

Town of

Tyngsborough, MA

TYNGSBOROUGH SEWER COMMISSION

Technical Specifications

February 13, 2003



TABLE OF CONTENTS

<u>Division</u>	<u>Section Number</u>
INTRODUCTION	
1 GENERAL REQUIREMENTS	
Construction Photographs	01320
Submittal of Operation And Maintenance Manuals	01329
Dust Control	01562
Environmental Protection	01570
Equipment Checkout and Testing	01750
Startup and Testing	01752
Operations and Maintenance Manuals	01760
Project Closeout	01770
2 SITE WORK	
Controlled Density Fill	02058
Polyethylene Pressure Pipe	02081
Polyvinyl Chloride Gravity Pipe and Fittings (SDR-35)	02085
Polyvinyl Chloride Pressure Pipe and Fittings (Schedule 80)	02087
Ductile Iron Gravity and Force Main Pipe and Fittings for Sewers	02089
Clearing and Grubbing	02230
Dewatering	02240
Support of Excavation	02252
Earthwork	02300
Rock Excavation and Disposal	02324
Bentonite Dams	02347
Television Inspection of New Pipelines	02441
Insulation	02513
Tracer Tape	02518
Building Connections & Drop Connections	02530
Sewer Chimneys	02531
Valves & Appurtenances for Wastewater Work	02532
Connections to Existing Structures (Wastewater)	02533
Precast Wetwells	02535
Precast Concrete Vault And Appurtenances	02536
Abandonment of Existing Wastewater Disposal Systems	02546
Raising and/or Setting of Sewer Manhole Frame & Cover	02629
Building Manhole Inverts	02630
Precast Manholes	02631

<u>Division</u>	<u>Section Number</u>
Paving	02745
Curbing	02771
Sidewalk Construction and Replacement	02775
Loaming and Seeding	02920
Landscaping	02931
3 CONCRETE	
Cast in Place Concrete	03300
Field Concrete	03302
5 METALS	
Miscellaneous Metals	05500
9 FINISHES	
Painting	09900
11 EQUIPMENT	
Submersible Concrete Pump Stations	11303
Semi-Positive Displacement Residential Grinder Pump Units	11305
Centrifugal Grinder Pump Units	11306
Packaged Suction Lift Pump Station	11307
Blower System	11376
13 SPECIAL CONSTRUCTION	
Pre-engineered Building	13121
Prefabricated Fiberglass Shelter	13122
Precast Concrete Utility Building	13127
Instrumentation	13424
15 MECHANICAL	
Plumbing	15408
Ventilation Odor Control System	15860
16 ELECTRICAL	
Gas Engine Driven Generator (Various Generator Sizes)	16230

**Section
Number**

Division

APPENDIX A – Standard Details

APPENDIX B – Design Criteria

END OF SECTION

INTRODUCTION

The intent of these technical specifications is to set quality standards for the installation of public and private sewers and building service connections within the Town of Tyngsborough, Massachusetts. These specifications are directed toward connections for Residential and Commercial properties and should be used in conjunction with the current sewer use-regulations and all other State and Local permits. This is not intended to serve as a contract document or agreement between the said "Owner" (Town) and the "Contractor" (person/company installing the sewer).

The specifications and attached details pertaining to the actual pipe installation (i.e. Earthwork, Rock Excavation and Disposal, Precast Manholes, PVC pipe, Tracer Tape, etc.) shall act as minimum standards for administration, design, installation, inspection, testing and recordation, set forth by the Town of Tyngsborough Sewer Commission. These sections must be complied with so that all aspects of the proposed work can be approved and administered by the Superintendent. It should be noted that some instances it might be necessary to use higher standards or stronger materials based on existing conditions. As noted in the appended specifications, all State standards and requirements, as amended, shall be mandatory.

The specifications contain sections indirectly related to the pipeline installation (i.e. Clearing and Grubbing, Paving and Sidewalk Replacement, etc.). These are intended as suggested guidelines. The owner, designer and Contractor shall be aware of all of the requirements set forth herein. The Town except as set forth in these regulations will not address issues relating to scope and extent of the work by any party.

SECTION 01320

CONSTRUCTION PHOTOGRAPHS

1. Scope

- A. This section covers preconstruction survey photographs to be furnished by the Contractor on the project.

2. Frequency of Photographs

Photographs shall be taken using a digital camera before the project breaks ground.

3. Number of Photographs

The Contractor shall have twenty-four views taken at each of the intervals specified above. The Owner shall approve selection of views. The twenty-four views shall be delivered to the Owner on a CD-ROM Disc in .gif, .jpeg, .bmp or .tif format within six days of exposure. The Owner will select eight views to be made into prints.

4. Prints

- A. Three prints shall be furnished on 4 x 6 full color on single weight, white base, and glossy paper, mounted with binder tabs for each of the eight views selected by the Owner.
- B. Each print shall be identified on the back with name of project, phase, orientation of view, date and time of exposure, name and address of photographer, and photographer's numbered identification of exposure.
- C. Prints shall be delivered within 15 days after Owner selects slides to be made into prints.

5. Computer Disc

- A. Disc's turned over to the Owner shall be retained by the Owner for future reference during the project.

END OF SECTION

SECTION 01329

SUBMITTAL OF OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL:

1.01 OPERATION AND MAINTENANCE MANUALS

- A. As required by the General Conditions, and Section 01760 OPERATION AND MAINTENANCE MANUALS and Technical Specifications, the Contractor shall submit a schedule of Operation and Maintenance Manuals.
- B. In accordance with the accepted schedule, the Contractor shall submit promptly to the Owner, through its authorized resident representative at the job site, or by mail, attention: Tyngsborough Sewer Commission six (6) copies each of Operation and Maintenance Manual required as noted in the technical specifications sections for this Contract.
- C. The manuals shall be prepared in accordance with Specification Section 01760 - OPERATION AND MAINTENANCE MANUALS.
- D. Such manuals shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawings.
- E. All manuals shall be submitted to the Owner by and/or through the Contractor, who shall be responsible for obtaining manuals from his subcontractors and returning reviewed manuals to them. A Weston & Sampson standard shop drawing transmittal form with a description of the manual shall accompany each shipment of manuals.
- F. The Contractor shall be responsible for the prompt submittal and resubmittal, as necessary, of all manuals so that there will be no delay in the startup operation of the facility due to the absence of such manuals.
- G. The Owner will review the manuals as to their general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections of comments made in the manuals during the review does not relieve the Contractor from compliance with requirements of the Contract Documents.
- H. With few exceptions, O&M Manuals will be reviewed and returned to the Contractor within 30 days of submittal.

1.02 OPERATING AND MAINTENANCE MANUALS AND SPARE PARTS LISTS

- A. Where reference is made in technical specification sections to operating and maintenance manuals and/or spare parts lists, the Contractor shall submit six copies to the Owner for review in accordance with the instructions furnished under "Shop and Working Drawings." If the submittal is complete and does not require any changes, an acknowledgement (copy of transmittal) will be returned noting status. If the submittal is incomplete or does require changes, corrections, additions, etc., two copies of the

submittal will be returned with a copy of transmittal noting status. Six copies of the final operating and maintenance manuals and/or spare parts list shall be delivered to the Owner prior to or with the equipment when it is delivered to the job site. For systems requiring field adjustment and balancing, such as heating and ventilating, the Contractor shall submit separate test results and adjustment data on completion of the work, to be incorporated into the system manual.

- B. Operating and maintenance manuals shall be submitted in accordance with Specification Section 01760 - paragraph 1.01.A through K inclusive.
- C. The information included in the manual shall be as described in the individual specification sections, but as a minimum shall contain clear and concise instructions for operating, adjusting, lubricating and maintaining the equipment, an exploded assembly drawing, identifying each part by number and a listing of all parts of the equipment, with part numbers and descriptions required for ordering spare parts. Spare parts lists shall include recommended quantity and price.

END OF SECTION

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**OPERATION AND MAINTENANCE MANUAL
REVIEW CHECKLIST**

1. Name, address, telephone/fax number of the manufacturer
2. Name, address, contact name, telephone/fax of local representative
3. Name, address, telephone/fax number of the contractor
4. Exploded view/general arrangement of materials of construction
5. Description of operation/operating principal
6. Project specific Operating parameters
7. Wiring Diagrams (If Applicable)
8. Troubleshooting checklist
9. Recommended spare parts list with prices, and ordering instructions
10. Model number and the serial number of the model provided
11. Performance curves or tabulated data
12. Routine Maintenance instructions/service instructions with recommended Intervals
13. Assembly and disassembly instructions
14. Recommended lubricates and lubrication schedule.
15. Approved copies of Shop Drawings are to be included in the manual
16. Startup/break-in and adjustment instructions
17. Warranty information

Reviewed By: _____

Date: _____

SECTION 01562

DUST CONTROL

1. Description

This section of the specification covers the control of dust via calcium chloride and water, complete.

