2467.

Pipe Connections: Socket solvent weld in accordance with ASTM D3036.

Primer: Prime all contact surfaces of pipes and fittings with “Purple Prime” prior to application of solvent cement.

Cement: Solvent cement shall be specifically formulated for PVC pipe pressure applications in accordance with ASTM D-3564. Do not use “Muti-Purpose” PVC cements.

Gaskets: Rubber, full face, 1/8" thick in accordance with ANSI/AWWA C110/A21.10 for flanged connections.

Bolting: To be in accordance with piping manufacturer’s recommendation

Remarks:
1. PVC line is not to be placed under a building slab or in an interior run, unless otherwise indicated on drawings.
2. Pipe embedment is to be in accordance with ASTM D2321.
3. Above grade piping shall be formulated for high (UV) ultraviolet resistance.
<table>
<thead>
<tr>
<th>Service:</th>
<th>150 psig to 73°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyvinyl Chloride Type 1, Grade 1, 1120, Cell Classification 12454-B as outlined in ASTM D1784</td>
<td></td>
</tr>
<tr>
<td>¼” dia. through 12” dia. - Schedule 40 in accordance with ASTM D1785</td>
<td></td>
</tr>
<tr>
<td>Fittings:</td>
<td>150 psi rating, Socket Type PVC 1120 in accordance with ASTM D2467.</td>
</tr>
<tr>
<td>Pipe Connections:</td>
<td>Socket solvent weld in accordance with ASTM D3036.</td>
</tr>
<tr>
<td>Flanges:</td>
<td>Sch. 40 Socket Solvent weld in accordance with ASTM D-2467</td>
</tr>
<tr>
<td>Gaskets:</td>
<td>Rubber, full face, 1/8&quot; thick in accordance with ANSI/AWWA C110/A21.10 for flanged connections.</td>
</tr>
<tr>
<td>Bolting:</td>
<td>To be in accordance with piping manufacturer’s recommendation</td>
</tr>
<tr>
<td>Remarks:</td>
<td>1. PVC line is not to be placed under a building slab or in an interior run, unless otherwise indicated on drawings.</td>
</tr>
<tr>
<td></td>
<td>2. Pipe embedment is to be in accordance with ASTM D2321.</td>
</tr>
<tr>
<td></td>
<td>3. Above grade piping shall be formulated for high (UV) ultraviolet resistance.</td>
</tr>
</tbody>
</table>
Service: 150 psig to 73°F, below grade, open trench or horizontal directional boring installation.

Pipe: High Density Polyethylene (HDPE), high density, extra-high molecular weight (EHMW), cell classification 3464C, PE3408 (black)

½” dia. through 3” dia. – minimum dimension ratio of DR-11. Selection Shall be based on Plastic Pipe Institute (PPI) recommended hydrostatic Design basis (HDB) for appropriate design and service factors*.

Color Coding: Pipe shall be color coded in accordance with striping codes developed by The Utility Location & Coordination Council of the American Public Works Association (APWA) as noted below:

Water Pipe: Blue Stripe
Sewer Pipe: Green Stripe

Fittings: Pressure rated molded or fabricated.

Pipe Connections: Heat fusion welded (Butt Fusion, Saddle Fusion, or Socket Fusion) in accordance with the Plastic Pipe Institute (PPI) TR-33, Generic Butt Fusion Procedures and TR-41, Generic Saddle Fusion Procedures.

Flanges: Molded butt fusion, flange adapter/stub end with ductile iron class A563 (65/14/12), or stainless steel where indicated, back-up ring. Bolt circle ANSI B.16.5 Class 15, mates with ANSI B16.5, B16.1, AWWA C207, table 2. Class D.

Mechanical Joint: Molded butt fusion mechanical joint adapter.

Bolting: Cor-Ten bolts and nuts for ductile iron connections, type 316 SST for stainless steel connections.

Remarks: 1. Reference specification Section 15051, Buried Pipe Installation for pressure testing of installed piping.
2. * Modify this Piping Specification Sheet to include diameter(s) and Dimension Ratio(s) of pipe to be used for project.
Service: 150 psig to 73°F - PVC Sewer Force Main Piping

Pipe: Polyvinyl chloride 4" diameter through 12" diameter - maximum dimension ratio allowable - 18, and shall be in accordance with AWWA C900 and 14" diameter through 48" diameter – maximum dimension ratio of 21 through 24" and 32.5 through 48" in accordance with AWWA C905.

Fittings: 4" – 48" = ductile iron – mechanical joint, grade 70-50-05, 250 PSI pressure rated in accordance with ANSI/AWWA C110/A21.10 or 4" – 24" 350 PSI pressure rated in accordance with ANSI/AWWA C153/A21.53 ductile iron compact fittings. All fittings shall be complete with gaskets follower glands, alloy steel tee bolts and hex nuts.

OR:

4" – 48" = ductile iron – restrained joint, bell and spigot, compression-type, push-on in accordance with requirements of ANSI/AWWA C111/A21.11.

Pipe Connections: Bell and spigot type with rubber ring sealing gasket.

Gaskets: Rubber ring gasket in accordance with AWWA C11 standard for cast iron pipe and fittings.

Bolting: To be in accordance with piping manufacturer’s recommendations.

Remarks: Where noted on the plans and/or specifications, restrained joints for fittings shall utilize a ductile iron, mechanical joint follower gland with integral, mechanically actuated gripping wedges similar to the EBBA Iron Series 3000 restraint. Restrained PVC bell to plain end pipe joints shall utilize a system of a wedge action gland and a follower ring with tie rods similar to the EBBA Iron Series 3500 and Series 3600 restraints.
Service: Acid Systems requiring high corrosion resistant, pressure pipe features.

Pipe: Polyvinylidene Fluoride (PVDF) pipe shall conform to ASTM D2837-85 for establishing a hydrostatic design basis. Pipe shall be able to withstand 230 psi at 73°F and 150 psi at 73°F for pipe above 2¼" diameter with a standard diameter ratio of eleven. Pipe shall be Schedule 80 I.P.S. and shall be made to the dimensions and tolerances found in ASTM D1785.

Fittings: Schedule 80 I.P.S., same materials as pipe, produced to the dimensions and tolerances of ASTM D2467 for socket fittings.

Connections: All pipe end fittings shall be prepared using butt-fusion or socket weld techniques as outlined in ASTM D2657.

Remarks: Buried pipe shall be bedded and backfilled in accordance with manufacturer's recommendations.

Exposed vertical piping shall be supported with riser clamps or wall brackets at each floor or on ten foot centers (whichever is less). Horizontal exposed piping shall be supported to allow for expansion and contraction in the line.
Service: Below Grade Sanitary Sewer Force Main

Pipe: High density, extra high molecular weight (EHMW) PE3408 Polyethylene pipe (HDPE). Cell classification ASTM D3350

Size: Size as shown on construction drawings

Pipe Thickness: Unless otherwise noted, all pipe and fittings shall be Ductile Iron Pipe Size (DIPS).

Dimension Ratio: Dimension Ratio (DR) shall be no less than DR17. The dimension ratio shall be calculated for each installation and noted on the construction drawings.

Pipe Joining: Heat fusion: butt, saddle, socket, and electrofusion.

Fittings: Molded butt fusion or socket fusion and fabricated butt fusion fittings. Fittings shall be same dimension ratio as the pipe.

Connections to Dissimilar Materials: Provide a molded butt fusion mechanical joint adapter with ductile iron back-up ring for connection to ductile iron piping. Provide molded butt fusion mechanical joint adapter HDPE to PVC pipe. Provide molded saddle fusion fittings for connection of small diameter force mains into the HDPE force main.

Connection to Manholes: Manhole connection require one (1) full joint of M.J. ductile iron pipe of same diameter as HDPE pipe stubbed out from the manhole. Connect HDPE pipe to the D.I.-M.J. end with molded butt fusion MJ adapter and D.I. back-up ring.

Color Coding: Pipe shall be black in color with three or four, equally spaced, green longitudinal stripes in accordance with APWA/ULCC Uniform Color Code.

Direct Burial: A minimum of 30 inches cover shall be maintained between top of pipe and finish grade. Force main pipes shall be installed in accordance with ASTM D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping and pipe manufacturer’s recommendations.

Horizontal Directional Drilling: See Project Specifications

Tracer Wire: All piping, where noted on the plans and specifications, shall be installed with a continuous TW, THW, THWN, or HWWPE insulated copper, 10 gauge, or thicker, wire for pipeline location by means of an electronic line tracer. The wire shall be installed along the top face of the piping for the entire length.
Service: Atmospheric pressure – Concrete culvert and storm sewer pipe

Circular Pipe: Reinforced Concrete Pipe in accordance with ASTM C-443/AASTO M170 and an earth cover as shown on the plans with an AASHTO HS-20 truck live load, all in accordance with AWWA Standard C304-99 and AWWA C301-99.

Arch Pipe: Reinforced Concrete Arch-Pipe in accordance with ASTM C-506 and an earth cover as shown on the plans with an AASHTO HS-20 truck live load, all in accordance with AWWA Standard C304-99 and AWWA C301-99.

Reinforcing: Pipe shall be manufactured in accordance with applicable specifications with reinforcing steel as required by ASTM C-76, Standard Specification For Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

Pipe Joints: Tongue (spigot) and Groove (bell) sealed with mortar or preformed flexible Sealants in accordance with ASTM C 990/AASHTO M 198.

Gaskets: AASHTO M-170, or ASTM C-443 Standard Specifications for Concrete Pipe and Manholes Using Rubber Gaskets.


ENGINEERING STANDARD

PIPING SPECIFICATION SHEET

V-200

01/01/08

Type: Swing Check AWWA C508

Rating: 2” – 12” = 150 psi Water

Ends: Flanged, F.F., 125# ANSI B16.1

Body: Cast Iron ASTM A126, Class B

Bonnet: (Cover) Cast Iron, ASTM A 126, Class B

Body & Bonnet Bolting: ASTM A307, Gr. B

Disc: Cast Iron, ASTM A 126, Class B with bronze bushing

Stem: (Clapper Arm Shaft) Bronze, Aluminum Bronze or Stainless Steel

Seat: Bronze, renewable

Seals (or Packing): “O” Ring, Buna-N

Operator: Outside weight and lever

Remarks: Horizontal or vertical installation

ACCEPTABLE VALVE EQUIVALENTS

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Flow Control</td>
<td>Series 50</td>
<td>3” – 12”</td>
<td></td>
</tr>
<tr>
<td>Kennedy</td>
<td>Style 106 LW</td>
<td>2&quot;-12”</td>
<td></td>
</tr>
<tr>
<td>Clow, List 114</td>
<td>F-5382</td>
<td>2”- 12”</td>
<td></td>
</tr>
<tr>
<td>Mueller</td>
<td>A-2600-601-01</td>
<td>2 1/2”-12”</td>
<td></td>
</tr>
</tbody>
</table>
The Design Engineer shall select the valve(s) most appropriate for the project and include the attached Valve Specification(s) Sheets bound into the Contract Specifications for the project.

Should a valve be required that is not included herein, the Design Engineer shall create a new Valve Specification Sheet for that following the guidelines of the current specifications sheets and submit it to MAWSS for approval and acceptance.

These Specification Sheets are to be used by the Contractor to ensure obtaining the materials specified for the project.

<table>
<thead>
<tr>
<th>Series Designation</th>
<th>Valve Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-001</td>
<td>Ball Valves</td>
</tr>
<tr>
<td>V-200</td>
<td>Butterfly Valves</td>
</tr>
<tr>
<td>V-300</td>
<td>Check Valves</td>
</tr>
<tr>
<td>V-400</td>
<td>Diaphragm Valves</td>
</tr>
<tr>
<td>V-500</td>
<td>Gate Valves</td>
</tr>
<tr>
<td>V-600</td>
<td>Globe Valves</td>
</tr>
<tr>
<td>V-700</td>
<td>Pinch Valves</td>
</tr>
<tr>
<td>V-800</td>
<td>Plug Valves</td>
</tr>
<tr>
<td>V-900</td>
<td>Slide and Sluice Gates</td>
</tr>
<tr>
<td>V-1000</td>
<td>Control Valves</td>
</tr>
</tbody>
</table>
GUIDE TO MAWSS VALVE SPECIFICATIONS

Sample valve specification sheets attached:

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-001</td>
<td>True-Union, PVC Ball Valve, Socket Weld</td>
</tr>
<tr>
<td>V-004</td>
<td>Two-Piece, Bronze Ball Valve, Threaded Ends</td>
</tr>
<tr>
<td>V-200</td>
<td>Flanged, AWWA C508 Check Valve</td>
</tr>
<tr>
<td>V-203</td>
<td>PVC Ball Check, Socket Weld</td>
</tr>
<tr>
<td>V-235</td>
<td>Flanged, Cushion Controlled, Check Valve</td>
</tr>
<tr>
<td>V-240</td>
<td>Combination Air and Vacuum Release Valve</td>
</tr>
<tr>
<td>V-241</td>
<td>Automatic Air Release Valve</td>
</tr>
<tr>
<td>V-513</td>
<td>Resilient Seated Gate Valve, NRS, Mechanical Joint</td>
</tr>
<tr>
<td>V-516</td>
<td>Resilient Seated Gate Valve, NRS, Flanged</td>
</tr>
</tbody>
</table>
# Valve Specification Sheet

**Type:** Ball  
**Rating:** 150 psi at 75°F. water - non shock  
**Ends:** Socket weld - union  
**Body:** PVC  
**Bonnet:** PVC  
**Body & Bonnet Bolting:**  
**Disc:** (Ball) PVC  
**Stem:** PVC  
**Seat:** Teflon  
**Seals (or Packing):** Viton U-Ring  
**Operator:** Lever  
**Service:**  
**Remarks:** PVC must meet ASTM D-1784 cell classification 12454-B

## Acceptable Valve Equivalents

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemtrol</td>
<td>TU Series</td>
<td>½&quot; - 3&quot;</td>
<td></td>
</tr>
<tr>
<td>Hayward Mfg. Co.</td>
<td>True Union</td>
<td>¼&quot; - 4&quot;</td>
<td></td>
</tr>
</tbody>
</table>
ENGINEERING STANDARD

ISSUED 01/01/08  VALVE SPECIFICATION SHEET  V-004

Type: Ball (End Entry) Bronze Full Port
Rating: 600 psig WOG, Cold Non-Shock. 150 psig saturated steam
Ends: Threaded FNPT
Body: Bronze, ASTM B-584
Ball: Chrome Plated Brass
Thrust Washer: PTFE
Stem: Brass ASTM B16, or B99
Stem Packing: PTFE
Seat: PTFE
Handle: Zinc Plated Carbon Steel with Vinyl Coating
Operator: Handle (1/4 Turn)
Service: Water, oil and gas

ACCEPTABLE VALVE EQUIVALENTS

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIBCO</td>
<td>T-5885-70</td>
<td>¼&quot; - 2&quot;</td>
<td></td>
</tr>
<tr>
<td>Apollo</td>
<td>77-100 Series</td>
<td>¼&quot; – 21/2&quot;</td>
<td></td>
</tr>
<tr>
<td>Watts</td>
<td>Series B6080</td>
<td>¼&quot; - 2&quot;</td>
<td></td>
</tr>
<tr>
<td>Stockham</td>
<td>T-285</td>
<td>3/8&quot; – 3&quot;</td>
<td></td>
</tr>
</tbody>
</table>
Type: Ball Check
Rating: 150 psi at 75° Water – non-shock
Ends: Socket Weld
Body: PVC
Disc: (Ball) PVC
Seat: Viton O-Ring
Note: Provide valve extension, valve box, and other accessories to suit installation.