2. Calcium Chloride

- A. Calcium chloride shall conform to the requirements of AASHTO-M 144, Type I or Type II and Specification for Calcium Chloride, ASTM D98. The calcium chloride shall be packaged in moisture proof bags or in airtight drums with the manufacturer, name of product, net weight, and percentage of calcium chloride guaranteed by the manufacturer legibly marked on each container.
- B. Calcium chloride failing to meet the requirements of the aforementioned specifications or that which has become caked or sticky in shipment, may be rejected by the Owner.

3. Water

- A. Water shall not be brackish and shall be free from oil, acid, and injurious alkali or vegetable matter.

4. Application

- A. Calcium chloride shall be applied when ordered by the Owner and only in areas which will not be adversely affected by the application. See Section 01570, ENVIRONMENTAL PROTECTION.
- B. Calcium chloride shall be uniformly applied at the rate of 1-1/2 pounds per square yard or at any other rate as directed by the Owner. Application shall be by means of a mechanical spreader, or other approved methods. The number and frequency of applications shall be determined by the Owner.
- C. Water may be sprinkler applied with equipment including a tank with gauge-equipped pressure pump and a nozzle-equipped spray bar.
- D. Water shall be dispersed through the nozzle under a minimum pressure of 20 pounds per square inch, gauge pressure.

END OF SECTION

SECTION 01570

ENVIRONMENTAL PROTECTION

1. Description
2. Notification
3. Implementation
4. Area of Construction Activity
5. Protection of Water Resources
6. Construction in Areas Designated as Wetlands on the Drawings
7. Streams Crossing
8. Protecting and Minimizing Exposed Areas
9. Location of Storage Areas
10. Protection of Landscape
11. Clearing and Grubbing
12. Discharge of Dewatering Operations
13. Dust Control
14. Separation and Replacement of Topsoil
15. Baled Hay or Straw
16. Silt Fence
17. Surface Restoration of Cross Country Areas
18. Siltation Control Device

1. Description

- A. The work covered by this section of the specifications consists of furnishing all labor, materials, tools and equipment and performing all work required for the prevention of environmental pollution during and as a result of construction operations under this contract.
- B. The requirements set forth in this section of the specifications apply to cross-country areas, river and stream crossings, and construction in and adjacent to wetlands, unless otherwise specifically stated.
- C. All work under this Contract shall be in accordance with the Conservation Commissions' Orders of Conditions as well as any conditional requirements applied.

2. Notification

The Owner will notify the Contractor in writing of any non-compliance with the foregoing provisions. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails to act promptly, the Owner may order stoppage of all or part of the work until satisfactory corrective

action has been taken. No claim for an extension of time or for excess costs or damage incurred by the Contractor as a result of time lost due to any stop work orders shall be made unless it was later determined that the Contractor was in compliance.

3. Implementation

- A. Prior to commencement of work, the Contractor shall meet with representatives of the Owner to develop mutual understandings relative to compliance of the environmental protection program.
- B. It is the Contractor's responsibility to be aware of and in compliance with all environmental requirements governing his work under this Contract, whether by law, regulation, permit, license, or Contract condition. Notwithstanding the foregoing, in the event that the Owner becomes aware of the Contractor's non-compliance with any environmental protection provisions or requirements relative to the work, the Owner will notify the Contractor in writing of such non-compliance. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails to act promptly, the Owner may order stoppage of all or part of the work until satisfactory corrective action has been taken. No claim for an extension of time or for excess costs or damage incurred by the Contractor as a result of time lost due to any stop work orders shall be made unless it was later determined that the Contractor was in compliance.
- C. The Contractor shall submit for approval seven sets of details and literature fully describing environmental protection methods to be employed in carrying out construction activities within 100 feet of wetlands or across areas designated as wetlands. The Contractor shall submit six sets to the Owner and one set to the Conservation Commission.

4. Area of Construction Activity

Insofar as possible, the Contractor shall confine his construction activities to those areas defined by the plans and specifications. All land resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their present condition or be restored to a condition after completion of construction at least equal to that, which existed prior to work under this contract.

5. Protection of Water Resources

- A. The Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumens, calcium chloride, acids or other harmful materials. It is the Contractor's responsibility to comply with all applicable Federal, State, County and Municipal laws regarding pollution of rivers and streams.

- B. Special measures should be taken to insure against spillage of any pollutants into public waters.

6. Construction in Areas Designated as Wetlands

- A. Insofar as possible, the Contractor shall make every effort to minimize disturbance within areas designated as wetlands. Contractor shall remain within easement limits.
- B. The Contractor shall perform his work in such a way that these areas are left in the condition existing prior to construction.
- C. The elevations of areas designated as wetlands shall not be unduly disturbed by the Contractor's operations outside of the trench limits. If such disturbance does occur, the Contractor shall take all measures necessary to return these areas to the elevations which existed prior to construction.
- D. In areas designated as wetlands, the Contractor shall carefully remove and stockpile the top 24 inches of soil. This topsoil material shall be used as backfill for the trench excavation top layer. The elevation of the trench shall be restored to the preconstruction elevations wherever disturbed by the Contractor's operation.
- E. The Contractor shall use a trench box, sheeting or bracing to support the excavation in areas designated as wetlands.
- F. Excavated materials shall not be permanently placed or temporarily stored in areas designated as wetlands. Temporary storage areas for excavated material will be determined as directed by the Owner.
- G. The use of a temporary gravel roadway to construct the pipeline in the wetlands area is not acceptable. The Contractor will be required to utilize timber or rubber matting to support his equipment in these areas. The timber or rubber matting shall be constructed in such a way that it is capable of supporting all equipment necessary to install the pipeline. The timber or rubber matting shall be constructed of materials and placed in such a way that when removed the material below the matting will not be unduly disturbed, mixed or compacted so as to adversely affect recovery of the existing plant life.
- H. Bentonite dams shall be placed in wetlands to prevent drainage. Locations for dams are as indicated on the drawings or as directed by the Owner.
- I. During construction, easements within wetlands shall be lined with a continuous haybale/siltation fence barrier.

7. Stream Crossing

- A. The Contractor shall take adequate measures to minimize siltation of the tributary areas downstream of the pipeline crossing.
- C. The sewer pipe shall be encased in concrete within streams crossings, as specified under Section 03302, FIELD CONCRETE.
- D. The Contractor shall not disturb the flow in such a manner that excessive erosion of the banks occurs. If such erosion does occur, the Contractor shall halt construction and take measures to prevent the erosion.
- E. Unless otherwise approved by the Owner in writing, the crossings shall be performed at right angles to the existing flow as shown on the drawings and during months of low flow and low rainfall (July 1 to September 30).
- F. Unless otherwise noted, upon completion of the project the exposed slopes shall be stabilized with mulch and then revegetated with plant materials as outlined in Section 02931 LANDSCAPING.
- G. The elevation of the beds and banks of the brook shall be restored to the level existing prior to construction.
- H. The material which is excavated from the brook bed shall be stockpiled outside of wetland area and replaced as backfill over the concrete pipe encasement.
- I. The Contractor shall not divert the brooks out of their natural channels during construction.

8. Protecting and Minimizing Exposed Areas

- A. The Contractor shall limit the area of land, which is exposed and free from vegetation during construction. In areas where the period of exposure will be greater than two (2) months, temporary vegetation, mulching or other protective measures shall be provided as specified.
- B. The Contractor shall take account of the conditions of the soil where temporary cover crop will be used to insure that materials used for temporary vegetation are adaptive to the sediment control. Materials to be used for temporary vegetation shall be approved by the Owner.

9. Location of Storage Areas

- A. The location of the Contractor's storage areas for equipment and/or materials shall be upon cleared portions of the job site or areas to be cleared as a part of this project, and

shall require written approval of the Owner. Plans showing storage facilities for equipment and materials shall be submitted for approval of the Owner.

- B. No excavated materials or materials used in backfill operations shall be deposited within a minimum distance of one hundred (100) feet of any watercourse or any drainage facility. Adequate measures for erosion and sediment control such as the placement of baled hay or straw around the downstream perimeter of stockpiles shall be employed to protect any downstream areas from siltation.
- C. There shall be no storage of equipment or materials in areas designated as wetlands.
- D. The Owner may designate a particular area or areas where the Contractor may store materials used in his operations.
- E. Storage areas in cross-country locations shall be restored to pre-construction conditions with the planting of native species of trees and shrubs.

10. Protection of Landscape

- A. The Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without written authority from the Owner. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorages unless specifically authorized by the Owner. Excavating machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees, which are not to be removed, particularly overhanging branches and limbs. The Contractor shall, in any event, be responsible for any damage resulting from such use.
- B. Branches, limbs, and roots shall not be cut except by permission of the Owner. All cutting shall be smoothly and neatly done without splitting or crushing. When there is unavoidable injury to branches, limbs and trunks of trees, the injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.
- C. Where, in the opinion of the Owner, trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or by his blasting or other operations, the Owner may direct the Contractor to adequately protect such trees by placing boards, planks, poles or fencing around them. Any trees or landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the expense of the Contractor. The Owner will decide what method of restoration shall be used, and whether damaged trees shall be treated and healed or removed and disposed of under the provisions of Section 02230, CLEARING AND GRUBBING.
- D. Cultivated hedges, shrubs, and plants which could be injured by the Contractor's operations shall be protected by suitable means or shall be dug up, balled and temporarily replanted and maintained. After construction operations have been substantially

completed, they shall be replanted in their original positions and cared for until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of a kind and quality at least equal to that existing at the start of the work.

11. Clearing and Grubbing

- A. The Contractor shall clear and grub only on the Owner's land or the Owner's easements, and only the area required for construction operations, as approved by the Owner. Removal of mature trees (4 inches or greater DBH) will not be allowed on temporary easements.
- B. The Contractor shall not remove trees in the Owner's temporary easements without permission of the Owner.

12. Discharge of Dewatering Operations

- A. Any water that is pumped and discharged from the trench and/or excavation as part of the Contractor's water handling shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.
- B. Under no circumstances shall the Contractor discharge water to the areas designated as wetlands. When constructing in a wetlands area, the Contractor shall discharge water from dewatering operations directly to the nearest drainage system, stream, or waterway after filtering by an approved method. The Contractor is responsible for obtaining the appropriate permits.
- C. The pumped water shall be filtered through baled hay, a vegetative filter strip or a vegetated channel to trap sediment occurring as a result of the construction operations. The vegetated channel shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.
- D. The Contractor shall submit a dewatering plan to the Conservation Commission for approval prior to commencement of dewatering operations. The plan shall include the method for dewatering, the proposed filtering system, and discharge location(s). The plan shall meet the requirements specified herein and as specified in Section 02240 – Dewatering. No dewatering work will be allowed without Conservation Commission approval.

13. Dust Control

- A. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, to minimize creation and dispersion of dust. If the Owner decides it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish and spread

the material, as directed. Calcium chloride shall be as specified under Section 01562, DUST CONTROL.

- B. Calcium Chloride shall not be used for dust control within a drainage basin or in the vicinity of any source of potable water.

14. Separation and Replacement of Topsoil

Topsoil shall be carefully removed from cross-country areas where excavations are to be made, and separately stored to be used again as directed. The topsoil shall be stored in an area acceptable to the Owner and adequate measures shall be employed to prevent erosion of said material.

15. Baled Hay or Straw

To trap sediment and to prevent sediment from clogging drainage systems, baled hay or straw shall be used where shown on the drawings. Care shall be taken to keep the bales from breaking apart. The bales should be securely staked to prevent overturning, flotation, or displacement. All deposited sediment shall be removed periodically. Hay bales shall not be placed within a waterway during construction of the pipeline crossing.

16. Silt Fence

- A. Where indicated on the drawings or where directed by the Owner, the Contractor shall erect and maintain a temporary silt fence. In areas designated as wetlands, the Contractor shall line the limits of the construction easement with a silt fence. The silt fence shall be used specifically to contain sediment from runoff water and to minimize environmental damage caused by construction.
- B. The silt fence shall consist of a 3-foot wide continuous length sediment control fabric, stitched to a 22-foot wide, continuous length support netting, and stapled to preweathered oak posts installed as shown on the drawings. The oak posts shall be 1½-inches by 1½-inches (Minimum Dimension) by 48 inches and shall be tapered. The support netting shall be industrial strength polypropylene. The bottom edge of the sediment control fabric shall be buried as shown on the drawings. The sediment control fabric shall conform to the following properties:

<u>Property</u>	<u>Value</u>	<u>Test Method</u>
1. Grab Strength (lbs.)	124	ASTM D-4632
2. Elongation (%)	15%	ASTM D-4632
3. Puncture Strength (lbs.)	65	ASTM D-4833
4. Burst Strength (psi)	300	ASTM D-3786
5. Trapezoid Tear (lbs.)	60	ASTM D-4533
6. Equivalent Opening Size (U.S. Sieve)	No. 30	ASTM D-4571
7. Permittivity (sec ⁻¹)	0.10	ASTM D-4491
8. Water Flow Rate (gal/min/sf.)	10	ASTM D-4491
9. UV Resistance (%)	70	ASTM D-4355

C. The silt fence shall be Mirafi Envirofence manufactured by Mirafi, Inc. or approved equal.

17. Surface Restoration of Cross Country Areas

Plantings detailed in Section 02921 shall be conducted when construction of the pipeline has been completed within the areas designated. A one-year guarantee of maintenance will be required on these plantings to ensure that they establish in the area.

18. Siltation Control Device

- A. As directed by the Owner, a siltation control device shall be used to trap sediment and prevent the drainage system from clogging. Siltation control device(s) shall be installed between the catch basin frame and grate. The Contractor shall clean and maintain the siltation control device(s) on a regular basis and as directed by the Owner.
- B. The siltation control device shall be a woven sack that is sewn with a double needle machine using high strength thread.
- C. The siltation control device seams shall have an average strength per ASTM D-4884 as follows:

<u>STYLE</u>	<u>TEST METHOD</u>	<u>TEST RESULT</u>
HI FLOW	ASTM D-4884	100 LB/IN

- D. The siltation control device will be manufactured to fit the opening of the catch basin or drop inlet. The siltation control device will have the following features; two dump straps attached to the bottom of the sack to facilitate the dumping of the trapped sediment. The top of the siltation control device shall have lifting loops as an integral part of the sack to be used to lift the partially full sack out to empty. The siltation control device shall have a restraining strap approximately halfway up the sack to keep the sides away from the catch basin walls. This yellow strap is a visual means of determining when the sack needs to be emptied. Once the strap is covered with sediment, the siltation control device should be emptied, cleaned and placed back into the catch basin.

- E. The geotextile fabric shall be woven fabric with the following properties:

HI FLOW

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>TEST RESULT</u>
Grab Tensile	ASTM D-4632	265 lbs.
Grab Elongation	ASTM D-4632	20 Percent
Puncture	ASTM D-4833	135 lbs.
Mullen Burst	ASTM D-3786	420 P.S.I.
Trapezoid Tear	ASTM D-4533	45 lbs.
UV Resistance	ASTM D-4355	90 Percent
Apparent Opening Size	ASTM D-4751	20 US Sieve
Flow Rate	ASTM D-4491	200 Gal/Min/s.f.
Permittivity	ASTM D-4491	1.5 sec ⁻¹

All properties are minimum average roll values.

F. CONSTRUCTION SEQUENCE:

1. Remove the grate and lower the siltation control device into the opening. Leave approximately six inches above the frame. This is the area of the lifting loops. Replace the grate to hold the siltation control device in place.
2. The siltation control device is considered full and should be emptied when the restraining strap is no longer visible.
3. To remove the siltation control device, take two pieces of 1" diameter rebar and place through the lifting loops on the long side of the siltation control device. Attach lifting cables to the rebar and lift out.
4. To empty the siltation control device, place it where you want the sediment. Place the lifting rebar through the dump straps and turn the siltation control device inside out. Clean with a shovel or rinse the fabric. Return the siltation control device to its original shape and reinstall in the catch basin.
5. The siltation control device is reusable. Once the construction project is complete and it is no longer needed for sediment control, remove the siltation control device from the catch basin and store out of the sunlight until needed on the next catch basin.

END OF SECTION

SECTION 01750

EQUIPMENT CHECKOUT AND TESTING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The physical checkout and testing requirements in this Section are in addition to those requirements defined in the technical specifications.

1.02 RELATED WORK:

- A. Section 01752, STARTUP AND TESTING
- B. Division 11 through Division 16.

1.03 DEFINITIONS:

- A. Shop Testing is defined as testing that is performed by the manufacturer either at the place of manufacture, or the place of assembly, for the purpose of proving that the equipment meets the requirements of the technical specification(s).
- B. Physical Checkout is defined as the process whereby the Contractor physically inspects products after they have been installed in the work, and certifies that the products have been properly and completely installed, and are ready for field testing.
- C. Field Testing is defined as testing that is performed on products by the Contractor with the assistance of the manufacturer's representative, after the performance of physical checkout, for the purpose of proving that the tested products meet the specifications. While field testing can be described as "shop testing in the field", it may be required whether or not shop testing was performed on the product.
- D. System Testing is defined as testing performed on a "system" normally comprised of two or more pieces of equipment, after physical checkout and field testing have been completed, for the purpose of proving that the system meets specifications. System testing is described in Section 01752, STARTUP AND TESTING.
- E. Manufacturer's representative, sometimes referred to as the Factory-Trained Service Technician, is defined as a person provided by the manufacturer, who is qualified by training and experience to provide technical and process related advice, and/or assistance, relating to the installation or utilization of the products provided by the manufacturer. Minimum training and experience shall include not less than three years participation in similar work, including no less than three similar projects during this three year period.