ACCEPTABLE VALVE EQUIVALENTS

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemlinel</td>
<td>Bt Series</td>
<td>½” – 4”</td>
<td></td>
</tr>
<tr>
<td>Hayward</td>
<td>Ball Check</td>
<td>¼” – 6”</td>
<td></td>
</tr>
</tbody>
</table>
ENGINEERING STANDARD

ISSUED 01/01/08  VALVE SPECIFICATION SHEET  V-235

Type: 3-Stage Oil Control, Side Mounted, Cushion Controlled, Swing Check
Rating: Class 200 psi at 150°F, AWWA C-508-01
Ends: Flanged, 125# ANSI B16.42
Body: Cast Iron, ASTM A126, Gr. B
Cover: Cast Iron, ASTM A126, Gr. B
Body & Cover Bolting: ASTM A193, Gr. B7
Disc: Ductile Iron, ASTM A536
Shaft: Stainless Steel, Type 17-4PH with Bronze Bushings
Body Seat Ring: Stainless Steel, renewable
Disc Seat: Buna-N
Dashpot Cylinder: Steel, Per N.F.P.A. Standards, One for 2”-8”, Two for 10” – 20”
Pivot Shaft: Stainless Steel, Type 17-4PH
Counter Weight Arm: One for 2”-8”, two for 10” – 20”
Operator: External Lever(s) and Weight(s) Cast Iron and Steel
Service: Water, and Wastewater
Remarks: Horizontal or Vertical Installation. 1st Stage- Rapid closure from full open to any degree of closing (timing valve). 2nd Stage- Variable speed towards final closure (flow control valve). 3rd Stage- Variable speed closure to shut off (internal cushion adjustment of the cylinder). Each stage independently adjustable for prevention of surge and water hammer.

ACCEPTABLE VALVE EQUIVALENTS

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>APCO, Valve and Primer, Corporation</td>
<td>Series 6100</td>
<td>2” – 20”</td>
<td></td>
</tr>
<tr>
<td>CCNE, LLC</td>
<td>Series 9000</td>
<td>3” – 48”</td>
<td></td>
</tr>
</tbody>
</table>

Note: Revised this specification sheet as required to suit application.
**Type:** Combination Air and Vacuum Release Valve for Sewage

**Rating:** Working Pressure: 3-150 psi

**Ends:**
- Inlet Connection: 2” = FNPT, 3” & 4” = Flanged ANSI standard
- Outlet Connection: 1 1/2” threaded Polypropylene

**Body:** Two-Part Type 316 Stainless Steel

**Floats:** Formed Polypropylene

**O-Ring:** Viton/Buna-N

**Seals:** Viton

**Trim:** Type 316 Stainless Steel

**Body Drain Valve:** Brass or Stainless Steel

**Note:** Provide 2” V-004, 3” or 4” V-516 as required for installation.

### ACCEPTABLE VALVE EQUIVALENTS

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARI Flow Control Accessories</td>
<td>D-025 ST.ST.</td>
<td>2” – 4”</td>
<td></td>
</tr>
</tbody>
</table>
Type: Automatic Air Release Valve for Sewage

Rating: Working Pressure: 3-150 psi

Ends: Inlet Connection: 2" = FNPT, 3" & 4" = Flanged ANSI standard
      Outlet Connection: 1 1/2" threaded Polypropylene

Body: Two-Part Type 316 Stainless Steel

Floats: Formed Polypropylene

O-Ring: Viton/Buna-N

Seals: Viton

Trim: Type 316 Stainless Steel

Body Drain Valve: Brass or Stainless Steel

Note: Provide 2" V-004, 3" or 4" V-516 as required for installation.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARI Flow Control</td>
<td>S-020 ST.ST.</td>
<td>2&quot; – 4&quot;</td>
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</tbody>
</table>
ENGINEERING STANDARD

<table>
<thead>
<tr>
<th>ISSUED</th>
<th>01/01/08</th>
<th>VALVE SPECIFICATION SHEET</th>
<th>V-513</th>
</tr>
</thead>
</table>

| Type:        | Gate - (Resilient Seated) |
| Rating:      | 250 PSI working water pressure to meet or exceed AWWA C509 requirements. |
| Ends:        | Mechanical Joint – AWWA Spec. C111 and ANSI A21.11 |
| Body:        | Cast Iron, ASTM A 126 |
| Bonnet:      | Cast Iron, ASTM A 126 |
| Body Bolting:| ASTM A 307, Gr. B |
| Disc:        | Cast Iron with resilient seat of SBR or Buna "N" rubber vulcanized to gate. |
| Stem:        | Bronze with Bronze Nut Independent of Gate (Non-Rising) |
| Seat:        | Resilient Seated Gate |
| Seals (or Packing): | O-ring stem seals. S.S., Delrin, Teflon or Polymer thrust washers. |
| Operator:    | 2" AWWA Operating Nut |
| Service:     | Water or Wastewater |
| Remarks:     | Valves larger than 12” shall be furnished with bevel gearing. Valve shall be furnished with all accessories for proper installation. Fusion bonded epoxy coating interior and exterior. |

<table>
<thead>
<tr>
<th>ACCEPTABLE VALVE EQUIVALENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANUFACTURER</td>
</tr>
<tr>
<td>American Flow Control</td>
</tr>
<tr>
<td>Clow</td>
</tr>
<tr>
<td>Mueller</td>
</tr>
<tr>
<td>Kennedy</td>
</tr>
</tbody>
</table>
**ENGINEERING STANDARD**

**VALVE SPECIFICATION SHEET**

**V-516**

<table>
<thead>
<tr>
<th>ISSUED</th>
<th>01/01/08</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVISED</td>
<td></td>
</tr>
</tbody>
</table>

- **Type:** AWWA C-509 Gate – (Resilient Sealed)
- **Rating:** 200 PSI working water pressure to meet or exceed AWWA C509 requirements.
- **Ends:** Flanged, F.F., 125# ANSI B16.1
- **Body:** Ductile Iron, ASTM A536
- **Bonnet:** Ductile Iron, ASTM A536
- **Body Bolting:** ASTM A 307, Gr. B
- **Disc:** Ductile Iron encapsulated with EPDM rubber.
- **Stem:** Bronze, non-rising
- **Seat:** Resilient Seated Gate
- **Seals (or Packing):** O-ring stem seals. S.S., Delrin, Teflon or Polymer thrust washers.
- **Operator:** Handwheel unless otherwise shown on Plans.
- **Service:** Water and Wastewater

**Remarks:** Valves larger than 12” shall be furnished with bevel gearing. Valve shall be furnished with all accessories for proper installation. Fusion bonded epoxy coating interior and exterior.

### ACCEPTABLE VALVE EQUIVALENTS

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>FIG. NO.</th>
<th>SIZE RANGE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Flow Control</td>
<td>Series-500/2500</td>
<td>4&quot;-12&quot;/14&quot;-24&quot;</td>
<td></td>
</tr>
<tr>
<td>Clow</td>
<td>F-6102</td>
<td>2&quot; - 24&quot;</td>
<td></td>
</tr>
<tr>
<td>Mueller</td>
<td>A-2360/A-2361</td>
<td>4&quot;-12&quot;/14&quot;-36&quot;</td>
<td></td>
</tr>
<tr>
<td>Kennedy</td>
<td>C515/Large RW</td>
<td>4&quot;-12&quot;/14&quot;-24&quot;</td>
<td></td>
</tr>
</tbody>
</table>
The following specifications are for MAWSS approved wet well and manhole lining system products and applications to ensure a standardized quality of materials and performance. Manufacturers and applicators of other products must receive written approval from MAWSS prior to submitting a bid for this Work.

Lining and coating system manufacturers and applicators may submit their products for review by the MAWSS Engineering Department. Approval of reviews is based on “or equal” or similar products that meet or exceed the performance characteristics of the products specified.

The Design Engineer shall select the lining system(s) most appropriate for the pumping station wet well and include the attached specification(s) bound into the Contract Specifications for the project.
EPOXY WET WELL AND MANHOLE COATING SYSTEMS

PART 1 GENERAL

A. Description of Work

CONTRACTOR shall provide all labor, materials, tools and equipment necessary to field apply a 100% solids, high build epoxy coating system to all exposed concrete wet well surfaces.

The coating/lining system shall be applied to exposed surfaces of the pump discharge piping and fittings within the wet well. Do not coat the pump, or pump matting surfaces of the discharge elbow, or any non-ferrous metals such as pump guide rails, etc.

1.2 REFERENCES

A. Referenced Standards

5. ASTM D4414 - Wet Film Thickness by Notch Gages
6. ASTM D2584 – Volatile Matter Content.
7. ASTM D2240 – Durometer Hardness, Type D.
10. ASTM C297 – Flatwise Tensile Strength of Sandwich Constructions.
12. NACE – The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

1.3 SUBMITTALS

A. Shop Drawings and Manufacturer's Literature

1. Submit shop drawings or manufacturer’s “cut” of all material for this work in accordance with MAWSS Section 13.1.07, Construction Submittals.
2. A copy of the executed 10 year warranty shall be submitted for approval prior to the installation of any products. Failure to submit warranty is grounds for rejection of all coating submittals.

1.4 QUALITY ASSURANCE

A. **Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM and NACE standards together with pull testing and vacuum testing to assure a high quality project.**

B. Applicator shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. The supervisor and foreman must have a minimum of five (5) years experience in epoxy restoration via plural component spray application with 100% solid epoxy.

C. Applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish the work of this Section in a timely manner. Application equipment must be approved by the coating manufacturer.

1.5 QUALIFICATIONS AND RESPONSIBILITY OF APPLICATOR

A. The Applicator shall apply the system and be responsible for the complete performance of the system, including materials, application and quality control. Applicator shall provide documentation that Applicator is an approved installer and licensed by the epoxy system manufacturer and specialized equipment supplier, (WES).

B. Applicator shall provide documentation as follows:

1. A list of at least five (5) past clients, including names and telephone numbers, to verify previous satisfactory performance on projects of similar or greater size and difficulty factor. The contractor must have at least five (5) years experience in the application of 100% solid epoxy.

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials are to be kept dry, protected from weather and stored under cover and stored between 50 degrees F and 100 degrees F. Materials should not be stored near flame, heat or strong oxidants.
B. Protective coating materials are to be handled according to their material safety data sheets.

1.7 ENVIRONMENTAL CONDITIONS

A. The CONTRACTOR shall provide and maintain safe working conditions for all employees. Fresh air ventilation shall be provided to continuously remove fumes from working spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside.

Respirators shall be used for spraying type operations. Fumes shall, if possible, be exhausted to the outside from the lowest level in the confined space. Electrical fan motors shall, if located in the working space, be explosion proof. No smoking or open fires will be permitted in the working space.

1.8 SCAFFOLDING AND PROTECTION

A. Furnish, maintain and remove all scaffolding, ladders and planks required for this work and all drop cloths for the protection of concrete walks, floors, prefinished materials, building fixtures, etc. Finished surfaces subject to damage or defacement due to other work on the building shall be properly protected and covered. The CONTRACTOR shall be responsible for any and all damage to work performed under this Section and to that of other work caused by operations under this Section.

1.9 WARRANTY

A. The CONTRACTOR at no additional expense to MAWSS shall provide an unconditional 10-year warranty against defects of material and workmanship discovered during the warranty period. The Warranty shall commence on the date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURER AND EQUIPMENT SUPPLIER

A. Warren Environmental, Inc., P.O. Box 1206, Carver, MA 02330 Telephone (508) 947-8539.

B. The product of a manufacturer meeting all aspects of this specification as approved by MAWSS and the ENGINEER.
2.2 REPAIR MATERIALS

A. Repair materials must be accepted and approved by the specifying engineer and must be compatible with the specified epoxy surfacing system. No cementations repair materials will be allowed. The manufacturer will only approve 100% solid epoxy mastic repair materials to profile or build out deteriorated walls.

2.3 STRUCTURAL EPOXY SURFACING SYSTEM

A. Warren Environmental System S-301, a unique non-toxic, 100% solids, solventless epoxy resin system as applied with the patent protected process of Warren Environmental, Inc. and exhibiting the following characteristics.

<table>
<thead>
<tr>
<th>Product</th>
<th>S-301 Structural Epoxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product type</td>
<td>Amine Cured Epoxy</td>
</tr>
<tr>
<td>Color</td>
<td>Blue, White or Light Grey</td>
</tr>
<tr>
<td>Solids Content (vol %)</td>
<td>100%</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>ASTM D695 11,000 p.s.i.</td>
</tr>
<tr>
<td>Flatwise Tensile Strength of Sandwich Constructions</td>
<td>ASTM C297 2,608 p.s.i.</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D638 6,000 p.s.i.</td>
</tr>
<tr>
<td>Tensile Elongation</td>
<td>ASTM D638 4%</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>ASTM D790 11,000 p.s.i.</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>ASTM D790 400,000 p.s.i.</td>
</tr>
<tr>
<td>Bond Strength – Concrete</td>
<td>ASTM D4541 Concrete Failure</td>
</tr>
<tr>
<td>Chemical Resistance to:</td>
<td></td>
</tr>
<tr>
<td>Sulfuric Acid, 10%</td>
<td>ASTM D543 Immersion Service</td>
</tr>
<tr>
<td>Sodium Hydroxide, 20%</td>
<td>ASTM D543 Immersion Service</td>
</tr>
</tbody>
</table>

B. The monolithic surfacing system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the manhole according to ASTM D4541 testing. Coating thickness shall be designed for hydrostatic loading.

C. The cured epoxy will be monolithic with proper sealing to all internal connections and shall be placed and cured in 1 or 2 applications in conformance with the recommendations of the structural epoxy system manufacturer. Recommended thickness of the applied epoxy can vary due to substrate conditions and will be applied per the recommendations of the coating manufacturer and the specifying engineer.
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EPOXY WET WELL AND MANHOLE COATING SYSTEMS

D. When cured, the system shall form a continuous, tight-fitting, hard, impermeable surfacing that is suitable for sewer system service and chemically resistant to any chemicals, bacteria or vapors normally found in domestic or industrial sewer.

E. The system shall effectively seal the interior surfaces of the structure and prevent any penetration or leakage of groundwater (infiltration).

F. The system shall be compatible with the thermal conditions of the existing sewer structure.

2.4 STRUCTURAL EPOXY APPLICATION EQUIPMENT

A. Heated, plural component, specially designed equipment for use in the spray or spincast application of the specified system approved for use by the structural epoxy manufacturer as designed and developed by Warren Environmental, Inc. There will no exception to this equipment specification. The product may also be hand towed.

PART 3 – EXECUTION

3.1 PRE-COAT INSPECTION

A. All structures to be coated shall be readily accessible to Applicator.

B. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

C. Active flows shall be diverted with flow through plugs or by pass pumped as required to ensure that the liquid flow is maintained off the surfaces to be lined.

3.2 SURFACE PREPARATION

A. Applicator shall inspect all surfaces specified to receive the monolithic surfacing system prior to surface preparation. Applicator shall notify MAWSS of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.

B. All concrete that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants must be removed.
C. Surface preparation method(s) shall be based upon the conditions of the substrate and the requirements of the monolithic surfacing system to be applied.

D. Quick setting high strength concrete with latex or curing agent additives cannot be used to re-profile the surface to be epoxy lined. Quickset cements can only be used as a spot repair to stop or slow down flowing water prior to chemical grouting to permanently stop infiltrating. Proper surface preparation procedures must be followed to ensure adequate bond strength to any surface to be coated. New cement must cure at least 30 days prior to coating.

E. Existing coatings should be removed or thoroughly abraded to provide adequate surface profile for mechanical bond by the new system. Applicator is to maintain strict adherence to the monolithic surfacing system manufacturer’s recommendations with regard to proper surface preparation and compatibility with existing coatings.

F. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound concrete surface with adequate profile and porosity to provide a strong bond between the monolithic surfacing system and the substrate. The first procedure upon entering each structure will be to blast all specified surfaces by low-pressure water cleaning. When all grease oil and loose contaminated debris has been removed, the surface will be acid etched with a 10% to 20% muriatic acid solution to clean and open the pores of the substrate. Then the surface will be water blasted by the use of a hand held wand again, at 4,000-10,000 psi. The wash water shall include a dilute solution of chlorine to diminish microbiological bacteria growth and to kill any bacteria residing on or in the surface. The surface will be rinsed with copious amounts of clean water and then tested at this point to ensure that the pH is within acceptable limits (not to exceed 8.5). These tests will be performed with litmus paper on various areas within the structure. All test results will be retained for review by the Engineer. Acid etching is essential to remove residual salts and contaminants left on the concrete surface during the concrete curing process. It is not uncommon for mold release agents to be trapped in the latency layer. The latency layer is very dense and will not allow epoxies to penetrate into the substrate and by nature it is very weak in tensile strength and will act as bond breaker if the residual salts and contaminants are not totally removed.

G. Surfaces that require additional cleaning or profiling will be prepared by abrasive blast to rough the surface sufficient to obtain and ensure adequate bonding of the system. A minimum surface profile of 8-10 mils
EPOXY WET WELL AND MANHOLE COATING SYSTEMS

to assure proper adhesion. Detergent water cleaning and hot water blasting may be necessary to remove oils and grease from the concrete. Whichever methods are used, they shall be performed in a manner that provides a uniform, sound clean surface.