1.04 SHOP TESTING:

- A. When required by the specifications, shop testing shall be performed prior to delivery of the equipment or material. If shop testing is not required by the technical specifications, provide shop testing as detailed in Paragraph 1.06. Provide a minimum of fifteen days written notice, indicating the time and place of testing. Submit the following to the Owner for approval not less than fifteen days prior to this notice.
1. Description of the test - Outline how the tests will conform to the requirements of the specifications.
 2. Testing devices that will be used in the tests - description must state how the devices will perform or what they will measure, and the device accuracy. Submit sample measurement results and catalog cuts.
 3. Schedule for testing - schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or test failure.
 4. Test forms - submit samples of all forms used to record and report on shop test data. Forms shall include description of test, test date, equipment used, equipment tested, personnel present, equipment tag ID numbers, and measurements made. Forms shall have a place for signature by the chief testing person, and an officer of the manufacturer certifying that the tests results shown are true, accurate, have met the required criteria, and that the equipment will operate as indicated.
- B. Submit the following to the Owner within one week after completion of the tests.
1. Completed test forms for each device tested.
 2. Completed certification.
 3. A written summary of testing, reporting results.
 4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the specification test requirements at no additional cost to the Owner. Additional travel required by the Owner personnel to witness retesting shall be paid by the Contractor, at no additional cost to the Owner.
- C. Contractor shall include in the contract price the cost for Owner personnel to witness shop testing of equipment or systems as listed below. Round trip air fare (coach or equivalent) for flights on working days without weekend stopovers, unless otherwise approved by the Owner, lodging, meals and rental car(s) shall be provided for the number of people and the durations listed below.

WITNESSING SHOP TESTING OF EQUIPMENT						
Spec Section	Equipment	Number of People		Days of Lodging & Meals		Rental Cars
		Engineer	Owner	Engineer	Owner	

1.05 PHYSICAL CHECKOUT:

A. Physical checkout shall include the following, where applicable:

1. Verify exterior areas for backfill, grading, surfacing, drainage, landscaping, roadways, fencing, and gates.
2. Verify buildings for structure, masonry, architectural, mechanical systems, electrical/lighting, communications, and HVAC.
3. Verify concrete structures for structural integrity, finish tolerance, durability, appearance, embedded and inserted items, painting and surface applications.
4. Verify steel structures for member alignment, connection bolts torque, connection welds integrity, painting, fire proofing and surface applications.
5. Verify mechanical systems and items for setting, alignment and securing, check and adjust packing and seals, lubrication, drying out, drive connection and alignment including rotation and belt/chain tension, painting or surface applications, and tagging for project system.
6. Verify piping systems for material, size, components, direction, alignment of joints and bolts/welding, packing and seals, screens and filters and strainers, leak and

pressure hydro tests, painting and color coding, hangers and anchors and expansion provision and supports, clean out of foreign matter and tagging for project system.

7. Verify electrical and control/instrumentation systems for conduit and tray installation, wire/cable material and size, circuit continuity and identification, voltage testing, ground continuity and testing, terminal installation and identification, jar switches and circuit breakers and transformers tested, substation operation tested, and tagging for project system.
8. Verify communication system including telephone, fire/smoke alarm, security, paging, closed circuit TV similar to electrical above.
9. Verify computer systems by station, function, network interface.
10. Each piece of equipment and system must be certified by the manufacturer's representative as described in subsection 1.07.

1.06 MINIMUM SHOP AND FIELD TESTING REQUIREMENTS:

If the technical specifications do not define shop and field testing requirements, the following requirements shall be acceptable.

- A. Measurement of wearing ring clearances for all pumps requiring assembly, so equipped:
 1. Take a minimum of two readings, 90 degrees apart.
 2. All measured clearances shall be within supplier's specifications for new installations. Replace and recheck rings found to be out-of-round or out-of-specified tolerance.
- B. Measurement of impeller bore for all pumps requiring assembly:
 1. Take a minimum of two readings, 90 degrees apart.
 2. All measured clearances shall be within supplier's specifications for new installations. Replace and recheck impellers found to be out of round or out of specified tolerance.
- C. Measurement of shaft run out for all rotating equipment requiring assembly:
 1. Remove bearings from the shaft. Support shaft on pedestal rollers or in a lathe.
 2. Check each shoulder on the shaft.
 3. Take a minimum of two readings for each shoulder, 90 degrees apart.

4. All measured clearances shall be within supplier's specifications for new installations. Replace and recheck shafts found to be out of round or out of specified tolerance.

D. Vibration Measurements

1. Provide vibrational signature testing and documentation for each piece of direct drive or close coupled rotating equipment with a motor HP of 50 or above and a rated operating speed in excess of 999 RPM.
2. Unless specified otherwise, the current edition of the Hydraulic Institute Standard, "Acceptable Field Vibration Limits" shall be the standard for vibrational testing.
3. Take all specified vibrational readings in three directions; vertical, horizontal, and axial.
4. Provide vibrational measurements in the following engineering units:
 - a. Displacement in thousandths of an inch (mils), peak to peak.
 - b. Velocity in inches per second (ips), peak to peak.
 - c. Acceleration in feet per second, zero to peak.
 - d. Spike energy in g-SE.
5. The vibrational reading shall be less than the allowable maximum for the device rotating frequency and within the operating band specified by the supplier.
6. Amplitude Allowable Maximums:

<u>RPM</u>	<u>Amplitude Inches Peak to Peak</u>
3,000 and above	0.001
1,500 - 2,999	0.002
1,000 - 1,499	0.0025
999 and below	0.003

7. Utilize a Bently Nevada Dual Path Monitor, or equal for all vibrational measurements.

E. Belt Drives

All belts shall be in accordance with supplier's recommendations.

F. Gear Drives and Reducers

1. Check gears for lash at no less than three points around the gear.
2. Rotate a full 360 degrees while checking alignment.

G. Coupling/Shaft Alignment

1. Perform all final alignments and checks with a dial indicator or a laser device. Feeler gauges and straight edges are not acceptable.
2. Eliminate soft foot conditions prior to aligning.
3. When checking for final soft foot any displacement readings in excess of 0.002-in. must be corrected.
4. When checking for pipe strain, any displacement in excess of 0.002-in. requires piping realignment.
5. Alignments will not be regarded as final until the grout is set and all piping has been attached. Demonstrate that alignment is not changed by attachment of piping.
6. Shim the driving element; never the driven element.
7. Take bracket sag corrections into account when using a dial indicator. Bracket sag shall be determined on rigid pipe.
8. Mount a dial indicator to the driven element so that it can be rotated. Rotate both elements while aligning.
9. When aligning three coupled elements, align gear reduction elements with the driven element first, then align the driver to the gear reduction elements.
10. Check all four alignments: i.e. angular alignment in the vertical and horizontal planes, and parallel alignment in vertical and horizontal planes.
11. The minimum acceptable alignment accuracy for flexible couplings is +/- 0.005-in., or the supplier's specifications, whichever is more stringent.
12. The dial indicator must be perpendicular to the alignment surface.
13. Number hold down nuts prior to tightening. Loosen in reverse order. Tighten in ascending order.
14. Use only clean, deburred shims. Clean the machine base and remove rust or burrs prior to alignment.

H. Measurement of Noise (dB)

1. Eliminate noise sources generated by adjacent construction activity prior to testing.
2. Establish a background noise level prior to testing.
3. Perform noise level testing on each installation device as required by the technical specifications.
4. The maximum acceptable noise level exposure is 85 dBA over eight hours continuous for office, shop, and other areas where the Owner's personnel will be performing their assigned duties.

I. Hydrostatic Testing

1. AWWA C600 standards are the minimum acceptable standards for all hydrostatic testing.
2. Visually inspect all welds prior to testing, for cracks, undercut on surfaces greater than 1/32-in deep, lack of fusion on surface, reinforcement greater than Table 127.2.2 located in ANSI B31.1, Power Piping, and incomplete penetration (when accessible). Repair or rework as directed by the Owner.
3. At no time during hydrostatic testing shall any part of the piping system be subjected to a stress greater than 90% of its yield strength at test temperature.
4. After at least 10 minutes of full hydrostatic test procedures, make an examination for leakage of all joints, connections, and all regions of high stress, such as around openings and thickness transition sections.
5. Unless otherwise specified, the minimum required hydrostatic test pressure shall be 1.5 times the design pressure as specified and as indicated.
6. Unless otherwise specified, the minimum pressure holding time shall be 10 minutes plus the time required to inspect for leakage.
7. Maximum pressure shall not exceed the maximum rated pressure for any component in the system being tested.