H. Active water infiltration shall be stopped by using a hydroactive urethane grout that is compatible and suitable for topcoating with the specified monolithic surfacing system. Water plug or hydraulic grout can only be used as a spot repair to stop flowing infiltration. Care must be taken not to smear or spread the water stop cement over large areas. Quickset cement is a bond breaker if not used properly.

3.3 APPLICATION OF REPAIR MATERIALS

A. Areas where reinforcing steel has been exposed or removed shall be repaired by replacing spent rebar with new rebar to match existing. All new rebar will be embedded in 1 1/2 inch of epoxy mastic.

B. Repair materials shall meet the specifications of this Section. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces. The material thickness shall be specified by the Project Engineer according to MAWSS's requirements and manufacturer's recommendations.

C. All surfaces shall be inspected during and after preparation and prior to application of the monolithic surfacing system. Any evidence of remaining contamination or laitance shall be removed by additional water or abrasive blast, or other approved method before proceeding with application of the monolithic surfacing system.

D. All surfaces shall be sufficiently smooth and even, to ensure good flow handling characteristics when coated with epoxy materials.

3.4 STRUCTURAL EPOXY REHABILITATION SYSTEM

A. Application procedures shall conform to the recommendations of the structural epoxy manufacturer, including material handling, mixing, and environmental controls during application, safety, and equipment.

B. The equipment shall be specially designed to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.

C. The specified materials must be applied by an approved installer.

D. All specified surfaces will be lined with the structural epoxy system to provide a minimum total thickness of 250 mils for rehab structures and
Section 09745

EPOXY WET WELL AND MANHOLE COATING SYSTEMS

125 mils for new precast concrete. The epoxy liner shall be monolithic with proper sealing of connections to all unsurfaced areas and shall be placed and cured in one to two applications, depending on the existing structure’s conditions.

3.5 TESTING AND INSPECTION

A. During application a wet film thickness gauge, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notch Gages shall be used to ensure a monolithic coating and uniform thickness during application.

B. After the system has set hard to the touch it shall be inspected by the Engineer verifying the following:

1. The Engineer will measure the system-cured thickness from a specimen retrieved by the Applicator. Retrieval can be made by physically cutting through the epoxy liner (by drilling or coring) or a suitable non-destructive type of thickness measurement may also be used, (e.g. ultrasonic).

2. Groundwater infiltration of the system shall be zero.

3. All pipe connections shall be open and clear.

4. No cracks, voids, pinholes, uncured spots, dry spots, lifts, delamination or other type defects shall be evident in the system.

C. Measurement of bond strength of the system to the substrate can be made at regular intervals and along different sections of the structure (i.e. corbel, wall, bench). Bond strength can be measured in accordance with ASTM D4541. Any areas detected to have inadequate (less than 300 p.s.i. or 80% substrate failure to concrete) bond strength shall be evaluated by the Project Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer’s recommendations.

D. A final visual inspection shall be made by the Engineer and the Applicator. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by Applicator.
EPOXY WET WELL AND MANHOLE COATING SYSTEMS

E. The system may be put back into operational service as soon as the final inspection has taken place.

3.6 CLEANING

A. Trash and loose debris shall not be permitted to accumulate at the project site. All items shall be regularly removed and disposed of at an approved site in accordance with applicable regulatory agencies.

** END SECTION **
PART 1 – GENERAL

1.1 SCOPE

A. Description of Work

1. CONTRACTOR shall provide all labor, materials, tools and equipment necessary to field apply a 100% solids, rapid cure, two component modified urethane coating/lining system to all exposed interior concrete surfaces of the wet well.

2. The coating/lining system shall be applied to exposed surfaces of the pump discharge piping and fittings within the wet well. Do not coat the pump, or pump matting surfaces of the discharge elbow, or any non-ferrous metals such as pump guide rails, etc.

3. The minimum dry film thickness shall be 125 mils.

1.2 REFERENCES

A. Referenced Standards

1. ASTM D638, Tensile Properties of Plastics
2. ASTM D4541, Pull-off Strength of Coatings Using a Portable Adhesion Tester
3. ASTM D2584, Volatile Matter Content
4. ASTM D2240, Durometer Hardness, Type D
5. ASTM D543, Resistance of Plastics to Chemical Reagents
7. NACE - The published Standards of National Association of Corrosion Engineers (NACE International)

1.3 SUBMITTALS

A. Shop Drawings and Manufacturer’s Literature

1. Submit shop drawings or manufacturer’s “cut” of all material for this work in accordance with MAWSS Section 13.1.07, Construction Submittals.
2. A copy of the executed five (5) year warranty shall be submitted for approval prior to the installation of any products. Failure to submit warranty is grounds for rejection of all coating/linings system submittals.

1.4 QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM and NACE Standards.

B. Applicator shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

C. Applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish work of this Section in a timely manner.

1.5 QUALIFICATIONS AND RESPONSIBILITY OF APPLICATOR

A. The Applicator shall apply the system and be responsible for the complete performance of the system, including materials, application and quality control. The Applicator shall provide documentation that Applicator is an approved installer and licensed by the monolithic coating/lining system manufacturer and specialized equipment supplier for the installation of the material.

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials are to be kept dry, protected from weather and stored under cover and stored between 50 degrees F and 100 degrees F. Materials should not be stored near flame, heat or strong oxidants.

B. Protective coating materials are to be handled according to their material safety data sheets.

1.7 ENVIRONMENTAL CONDITIONS

A. The CONTRACTOR shall provide and maintain safe working conditions for all employees. Fresh air ventilation shall be provided to continuously remove fumes from working spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside. Respirators shall be used for spraying type operations. Fumes shall, if possible,
1.8 SCAFFOLDING AND PROTECTION

A. Furnish, maintain and remove all scaffolding, ladders and planks required for this work and all drop cloths for the protection of concrete walks, floors, pre-finished materials, building fixtures, etc. Finished surfaces subject to damage or defacement due to other work on the building shall be properly protected and covered. The CONTRACTOR shall be responsible for any and all damage to work performed under this Section and to that of other work caused by operations under this Section.

1.9 WARRANTY

A. The CONTRACTOR, at no additional expense to MAWSS, shall provide an unconditional five (5) year warranty against defects of material and workmanship discovered during the warranty period. The Warranty shall commence on the date of final payment for this work.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. The wet well lining system shall be a product of one of the following systems manufacturers:

2. The product of a manufacturer meeting all aspects of this specification as approved by MAWSS and the ENGINEER.

2.2 MATERIALS

A. Urethane Liner System:

1. The resin material shall be used to form the sprayed on structurally enhanced monolithic liner covering all interior surfaces of the structure, including benches and inverts of manholes, walls, floors, ceilings of wet wells, and all others surfaces noted on the Plans or in the Specifications. The finished liner shall conform to the minimum physical requirements listed below:
URETHANE WET WELL AND MANHOLE LINING SYSTEM

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength</td>
<td>ASTM D 695</td>
<td>14,000 psi</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D 638</td>
<td>5,000 psi</td>
</tr>
<tr>
<td>Shrinkage</td>
<td>ASTM D 2566</td>
<td>1/2 of 1%</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>ASTM D 790</td>
<td>10,000 psi</td>
</tr>
<tr>
<td>Bond</td>
<td></td>
<td>Shall exceed tensile strength of substrate</td>
</tr>
<tr>
<td>Flexural Modulus (initial)</td>
<td>ASTM D 790</td>
<td>600,000 psi</td>
</tr>
<tr>
<td>Density</td>
<td></td>
<td>81 +- pcf</td>
</tr>
</tbody>
</table>

The finished structure shall be corrosion resistant to: Hydrogen Sulfide; 20% Sulfuric Acid; 17% Nitric Acid; 5% Sodium Hydroxide as well as common ingredients of the sanitary sewage environment.

2. The wall of the resin liner will be either structurally designed to withstand the hydraulic load generated by the groundwater table or merely function as a corrosive barrier. The long term (50 yr.) value of the flexural modulus of elasticity will be a minimum of 500,000 psi and is an integral part of the engineering equation used to design the wall thickness of the structural liner. For this reason, the value of the long term flexural modulus of the proposed product will be certified by an independent, third party testing laboratory and submitted with the design calculations for each individual structure. (Long term value will be based on a fifty (50) year minimum period and verified by DMA testing.)

3. When groundwater loading is not an issue and only a corrosion barrier required, the lining may be installed to the thickness necessary to qualify as a monolithic (void free) liner. The roughness of the substrate will dictate the thickness needed to create the monolithic liner and eliminate any opportunity for voids in the lining. For this reason the substrate will need to be carefully examined and the extent of the deterioration disclosed. Normally most corrosion barrier rehabilitations may be successfully accomplished by installation of a liner having a maximum thickness of 250 mils. However, some installations with slight corrosion deterioration are able to create a monolithic liner by applying an average of 125 mils.

In the case of new construction, where the walls are extremely smooth and have no voids, a minimum lining thickness of 100 mils can successfully achieved to protect surfaces from future decay.
B. Substrate Patching Mix

1. A quick setting cementitious material shall be used as a patching mix. It shall be mixed and applied according to the manufacturer’s recommendations and shall meet the following minimum requirements:

<table>
<thead>
<tr>
<th>Compressive Strength</th>
<th>ASTM C 579 B</th>
<th>1400 psi @ 6 hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrinkage</td>
<td>ASTM C 590</td>
<td>60%@90% rel. humidity</td>
</tr>
<tr>
<td>Bond</td>
<td>ASTM C 321</td>
<td>150 @ 28 days</td>
</tr>
<tr>
<td>Density When Applied</td>
<td></td>
<td>105 +-. pcf</td>
</tr>
</tbody>
</table>

C. Substrate Infiltration Control Mix

1. A rapid-setting cementitious product specially formulated for leak control shall be used to stop minor water infiltration, shall be mixed and applied according to the manufacturer’s recommendations and shall meet the following minimum requirements:

<table>
<thead>
<tr>
<th>Compressive Strength</th>
<th>ASTM C 579 B</th>
<th>600 psi @ 1 hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength</td>
<td>ASTM C 579 B</td>
<td>1000 psi @ 24 hr.</td>
</tr>
<tr>
<td>Bond</td>
<td>ASTM C 321</td>
<td>30 psi @ 1 hr.</td>
</tr>
<tr>
<td>Bond</td>
<td>ASTM DC 321</td>
<td>80 psi @ 24 hr.</td>
</tr>
</tbody>
</table>

D. Grouting Mix

1. A cementitious grout shall be used for stopping very active infiltration, filling voids, and shall be mixed/applied according to manufacturer’s recommendations. The grout shall be volume stable and have a minimum 28 day strength of 250 psi and a one day strength of 50 psi.

2. Chemical grouts used for stopping very active infiltration shall be mixed and applied per manufacturer’s recommendations.

PART 3 – EXECUTION

3.1 INSTALLATION GENERAL

A. The system shall be applied in the field after all other work to the wet well is completed. This will insure a continuous lining across the joints and connections. The monolithic surfacing system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the wet well according to ASTM C882, Testing and, therefore, shall be designed for hydrostatic loading.
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URETHANE WET WELL AND MANHOLE LINING SYSTEM

B. The primer system shall be as recommended by the topcoat manufacturer.

C. The topcoat system shall provide a minimum dry film thickness of 125 mils exclusive of the substrate repairs, surfacer and primer.

D. The cured lining shall provide a sealed interface at all unsurfaced (piping, etc.) areas and shall be placed and cured in conformance with the recommendations of the 100% solids, rapid cure, two-component modified urethane surfacing system manufacturer. When cured, the system shall form a continuous, tight-fitting, flexible, impermeable surfacing that is suitable for domestic wastewater system service and chemically resistant to any chemicals, bacteria, or vapor normally found in domestic wastewater. The system shall be compatible with the thermal conditions of the existing surfaces.

3.2 PROTECTIVE COATING APPLICATION EQUIPMENT

A. Application of the primer shall be by standard airless spray equipment meeting the specifications of the product manufacturer.

3.3 PRE-COAT INSPECTION

A. The applicators vehicles and equipment must be able to access the structures to be coated under their own power.

B. All surfaces, including benches, inverts, joints, lift holes, and walls shall be made smooth and suitable for application of the interior surfacing system. All benches and inverts shall be in place and complete.

C. Active flows shall be dammed, plugged, or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated.

D. Installation of the protective coating shall not commence until the concrete substrate has properly cured.

3.4 SURFACE PREPARATION

A. Applicator shall inspect all surfaces specified to receive the lining system prior to surface preparation. Applicator shall notify ENGINEER of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.
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B. All concrete that is not sound, or has been damaged by chemical exposure, shall be restored to a sound concrete surface. All contaminants including: all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

C. Surface preparation method(s) shall be based upon the conditions of the substrate and the requirements of the lining system manufacturer.

D. New concrete shall be cured a minimum of 28 days at 75 degrees Fahrenheit or equivalent prior to coating application.

E. Check for excess moisture in accordance with ASTM C 4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

F. Remove all oil, grease, dirt, water or other contaminants in accordance with ASTM D 4258 and SSPC-SP-1.

G. Abrasive grit blast, wet abrasive blast or high pressure water blast all surfaces to be coated, to remove all laitance, efflorescence, surface hardness, curing compounds, old coatings, and loose concrete, in accordance with SSPC-SP-13/NACE No. 6 or ASTM D 4259. A surface texture similar to that of medium-coarse sandpaper should be attained.

1. The compressed air supply shall be completely free of all oil, water and other contaminants and provide the required volume of air at 100 psi or greater.

2. Abrasives used shall be clean, a uniform grade and of an appropriate size to obtain the finish and profile required. DO NOT use contaminated abrasives.

3. Water used with high-pressure water blasting or wet abrasive blasting shall be clean potable water.

H. Thoroughly clean all blasted surfaces to remove all dust and debris after dry blasting, or remove all water, sludge and debris after wet blasting.

I. Repair or remove or fill all cracks, voids, honeycombs, fins and other surface irregularities using a patching method recommended by the finish coating manufacturer.

J. Grind all form ties or other metallic protrusions below the surface, then patch or fill.
K. All expansion joints and moving cracks which have opened to a width of 1/16" or greater must be repaired with elastomeric caulking material per the caulking manufacturer's instructions.

L. Immediately prior to the application of the concrete surfacer or primer, thoroughly vacuum clean all surfaces to be coated, effectively removing all remaining dust.

1. Vacuum cleaning a roughened concrete surface is the only known effective method of removing dust from deep pits, cracks, crevices, bug holes, etc. and is considered a mandatory procedure.

3.5 APPLICATION OF FIELD APPLIED MONOLITHIC SURFACING SYSTEM

A. Application procedures shall conform to the recommendations of the two-part modified urethane monolithic coating/lining system manufacturer, including material handling, mixing, safety, equipment and environmental controls during application.

B. Newly constructed below or at grade concrete walls and slabs that will be internally coated must have a sheet or coating vapor barrier installed on the unprotected side of the concrete.

C. To minimize outgassing problems, all coating should be applied when the surface temperature of the concrete is declining.

D. Due to the inconsistent nature of concrete, surface porosity can vary greatly so a surfacer should always be used to reduce the occurrence of outgassing and pinholes. Extreme cases of surface porosity may require multiple coats of the surfacer or primer.

E. Specially designed plural component equipment designed to proportion the two components utilizing airless spray guns shall be used to apply each coat of the system.

F. Once the material is applied, the structure must be returned to active water service within 60 minutes to minimize sewer backup and lessen the likelihood of residential or commercial damage. This must be accomplished without damaging the newly applied resin.

3.6 TESTING AND INSPECTION

A. During application, the Applicator shall pay particular attention to the volume/time ratio of the application to ensure a monolithic coating and uniform thickness during application of a minimum thickness of 125 mils.
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After a minimum of 24 hours following completion, the ENGINEER may direct the CONTRACTOR to perform a series of 1" diameter core drills to provide verification of lining thickness throughout the applied liner system. A maximum of one core drill per 100 square feet will be required.

1. Lining thickness at each core drill shall be collected.

2. All lining thicknesses will be added together, then, divided by the number of core drills to provide an average thickness.

If the lining system thickness proves to be below that specified, the averaged thickness will be used to prorate payment for the applicator's services based on the Bid Item B111 “Urethane Wet Well Lining System” as shown in the Proposal. Payment will be reduced by a similar percentage as calculated on the actual applied thickness compared to the specified thickness.