J. Electrical Equipment

1. The testing standards for electrical components are those contained in Division 16 and in the pertinent technical specification(s).

1.07 SERVICES OF THE MANUFACTURER'S REPRESENTATIVE:

- A. Services of manufacturer's representatives shall be provided for equipment and systems specified in Divisions 11 through 16.
- B. Contractor shall coordinate services of the various representatives to avoid overlap, thereby ensuring all work may be observed by the Owner's operating personnel may receive all required training.
- C. Contractor shall notify the Owner in writing not less than ten working days prior to the visit of each manufacturer's representative.
- D. Manufacturer's representative shall provide services specified in Divisions 11 through 16. As a minimum, the services shall include the following:
 - 1. When each piece of equipment or system has been installed, including connection of permanent power and control, the equipment or system shall be started up and fully inspected, aligned and adjusted, including provision of lubrication and all pre-operative maintenance.
 - 2. Each piece of equipment or system shall be complete in all respects. Omission of any required items shall be corrected. Lack of discussion in the specifications of components which are necessary to equipment operation will not be accepted as the basis for an extra charge.
 - 3. At the time of the inspection the representative shall provide a minimum of two additional hours to train the Owner's operations personnel in the operation and maintenance of the equipment or system.
 - 4. Upon completion of this work the manufacturer's representative shall forward a copy of the report of his inspection to the Owner via the Contractor. The report shall be on a form suitable to the Owner and shall detail the work completed, deficiencies noted and/or corrected, any special instructions, and the names of Owner's personnel who received training. It shall also certify that the installation of the equipment or system is complete, ready for permanent operation, and free from any defects that would void the warranty.
 - 5. Satisfactory certification of all individual equipment and systems must be received by the Owner prior to the authorization to proceed with the overall start-up operation.
 - 6. The manufacturer's representative shall return at a later date to supervise field tests, assist in start-up and perform any additional training required. Reports of these visits, specifically detailing the results of all field tests, shall be forwarded to the Owner within 7 days of completion of the services.

1.08 CORRECTIONS TO THE WORK:

Correct any items of work failing to meet the specifications at no additional cost to the Owner. Correct the nonconforming items by re-work, modification, or replacement, at the option of the Owner. Provide all required labor, materials, and retesting as specified herein, to verify that the equipment or system conforms to the specifications.

1.09 SAFETY:

Conduct all test procedures in compliance with all applicable safety standards and regulations.

END OF SECTION

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SECTION 01752

STARTUP AND TESTING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section includes the startup and testing services required for the pump station(s) during system startup.

1.02 SYSTEM DESCRIPTION:

- A. The Contractor shall perform pump station startup to the satisfaction of the Owner. Startup and testing shall not be initiated until all required certifications and other required documentation has been submitted, as described herein.
- B. The purpose of the startup test is to provide a final operational checkout of all equipment prior to beneficial use by the Owner.
- C. As most components of each pump station are interrelated, substantial completion of the project shall not be certified until successful completion of startup.

1.03 SEQUENCING:

Testing, operator training and other like services to be provided under the technical sections of the specifications are not to be performed during startup without written authorization from the Owner.

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Three copies of the following shall be forwarded to the Owner for review two (2) weeks prior to commencement of startup:
 - 1. Certification by a representative of the manufacturer that each piece of equipment has been installed properly and is ready for operation.
 - 2. Certification by a representative of the equipment manufacturer that all equipment requiring calibration has been properly calibrated.
 - 3. A schedule of the testing, including staffing, and specific testing and operation of individual equipment items.
- B. At the conclusion of the test, all information recorded during the test shall be forwarded to the Owner.

- C. This test is not to be utilized as a general debugging of the system. All equipment shall be started, tested and calibrated prior to this test. This includes automatic and manual operation as well as instrumentation interfacing.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Prior to commencement of testing, the Owner shall be given three (3) days' written notice.
- B. The Contractor shall complete final debugging prior to startup.
- C. All telemetry equipment shall be operational prior to testing.
- D. The test shall be performed.
- E. Part of the test shall be accomplished on standby power.

3.02 TEST PROCEDURES:

- A. It is the general responsibility of the Contractor to insure that all equipment is completely operational throughout the test; provide the Owner with proper technical assistance as required to completely test all equipment and alarms; provide adequately trained personnel who can operate the pump station on an on/off basis so that the equipment is not damaged, whether the Owner is present or not during that portion of the test.
- B. It is the general responsibility of the Owner during the test period to supervise the testing of all equipment, associated alarms and devices; to vary the operation of the equipment as necessary, and to pump as required.

3.03 STOPPING OF TEST:

- A. The Owner shall stop the testing for any of the following reasons:
 - 1. Failure of critical system, including:
 - a. Pumps
 - b. Telemetry Equipment
 - c. Instrumentation
 - d. Standby Generating System
 - 2. Failure of any of the above systems to operate on standby power.

- B. If the test is stopped for any reason, the test shall be restarted from the beginning. The Contractor shall pay all costs associated with the Owner supervising additional testing as required.

3.04 EXPENDABLES:

Unless otherwise indicated, the General Contractor shall be responsible for providing all fuel during construction and providing a full tank of fuel oil at no additional cost to the Owner, at beneficial occupancy.

END OF SECTION

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SECTION 01760

OPERATIONS AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 FORMAT:

- A. Prepare data in form of an instructional manual.
- B. Binders: Commercial quality, 8 1/2 x 11 inch three-ring binders with hardback, washable, plastic covers; two inch maximum ring size. When multiple binders are used, correlate data into related, consistent groupings. Provide a table of contents in each binder.
- C. Cover: Identify each binder cover and spine with typed or printed title OPERATION AND MAINTENANCE INSTRUCTION; list title of Project facility; identify subject matter of contents.
- D. Arrange contents by systems under section numbers and sequence of Table of Contents.
- E. Provide tabbed flyleaf for each separate product and system; with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data - on 20-pound paper.
- G. Drawings: Provide with reinforced punched, binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Submit certification that the data and drawings provided pertain exactly to the model, size, and series product and equipment installed in the work.
- I. All documents will be electronically scannable.
- J. All products, systems, and drawings must be cross-referenced with tag ID numbers.

K. The manual for each piece of equipment shall be a separate document with the following specific requirement:

1. Contents:

Table of Contents and Index

Brief description of each system and components

Starting and stopping procedures

Special operating instructions

Routine maintenance procedures

Manufacturer's printed operating and maintenance instructions, parts list, illustrations, and diagrams

One copy of each wiring diagram

One copy of each approved shop drawing and each Contractor's coordination and layout drawing

List of spare parts, manufacturer's price, and recommended quantity

Name, address and telephone number of local service representatives.

2. Material

Loose leaf on 60 pound, punched paper

Holes reinforced with plastic cloth or metal

Page size, 8 ½ x 11 inches

Diagrams, illustrations and attached foldouts as required, of original quality, reproduced by dry copy method

Covers: oil, moisture and wear resistant 9 x 12 size

1.03 RELATED WORK:

A. General Requirements in their entirety (Section 01750 and Section 01752)

- B. Individual Technical Specification Sections Specific for Operation and Maintenance Data.

1.04 QUALITY ASSURANCE:

- A. Prepare instructions and data by personnel experienced in maintenance and operations of described products.

1.05 CONTENTS, EACH VOLUME (BINDER):

- A. Table of Contents: Provide title of Contract, schedule of products and systems, indexed to content of the volume. A listing of all relevant tag ID numbers for each volume shall be placed immediately after the Table of Contents.
- B. For each product or systems: List names, addresses, and telephone numbers of subcontractors and suppliers, including local source of suppliers and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- E. Text: As required to supplement product data, provide logical sequence of instructions for each procedure incorporating manufacturer's instructions.
- F. Warranties, Guarantees, and Bonds: Bind copy of each

1.06 MANUAL FOR MATERIALS AND FINISHES:

- A. Building Products, Applied Materials, and Finishes: Include product data with catalog number, size composition, and color and texture designations. Provide information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

- D. Additional Requirements: As specified in individual product specification sections.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS:

- A. Each Item of Equipment and Each System: Include description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- B. Data submitted on all equipment shall include complete maintenance instructions (including preventive and corrective maintenance) and parts lists in sufficient detail to facilitate ordering replacements.
- C. All products, systems, equipment, electrical wiring, instrumentation wiring, personnel protection systems wiring, presented in this manual will have tag numbers corresponding to contract drawings and specifications. In the event, numbers do not exist; the Owner will specify a series of numbers.
- D. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.
- E. Include color-coded wiring diagrams as installed.
- F. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequence. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter and any special operating instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required. Cross-reference lubricants to products offered by at least three major lubricant suppliers.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports, calibration data, alignment records, and other information.
- P. Additional Requirements: as Specified in individual product specification sections.
- Q. Provide a listing in table of Contents for design data with tabbed flysheet and space for insertion of data.
- R. Incorporation of all Physical Checkout information obtained through the field-testing and correction phases of the Work. Input must be specific to the actions and information obtained during those phases.