No additional payment will be made for this test or for repair of the lining system.

B. After a minimum of 24 hours following completion, the lining system shall be spark tested to ensure a pinhole-free lining. Defects must be patched per the manufacturer's instructions. The test voltage shall be a minimum 6,000 volts. The holiday detector shall be a Tinker Razor Model AP/W or an approved equal. The Applicator may enlist the services of an independent certified NACE inspector if desired.

C. The ENGINEER and the Applicator shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by Applicator.

3.7 REPAIRS

A. All damaged areas, faulty areas, and pinholes found during testing and inspection shall be repaired by the CONTRACTOR in accordance with the procedures recommended by the coating/lining system manufacturer.

B. All core drilled holes shall be cleaned, primed, repaired and coated in accordance with liner system manufacturer’s recommendations in order to maintain the system integrity and five (5) year warranty.

C. The complete monolithic coating/lining system, including the repaired areas shall be inspected and tested in accordance with Section 3.6 of these specifications. The CONTRACTOR shall repeat Section 3.7 until no further defects are detected.
3.8 FINAL INSPECTION, PAYMENT AND WARRANTY

A. The monolithic coating/lining system shall be considered complete and accepted subject to passing the inspection criteria listed under Sections 3.6 and 3.7.

B. Payment for this item of work shall be made when work is complete in accordance with this specification and after clean-up of all associated construction debris, empty containers, etc.

C. The CONTRACTOR shall warrant this work for a period of five (5) years. During this time period, the CONTRACTOR shall make all repairs to the monolithic coating/lining system at no expense to the MAWSS.

** END OF SECTION **
PART 1 – GENERAL

1.1 SCOPE

A. Description of Work

1. CONTRACTOR shall provide all labor, material, tools and equipment necessary to field apply a calcium aluminate cementitious coating/lining system to all exposed interior concrete surfaces of the wet well.

2. The coating/lining system shall not be applied to exposed surfaces of the pump discharge piping and fittings within the wet well. Do not coat the pump, or pump matting surfaces of the discharge elbow, or any non-ferrous metals such as pump guide rails, etc.

3. All non-ferrous metals, including discharge piping, within the wet well shall be painted in accordance with specification Section 09900 Painting.

1.2 REFERENCES

A. Referenced Standards

1. ASTM D638, Tensile Properties of Plastics
2. ASTM D4541, Pull-off Strength of Coatings Using a Portable Adhesion Tester
3. ASTM D2584, Volatile Matter Content
4. ASTM D2240, Durometer Hardness, Type D
5. ASTM D543, Resistance of Plastics to Chemical Reagents
7. NACE - The published Standards of National Association of Corrosion Engineers (NACE International)

1.3 SUBMITTALS

A. Shop Drawings and Manufacturer’s Literature

1. Submit shop drawings or manufacturer’s “cut” of all material for this work in accordance with MAWSS Section 13.1.07, Construction Submittals.
2. A copy of the executed five (5) year warranty shall be submitted for approval prior to the installation of any products. Failure to submit warranty is grounds for rejection of all coating/linings system submittals.

1.4 QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM and NACE Standards.

B. Applicator shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

C. Applicator shall use approved specialty equipment adequate in size capacity and number sufficient to accomplish work of this Section in a timely manner.

1.5 QUALIFICATIONS AND RESPONSIBILITY OF APPLICATOR

A. The Applicator shall apply the system and be responsible for the complete performance of the system, including materials, application and quality control. The Applicator shall provide documentation that Applicator is an approved installer and licensed by the monolithic coating/lining system manufacturer and specialized equipment supplier for the installation of the material.

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials are to be kept dry, protected from weather and stored under cover and stored between 50 degrees F and 100 degrees F. Materials should not be stored near flame, heat or strong oxidants.

B. Protective coating materials are to be handled according to their material safety data sheets.

1.7 ENVIRONMENTAL CONDITIONS

A. The CONTRACTOR shall provide and maintain safe working conditions for all employees. Fresh air ventilation shall be provided to continuously remove fumes from working spaces through the combined use of existing
openings, forced-draft fans and temporary ducts to the outside. Respirators shall be used for spraying type operations. Fumes shall, if possible, be exhausted to the outside from the lowest level in the confined space. Electrical fan motors shall, if located in the working space, be explosion proof. No smoking or open fires will be permitted in the working space.

1.8 SCAFFOLDING AND PROTECTION

A. Furnish, maintain and remove all scaffolding, ladders and planks required for this work and all drop cloths for the protection of concrete walks, floors, pre-finished materials, building fixtures, etc. Finished surfaces subject to damage or defacement due to other work on the building shall be properly protected and covered. The CONTRACTOR shall be responsible for any and all damage to work performed under this Section and to that of other work caused by operations performed under this Section.

1.9 WARRANTY

A. The CONTRACTOR, at no additional expense to MAWSS, shall provide an unconditional five (5) year warranty against defects of material and workmanship discovered during the warranty period. The Warranty shall commence on the date of final payment for this work.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. The wet well lining system shall be a product of one of the following systems manufacturers:


2. The product of a manufacturer meeting all aspects of this specification as approved by MAWSS and the ENGINEER.

2.2 MATERIALS

A. Lining material furnished under this specification shall be a prepackaged mortar mix, including all cement, aggregates, and any required additives. It is the intent of this specification that the CONTRACTOR only be
required to add the proper amount of potable water so as to produce concrete suitable for spray application. Do not add Portland cement, other aggregates, or any admixtures whatsoever to lining material. Typical package weights shall not be less than 50 lbs and shall be identical for all material furnished on this project.

B. The chemical composition of the cement portion, as well as the aggregates of the mortar mix, shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Al$_2$O$_3$</th>
<th>CaO</th>
<th>FeO + Fe$_2$O$_3$</th>
<th>SiO$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>39-44%</td>
<td>35-39%</td>
<td>9-14%</td>
<td>5-7%</td>
</tr>
</tbody>
</table>

C. The design properties of the mortar mix shall be as follows:

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength (ASTM C109)</td>
<td>&gt;6,000 psi</td>
<td>24 hours</td>
</tr>
<tr>
<td>Flexural Strength (ASTM C293)</td>
<td>&gt;8,000 psi</td>
<td>28 days</td>
</tr>
<tr>
<td>Splitting Tensile Strength (ASTM C496)</td>
<td>&gt;1,300 psi</td>
<td>24 hours</td>
</tr>
<tr>
<td>Slant Shear Test (ASTM C882)</td>
<td>&gt;1,600 psi</td>
<td>28 days</td>
</tr>
<tr>
<td>Shrink at 28 days (ASTM 596)</td>
<td>&gt;900 psi</td>
<td>24 hours</td>
</tr>
<tr>
<td>Freeze/Thaw after 300 Cycles (ASTM C666)</td>
<td>&gt;2,300 psi</td>
<td>28 days</td>
</tr>
<tr>
<td></td>
<td>&lt;0.08% cured @ 90% relative humidity</td>
<td>No visible damage after 300 cycles</td>
</tr>
</tbody>
</table>

D. The mortar mix shall be either “SewperCoat PG” or “SewperCoat 2000HS Regular”, both as manufactured by Kerneos Inc. – Chesapeake, Virginia.

E. Mortar mix must have at least seven (7) years of successful performance in similar applications and be supplied by an ISO 9001 certified manufacturer. Manufacturer’s ISO 9001 certificate shall be submitted to ENGINEER and MAWSS.

F. In addition, the mortar mix shall be designed to withstand long-term exposure to a bacterially corrosive hydrogen sulfide environment that may be expected to produce a pH of one (1) on normal Portland cement based concrete or typical brick and mortar surfaces.

G. Water used in mixing shall be fresh, clean, potable water, free from injurious amounts of oil, acid, alkali, vegetation, sewage and/or organic matter. Water shall be considered as weighing 8.32 pounds per gallon.
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H. Mortar mix shall be stored with adequate provisions for the prevention of absorption of moisture. It shall be stored in a manner that will permit easy access for inspection and identification of each shipment.

PART 3 – EXECUTION

3.1 SAMPLING AND TESTING

A. A recognized independent testing laboratory shall test mortar materials used on the project. The Manufacturer, instead of an independent laboratory, may test project sample specimens, provided MAWSS, ENGINEER, and Manufacturer are in agreement of this testing method prior to project commencement.

B. The cost of sampling and testing of the mortar mix during placement and the surface to which it is applied shall be born by the CONTRACTOR. Other testing required showing conformance with these specifications shall be the responsibility of the CONTRACTOR. Certified test reports and certificates, when so directed, shall be submitted in duplicate to the ENGINEER and to such other agencies or persons the ENGINEER may designate.

C. Any materials failing to meet the requirements of these specifications shall not be incorporated into the work plan.

3.2 QUALIFICATION OF WORK CREW

A. The lining material Manufacturer shall maintain a listing of competent CONTRACTORS that have demonstrated requisite skill and training to be qualified applicators of their materials.

B. Prior to project commencement, the CONTRACTOR must satisfy the ENGINEER that all CONTRACTOR’s work crew personnel have performed satisfactory work in similar capacities elsewhere for a sufficient period of time to be fully qualified to properly perform the work in accordance with the requirements of the related specifications.

C. Foreman shall have at least 4 years experience with similar work and project conditions.

D. Nozzlemen shall be qualified by having had similar work experience.

E. Work Crew responsibilities prior to application of lining material shall
include the following:

1. Surface preparation as discussed in Section 3.4.
2. Ensure the operating air pressure is uniform and provides adequate nozzle velocity for proper compaction.
3. Continuously regulate the water content so that the applied materials consistently achieve proper compaction with a low percentage of rebound and no visible “sag.”
4. Ensure that the installation equipment nozzle is held at the proper distance away from and as nearly perpendicular to the prepared subsurface as the working conditions will permit to secure maximum material compaction with minimum rebound and no visible “sag”.
5. Follow a sequence routine that will fill corners with adequately compacted material applied at a maximum practicable layer thickness.
6. Determine necessary operating procedures for placement in confined spaces, extended distances or around unusual obstructions where placement velocities and mix consistency may need to be adjusted.
7. Direct the crew as to when to start and stop the flow of materials during installation and to immediately stop all work when material is not arriving uniformly at the nozzle.
8. Ensure that slough pockets are removed and prepared for installation of replacement material.
9. Bring the installed materials to established finished elevations in a neat and timely manner and within established tolerances.

F. Applicator’s job foreman shall operate the mixing/placing equipment and direct the work of mixing crew personnel. Applicator’s work crew shall also maintain proper line pressures throughout the mixing/placing equipment to ensure the necessary consistent nozzle velocity. Applicator’s work crew shall further see that all material fed to the nozzle is uniformly fed through this equipment.

3.3 EQUIPMENT

A. Equipment shall be of spray type and approved by the material manufacturer. Alternate equipment may be utilized provided it meets the performance requirements of the specification. All equipment must be kept in operating condition and good repair.
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3.4 SURFACE PREPARATION

A. Ensure all sub-surfaces are clean and free of laitance, loose material, residue and all existing coating and lining materials. See Section 3.7 for Inflow and Infiltration Prevention. For detailed explanation of the required surface preparation see ACI RAP-3 “Spall Repair by Low Pressure Spraying” page 2. ACI 546R “Concrete Repair Guide”, chapter 2 also provides a good reference for important considerations for repairing concrete surfaces using mortar.

B. Sub-surfaces shall be thoroughly saturated with water prior to the application of the lining materials. In no instance shall shotcrete be applied in an area where running water exists. It is the intent of this specification that the existing surface be saturated and free of any running water just prior to installation – or SSD, “saturated surface dry condition.” To achieve this condition it may be necessary to presoak the sub-surface for at least 24 hours.

3.5 OPERATIONS

A. The CONTRACTOR shall provide all equipment necessary to individually gauge, control, and monitor the actual amounts of all component materials necessary to complete the lining installation. The type of equipment and methods used to gauge, control, and monitor component materials shall be subject to approval by the ENGINEER and Manufacturer.

B. All lining materials shall be thoroughly mixed by mechanical means to ensure all agglomerated particles are reduced to original size or removed prior to placement into the application equipment (i.e. the hopper). Each batch of material should be entirely discharged before recharging with fresh material. Mixing equipment shall be cleaned at regular intervals to remove all adherent materials.

C. The addition of water to the mix shall be in strict accordance with the Manufacturer’s recommendations.

D. Re-mixing or tempering shall not be permitted. Rebound materials shall not be reused.

3.6 PROTECTION OF ADJACENT SURFACES

A. During progress of the work, adjacent areas or grounds which may be permanently discolored, stained or otherwise damaged by dust and rebound material, shall be adequately protected and, if contacted, shall be cleaned by early scraping, brushing or washing as the surroundings permit.
3.7 INFLOW and INFILTRATION PREVENTION

A. If inflow or infiltration is observed within the structure after surface preparation is complete, a rapid setting crystalline enhanced hydraulic cement product specifically formulated for infiltration control shall be used to stop minor infiltration flows in accordance with the manufacturer's recommendations. The material shall meet the following strength requirements:

<table>
<thead>
<tr>
<th>Strength Requirement</th>
<th>Minimum</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength (ASTM C597B)</td>
<td>600 psi</td>
<td>24 hours</td>
</tr>
<tr>
<td></td>
<td>1,000 psi</td>
<td>7 days</td>
</tr>
<tr>
<td>Bond Strength (ASTM C321)</td>
<td>30 psi</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>80 psi</td>
<td>1 day</td>
</tr>
</tbody>
</table>

B. The material shall be Preco Plug, Octocrete, Burke Plug or ENGINEER approved equal. Where infiltration flows are more severe, pressure grouting may be required. The material for pressure grouting shall be Avanti A-220, DeNeef or ENGINEER approved equal installed in accordance with the manufacturer's written instructions.

C. All materials, labor, equipment, and incidentals required to correct inflow and infiltration conditions will be considered incidental to rehabilitation.

3.8 APPLICATION OF MATERIALS

A. Lining material shall not be applied to a frozen surface or to a surface that may freeze within 24 hours of application. Frozen conditions shall be defined as ambient temperatures of 32 degrees Fahrenheit or below.

B. Sequence of application may be from bottom to top or vice versa if rebound is properly removed.

C. Application shall be from an angle as nearly perpendicular to the surface as practicable, with the nozzle held at least one (1) foot from the working sub-surface (except in confined control). If the flow of material at the nozzle is not uniform and slugs, sand spots, or wet sloughs result, the nozzleman shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.

D. Application shall be suspended if:
   1. Air velocity separates the cement from the aggregate at the nozzle.
2. Ambient temperature approaches freezing and the newly placed SewperCoat cannot be protected and insulated.

E. The time interval between successive layers of material application must be sufficient to allow “tackiness” to develop but not final set. If final set does occur, this surface shall be prepared in accordance with Section 3.4 of this document.

F. Construction joints within a manhole shall be avoided. In the event a construction joint is necessary and approved by the ENGINEER, it shall be sloped off to a thin, clean, regular edge, at a 45-degree angle. Prior to placement of the adjoining materials, the sloped portion and adjacent applied material shall be thoroughly cleaned as necessary, then moistened and scourd with an air jet.

G. Nozzleman shall bring the material to an even plane and to well-formed corners.

H. After the body coat has been placed, the surface shall be trued with a thin-edge screed to remove high areas and expose low areas. Low areas shall be properly filled with additional material to insure a true, flat surface in accordance with Section 3.8.C of this document.

I. For manhole applications, the minimum thickness of SewperCoat shall be a 1/2-inch cover over all surfaces. For other larger structures (lift stations, wet wells, treatment plant structures, etc.), the minimum thickness of SewperCoat shall be a 1-inch cover over all surfaces.

3.9 CURING

A. If the material has been applied and furnished in accordance with the specifications, and it has been determined that the environment is not moist enough for natural curing, the CONTRACTOR will be required to apply a curing compound to all coated surfaces. Curing compound shall meet the requirements of ASTM C309 and have the approval of the lining material Manufacturer and the ENGINEER prior to use.

B. Moist curing may also be used in lieu of curing compound. If moist curing is selected, it should be implemented just after the notice of uniform heat generation of the installed lining. Moist curing can consist of the use of soaker hoses, water sprinklers, or vapor/misting machines. Regardless of delivery method, moist curing should continue for a minimum of 18 hours.

** END OF SECTION **