1.08 SUBMITTALS:

- A. Six complete sets of operation and maintenance instructions covering all equipment furnished under pump station specifications, requiring operation and maintenance manuals shall be delivered directly to the Tyngsborough Sewer Commission, at Town Hall.
- B. Submission and approval of each set of manuals is considered an integral part of furnishing and installing respective equipment or systems. Measurement for payment of equipment requiring an operation and maintenance manual will not exceed 92 percent, until the manuals meet the requirements of the contract documents.
- C. Submit six copies of first draft volumes as required in Specification Section 01750. This first draft shall contain all currently available product data. The submittal shall be in accordance with Paragraphs 1.04 and 1.05. One copy will be returned with comments.
- D. Submit six copies of completed second draft volumes in final form 90 days prior to startup and after Physical checkout to include the additional requirements set forth in paragraph 1.07.R, above.
- E. Submit six copies of the Final Operation and Maintenance Manuals as required in at completion.

END OF SECTION

SECTION 01770

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. This Section covers administrative and procedural requirements for closing out the project, including, but not limited to:

1. Project as-built documents
2. Checkout and Certification
3. Startup and Testing
4. Final Cleaning
5. Substantial Completion
6. Closeout Procedures
7. Final Completion
8. Correction/Warranty Period

B. Closeout checklist to be completed by Owner or Owner representative.

1.02 RELATED SECTIONS:

- A. General Requirements in their entirety.
- B. Division 2 through Division 16.

1.03 AS-BUILT DOCUMENTS:

A. Contractor shall maintain on site, separate from the documents used for construction, one set of the documents listed below, and as construction progresses, shall legibly record on these documents all changes made during construction.

1. Contract Drawings.
2. Specifications.

3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Written interpretations and clarifications.
7. Field Orders.
8. Field test reports properly verified.

B. The completed set of as-built documents shall be submitted to the Owner.

C. Contractor shall provide the Owner ties to all building service connections on these As-Built Drawings.

1.04 CHECKOUT AND CERTIFICATIONS:

A. Prior to checkout and certifications the following tasks shall be completed:

1. Construction shall be complete. For this purpose, completion of construction is defined as follows:
 - a. The Contractor has completed construction and erection of the work in conformance with the Contract Drawings and Specifications.
 - b. The Contractor has installed and adjusted operating equipment, systems, or facilities, as applicable, as defined by the manufacturers' erection, installation, operation and maintenance instructions.
2. All shop drawings shall have final approval.
3. All shop tests shall be complete and approved test results submitted to the Owner.

B. Refer to Section 01750 for requirements regarding equipment checkout and certification.

1.05 START-UP AND TESTING:

A. Prior to start-up the following tasks shall be complete:

1. All checkout and certifications shall be satisfactorily completed,
2. All operations and maintenance manuals shall be approved,
3. All preliminary training by the manufacturer's representative shall be completed,

4. An approved start-up procedure shall be in place.

B. Refer to Section 01752 for start-up and testing requirements.

1.06 FINAL CLEANING:

A. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

1. Clean the site, including landscape development areas of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved or planted, to smooth, even textured surfaces.
2. Remove waste and surplus materials, rubbish, fencing equipment, temporary utilities and construction facilities from the site, unless otherwise directed by the Owner.

1.07 SUBSTANTIAL COMPLETION:

A. Substantial Completion is officially defined in the General and Supplementary Conditions. The date of substantial completion will be certified by the Owner. This date will not be certified until the following requirements have been satisfied by the Contractor:

1. All Contract requirements are coordinated into a fully operational system. All individual units of equipment and treatment are fully operative and performing at specified efficiencies. Where efficiencies are not specified, performance shall meet acceptable standards for the particular unit.
2. All field tests have been satisfactorily completed and reports forwarded to the Owner.
3. All final training has been completed by the manufacturers' representatives.
4. All spare parts and lubricants have been satisfactorily delivered to the Owner. Spare parts are for the exclusive use of the Owner when the facility has been turned over. Contractor is responsible for all maintenance and repair materials required until the facility is accepted by the Owner.

1.08 CLOSEOUT PROCEDURES:

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and is complete in accordance with Contract Documents and ready for Owner's inspection.
- B. Accompany Owner on inspection to verify conformance with the Contract Documents. Prepare a punch list of work items that have been determined by inspection to not conform

with Contract Documents. Punch list items shall include work items that are missing, incomplete, damaged, incorrect items, or improperly installed or constructed. The Contractor shall correct the punch list deficiencies by re-work, modifications, or replacement, as appropriate, until the items conform to the Contract Documents. The initial punch list shall be produced by the Contractor, with copies to the Owner. When the Contractor has reduced the number of deficient items to a reasonable level, the Owner will develop a definitive punch list for the use of the Contractor.

- C. Provide submittals to Owner that are required by governing or other authorities.
- D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due. The Contractor shall submit the following documents with or prior to Final Application for Payment: Set of as-built documents, Contract Completion and Acceptance Certificate, Consent of Surety to Final Payment, Release and Waiver of Liens and Claims, Affidavit of Payment of Debts and Claims, and remaining releases, waivers, warranties/guarantees, and all other data required by the Contract Documents.

1.09 FINAL COMPLETION:

- A. Prior to final completion, the following tasks shall be completed:
 - 1. All items in the punch list shall be completed.
 - 2. All Contract closeout documentation shall be submitted to and accepted by the Owner.

1.10 CORRECTION/WARRANTY PERIOD:

- A. During the correction period, the Contractor shall correct all deficiencies in equipment and materials.
- B. During the warranty period, the Contractor shall perform all corrective work on warranty deficiencies.
- C. Corrective work will be identified by the Owner, as appropriate. The Contractor will be notified of the item(s) requiring corrective work.
- D. The Contractor shall begin work on all corrective work within ten days of being notified of the deficiency by the Owner and shall then work continuously until the deficiency is corrected. Upon completion of the corrective work, the Contractor shall submit a letter report to the Owner describing the deficiency and the corrective action that was taken.
- E. The Contractor shall coordinate all corrective work with the Owner.

1.11 COMPLETION CHECKLIST:

- A. The Project Completion Checklist which follows *shall be modified as required for the specific project* and shall be completed as the project nears completion. When it has been fully completed, Final Payment can be approved.

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PROJECT COMPLETION CHECKLIST

Owner _____ Job No. _____

Project _____

As part of the project closeout, all items listed below must be checked off as being complete or otherwise accounted for. The person verifying completion of the item shall list the completion date and his/her initials.

Project Closeout Checklist		
	Date Completion Verified	Verified by
AS-BUILT DOCUMENTS HANDED OVER		
1. Contract Drawings		
2. Specifications		
3. Addenda		
4. Change Orders/Contract Modifications		
5. Reviewed Shop Drawings, Product Data and Samples		
6. Written Interpretations/Clarifications		
7. Field Orders		
8. Field Test Reports		
EQUIPMENT CHECKOUT AND CERTIFICATIONS		
1. Construction Complete per Drawings/Specifications		
2. Equipment Installed and Adjusted		
3. All Shop Drawings have Final Approval		
4. All Shop Tests Complete and Results Submitted		

Project Closeout Checklist		
	Date Completion Verified	Verified By
START-UP AND TESTING		
1. All Checkout and Certifications Complete		
2. All O&M Manuals Approved		
3. All Preliminary Training by Manufacturers Rep. Completed		
FINAL CLEANING		
1. All Construction Facilities Removed		
2. All Construction Debris Removed		
3. All Areas Swept/Cleared		
SUBSTANTIAL COMPLETION		
1. All Items Coordinated Into a Fully Operational System		
2. All Equipment Units Operational at Specified Efficiencies		
3. All Field Tests Completed and Reports Submitted		
4. All Final Training by Manufacturer's Rep. Completed		
5. All Spare Parts and Lubricants Provided		
CLOSEOUT PROCEDURES		
1. Written Certification Submitted that Work is Ready for Owner Inspector		
2. Inspection by Owner & Contractor completed		
3. Punch List of Nonconforming Items Prepared		
4. Documents Required by Governing or Other Authorities Submitted (List Them)		
5. Final Application for Payment Received		
6. Contact Completion and Acceptance Certificate Submittal		
7. Consent of Surety to Final Payment Submittal		
8. Release and Waiver of Liens and Claims Submitted		
9. Affidavit of Payment of Debts and Claims Submitted		

Project Closeout Checklist

	Date Completion Verified	Verified By																
10. Warranties/Guarantees Submitted																		
11. Other Required Releases and Waivers Submitted (List Them)																		
12. Permits Submitted (List Them)																		
13. Weekly Payrolls Submitted as Required by Law																		
FINAL COMPLETION																		
1. All Items in Punch List Completed																		
2. All Other Required Documentation Submitted (List It)																		
CORRECTION/WARRANTY PERIOD																		
1. Correction Period Start Date: _____ End Date: _____																		
2. Specific Warranties Provided																		
<table border="0" style="width: 100%;"> <tr> <td style="width: 30%;"><u>Item</u></td> <td style="width: 30%;"><u>Warranty Duration</u></td> <td></td> <td></td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	<u>Item</u>	<u>Warranty Duration</u>																
<u>Item</u>	<u>Warranty Duration</u>																	

Full name of persons signing their initials on this checklist:

END OF SECTION

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SECTION 02058

CONTROLLED DENSITY FILL (CDF)

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Controlled Density Fill (CDF) material is a flowable, self consolidating, rigid setting, low density material that can be substituted for compacted gravel for backfills, fills and structural fills.
- B. There are two main categories of Controlled Density Fill; excavatable and non-excavatable, with a subcategory of flowable and very flowable.
- C. Controlled Density Fill is to be used where indicated on the contract drawings or as described in any Massachusetts Highway Department road opening permits included in the project.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02252, SUPPORT OF EXCAVATION

1.03 REFERENCES:

Commonwealth of Massachusetts Highway Department (MHD) Standard Specification for Highways and Bridges - Subsection M4.08.0, CONTROLLED DENSITY FILL.

PART 2 - PRODUCTS

2.01 MATERIALS:

Materials employed in the Controlled Density Fill shall meet the requirements as described in Subsection M4.08.0 as referenced in 1.03 of Section 02248.

2.02 TYPE OF CONTROLLED DENSITY FILL:

Controlled Density Fill for this project shall be, Type 1E - Very Flowable (Excavatable), as described in MHD Subsection M4.08.0.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Controlled Density Fill shall be batched at a ready mix plant and is to be used at a high or very high slump of approximately 10- to 12-inches. It shall be flowable, require no vibration and after it has been placed for Type 1E and 2E, be excavatable by hand tools and/or small machines.
- B. Controlled Density Fill shall be placed so as to not disturb adjacent structures, utilities or the sidewalls of trenches.
- C. Controlled Density Fill shall be installed to the limits shown on the drawings, or required by permit and shall be kept below the top of the trench to allow for the placement of the required depth of pavement as specified in these documents or as indicated in the contract drawings.
- D. The Controlled Density Fill shall be protected by steel road plates until the fill reaches a point that it will not be deformed by traffic passing over it.

END OF SECTION

SECTION 02081

POLYETHYLENE PRESSURE PIPE

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing, handling, hauling, laying, jointing, and testing of all polyethylene (PE) pressure pipe, fittings, and appurtenant work as specified herein.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 03302, FIELD CONCRETE

1.03 QUALITY ASSURANCE:

- A. All pipe and fittings shall be inspected and tested at the factory as required by the standard specifications to which the material is manufactured. The Contractor shall furnish in duplicate to the Owner sworn certificates of such tests.
- B. In addition the Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturers plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Water Works Association (AWWA)

AWWA C906-90 Polyethylene PE Pressure Pipe and fittings, 4 in. through 63 in., for Water Distribution

American Society for Testing and Materials (ASTM)

ASTM D1248 Specifications for Polyethylene Plastics Molding and Extrusion Materials.

ASTM D2837 Method for Obtaining Hydrostatic Design Basis for

Thermoplastic Pipe Materials.

ASTM F714 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

Plastic Pipe Institute (PPI)

PPI TR-3 Policies and Procedures for Developing Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Materials used for the manufacture of high-density polyethylene pipe and fittings shall comply with all requirements for Type III, Class C, Category 5, Grade P34 according to ASTM D1248, and have a PPI recommended designation of PE3408. Manufacturer shall be a member in good standing of the Plastics Pipe Institute.
- B. Materials used for the manufacture of the High Density Polypipe and fittings shall meet all physical property requirements as specified by the manufacturer.

2.02 PIPE AND FITTINGS:

- A. The Contractor shall submit certified data showing that the High Density Polypipe and fittings have been tested in-house in accordance with ASTM D2837, and validated in accordance with the latest revision of PPI TR-3.
- B. Pipe and fittings shall be pressure rated using only the data as specified in 2.02A. If no such data exists, the pipe shall not be accepted. The pipe shall be pressure rated according to the following formula:

$$P = \{2S \sqrt{SDR-1}\} \times F$$

Where SDR = D/t (SDR is abbreviation for Standard Dimension Ratio)

And P = Internal Pressure, psi

S = Long Term Hydrostatic Strength, psi (1600)

D = Outside Diameter, inches

t = Minimum wall thickness, inches

F = Design Safety Factor (0.5 for water at 73.4°F and long term service)

- C. Both pipe and fittings shall carry the same pressure rating. All fittings shall be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness of the fitting shall

meet the outside diameter and minimum wall thickness specifications of ASTM F714 for the same size of pipe. It will be necessary for the fittings to be manufactured utilizing the mitered concept. All fittings shall be properly rated according to manufacturer's written recommendations, and clearly labeled on the fittings as such. Manufacturer shall have a written specification for all standard mitered fittings, which establishes quality control criteria and tolerances. The manufacturer of the pipe shall be the same manufacturer as of the mitered fittings and fabrications.

- D. The pipe shall have product traceability. This shall be accomplished by the inclusion of a product code into the printline of all products. This shall list the manufacturer, the date of manufacture, the lot and supplier of raw material, the location of manufacture, and the production shift on which the product was produced. The ASTM standard shall appear as ASTM F714 and the material designation as PE3408.
- E. Pipe and fittings shall be butt fusible at 500" +/- 10"F. according to manufacturer recommended procedures. The socket or sidewall fittings shall be at 500"F. Pipe and fittings may also be joined with flanged adapters and convoluted ductile iron rings.
- F. The manufacturer shall certify to the Owner that the performance of the pipe is AWWA Standard C906 through written certification to the Owner and marking of the printline on the pipe accordingly. The manufacturer shall comply with National Sanitation Foundation (NSF) Standard 61 by certifying in writing to the Owner and marking the pipe with the NSF mark in the printline.
- G. The High Density Polypipe shall be manufactured by Poly Pipe Industries, PE3408, and EHMW Gainesville, TX; or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Polyethylene Pipeline shall be installed in accordance with manufacturer's recommendations and as indicated on the drawings.
- B. No defective pipe or fittings shall be laid or placed in the piping system, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
- C. Pipes and fittings shall be subjected to a careful inspection just before being installed.
- D. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the completed work.

3.02 PRESSURE AND LEAKAGE TESTS:

- A. Unless otherwise approved, all pipelines shall be given combined pressure and leakage tests between line valves. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner shall have the privilege of using their own gages. The test pressure required shall be equal to the design rating of the pipe being used.
- B. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires. However, pipelines in excavations or embedded in concrete shall be tested prior to backfilling of the excavation or placing of the concrete, and exposed piping shall be tested prior to field painting.
- C. Unless it has already been done, the section of pipe to be tested shall be filled with water and all air shall be expelled from the pipe. The Contractor shall follow established procedures for filling the pipe and expelling trapped air to avoid exposing the piping system to water hammer. If blowoffs are not available at high points for releasing air, the Contractor shall make the necessary excavations and install the necessary taps. If directed, he shall plug the holes after completion of the test and backfill as necessary.
- D. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
- E. The pressure test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test corrected to the gage location) to the pressure rating of the pipe. If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed to pass the pressure test.
- F. If the pressure test fails, the Contractor shall make a leakage test by metering the flow of water into the pipe while maintaining the specified pressure in the section being tested. If the average leakage during a two-hour period exceeds 11.6 gallons per day, per inch of diameter, per mile of pipe, the section shall be considered as having failed the leakage test. For example, if 1,000 feet of 4-inch pipe is to be tested, the allowable leakage is 0.73 gallons over a 2 hour period, calculated as follows:

$$L = \frac{(11.6 \text{ gal}) \times (4") \times (2 \text{ hr.}) \times (1000')}{(1") \times (24 \text{ hr.}) \times (5280')} = 0.73 \text{ gal}$$

G. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

H. **Air pressure testing of installed pressure pipe is expressly prohibited due to the catastrophic nature of failure should failure occur.**

END OF SECTION

SECTION 02085

POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing and installation of Polyvinyl Chloride (PVC) pipe and fittings, as specified herein.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02252, SUPPORT OF EXCAVATION
- C. Section 02441, TELEVISION INSPECTION OF NEW PIPELINES
- D. Section 02631, PRECAST MANHOLES
- E. Section 02532, VALVES AND APPURTENANCES
- F. Section 02518, TRACER TAPE

1.03 REFERENCES:

- A. The following standards form a part of these specifications as referenced:

American Society for Testing and Materials (ASTM)

ASTM	D2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM	D3034	Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM	D3212	Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM	F679	Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings (18" - 27")

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. PVC nonpressure sewer pipe 4-inches through 15-inches diameter shall conform to ASTM D3034, 18-inches through 27-inches diameter to ASTM F679, all with SDR of 35 unless noted, and shall meet the specific requirements and exceptions to the aforementioned specifications, which follow.
- B. PVC nonpressure sewer pipe shall be furnished in standard lengths.
- C. One pipe bell consisting of an integral wall section with a solid cross section rubber ring, factory assembled, shall be furnished with each standard, random and short length of pipe. Rubber rings shall be provided to the requirements of ASTM D3212.
- D. The rubber ring shall be retained within the bell of the pipe by a precision formed groove or recess designed to resist fish mouthing or creeping during assembly of joints.
- E. Spigot pipe ends shall be supplied with bevels from the manufacturer to ensure proper insertion. Each spigot end shall have an "assembly stripe" imprinted thereon to which the bell end of the mated pipe will extend upon proper jointing of the two pipes.
- F. PVC fittings shall be provided with bell and/or spigot configurations with rubber gasket joints compatible with that of the pipe. Bend fittings with spigot ends shorter than the pipe recess bells will not be allowed. The shorter spigot end would not allow proper seating of the spigot in the mating bell and would permit undesired contact between the mating bell and the outside of the fitting bell.
- G. All pipe delivered to the job site shall be accompanied by independent testing laboratory reports certifying that the pipe and fittings conform to the above-mentioned specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Owner to apply such of the tests specified, as he may from time to time deem necessary.
- H. When pipe is stock piled with long-term of exposure to direct sunlight, that is unavoidable, Contractor shall cover the PVC pipe with an opaque material, while permitting adequate air circulation above and around the pipe as required to prevent excessive heat accumulation.
- I. All cutting of pipe shall be done with a machine suitable for cutting PVC pipe. Cut ends shall be beveled when recommended by the pipe manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Except as modified herein, installation of the PVC pipe shall be in accordance with ASTM D2321.

- B. Each pipe length shall be inspected before being laid to verify that it is not cracked. Pipe shall be laid to conform to the lines and grades indicated on the drawings or given by the Owner. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.
- C. Contractor must only use lubricant supplied by the pipe manufacturer, to apply on the rubber gasket, prior to adjoining pipes.
- D. The pipe shall be supported by compacted, crushed stone. Crushed stone shall be as specified under Section 02300, EARTHWORK.
- E. The pipe shall not be driven down to grade by striking it with a shovel handle, timber, rammer, or other unyielding object. When each pipe has been properly bedded, enough of the backfill material shall be placed and compacted between the pipe and the sides of the trench to hold the pipe in correct alignment.
- F. Before a joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that inverts are matched and conform to the required line and grade.
- G. For pipe placed on crushed stone, immediately after the joint is made, the jointing area shall be filled with suitable materials so placed and compacted that the ends of either pipe will not settle under backfill load.
- H. No pipe or fitting shall be permanently supported on saddles, blocking, or stones.
- I. Branches and fittings shall be laid by the Contractor as indicated on the drawings, and/or as directed by the Owner. Open ends of pipe and branches shall be closed with PVC caps secured in place with premolded gasket joints or as directed by the Owner.
- J. All pipe joints shall be made as nearly watertight as practicable. There shall be no visible leakage at the joints and there shall be no sand, silt, clay, or soil of any description entering the pipeline at the joints. Where there is evidence of water or soil entering the pipeline, connecting pipes, or structures, the defects shall be repaired to the satisfaction of the Owner.
- K. The Contractor shall build a tight bulkhead in the pipeline where new work enters an existing sewer. This bulkhead shall remain in place until its removal is authorized by the Owner.
- L. Care shall be taken to prevent earth, water, and other materials from entering the pipe, and when pipe-laying operations are suspended, the Contractor shall maintain a suitable stopper in the end of the pipe and also at openings for manholes.
- M. As soon as possible after the pipe and manholes are completed on any street, the Contractor shall flush out the new pipeline using a rubber ball ahead of the water, and none of the flushing water or debris shall be permitted to enter any existing sewer.

3.02 QUALITY ASSURANCE

A. LEAKAGE TESTING:

1. On completion of a section of sewer, including building connections installed to the property line, the Contractor shall install suitable bulkheads as required, dewater and test the sewer for leakage.
2. Unless otherwise approved, the section shall be tested using low pressure air test procedures. If circumstances permit, the Owner may allow testing by infiltration or exfiltration in lieu of air testing.
3. The air test procedures shall conform to the Uni-Bell Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe, UNI-B-6. The starting air pressure for the test shall be 4 psi. The minimum duration permitted for the prescribed low pressure air exfiltration pressure drop between two consecutive manholes shall not be less than provided in Table I or Table II of UNI-B-6. The two tables are reproduced on the following pages.
4. If either infiltration or exfiltration testing is permitted by the Owner, the test shall be conducted for at least 24 hours. The amount of infiltration or exfiltration shall not exceed 100 gallons per inch-diameter per mile of sewer per 24 hours.
5. The infiltration test measures leakage into a section of sewer and may be used only where the groundwater level is one foot or more above the crown of the section of sewer pipe at its upper end and at least one foot above the top of building connections and chimneys. For making the infiltration tests, underdrains, if used, shall be plugged and other groundwater drainage shall be stopped to permit the groundwater to return to its normal level insofar as practicable. Allowances shall be made for water, which may enter the sewer through pipe connections and inlets during the infiltration test.
6. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the exfiltration test may be used. The sewers shall be subjected to an internal pressure by plugging the pipe at the lower end and then filling the pipelines and manholes with clean water to a height of 2 feet above the highest point in the system to be tested, including main pipeline, service connections and chimneys. When slopes between manholes are steep, the Contractor shall insure that this test can be accomplished without danger of forcing stoppers from wye or tee branches.
7. The rate of exfiltration from the sewers shall be determined by measuring the amount of water required to maintain the water level at the elevation established at the beginning of the test.
8. The Contractor shall construct such weirs or other means of measurements as may be required, shall furnish water and shall do all necessary pumping to enable the test to be properly made.

8. The Contractor shall be responsible for the satisfactory watertightness of the entire section of sewer. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing leaks and retesting as the Owner may require without additional compensation. A plan of the method of repairing any leaks that are found shall be submitted to the Owner for review.

B. TELEVISED PIPE INSPECTION:

1. Contractor shall televised inspect the pipe upon completion, in accordance to Section 02441, TELEVISION INSPECTION OF NEW PIPELINES.

C. PIPE DEFLECTION MEASUREMENT:

1. In accordance with ASTM D3034, no less than 30 days after completion of the PVC sewer pipe installation, the Contractor shall test the pipeline for deflection using a "go/no-go" deflection mandrel having a minimum of nine evenly spaced arms or prongs. The "go/no-go" gauge shall be hand pulled through all sections of the pipeline by the Contractor. The Contractor shall submit drawings of the "go/no-go" gauge to the Owner for approval prior to testing. Complete dimensions of the gauge for each diameter of pipe to be tested shall be in accordance with ASTM D3034.
2. Any section of pipe found to exceed 7.5 percent deflection shall be deemed a failed pipe and shall be excavated and replaced by the Contractor at his own expense.

TABLE 1

SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Pipe Diameter (in)	Minimum Time (min:sec)	Length for Min. Time (ft)	Length for Longer Length (sec)	Specification time for length (L) shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.52 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	31:09	35:36
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

TABLE 2

SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Pipe Diameter (in)	Minimum Time (min:sec)	Length for Min. Time (ft)	Length for Longer Length (sec)	Specification time for length (L) shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	26:26	25:38	28:51	
21	9:55	114	5.235 L	9:55	13	17:27	21:49	26:11	30:32	34:54	39:16	
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54	
30	14:10	80	10:683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	
33	15:35	72	12:926 L	21:33	32:19	43:56	53:25	64:28	75:24	86:10	96:57	
36	17:00	66	15:384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	

END OF SECTION

SECTION 02087

POLYVINYL CHLORIDE PRESSURE PIPE
AND FITTINGS (SCHEDULE 80)

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers polyvinyl chloride (PVC) Schedule 80 pressure pipe and fittings as shown on the drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02252, SUPPORT OF EXCAVATION
- C. Section 02631, PRECAST MANHOLES
- D. Section 02518, TRACER TAPE

1.03 QUALITY ASSURANCE:

- A. All pipe and fittings shall be inspected and tested at the factory as required by the standard specifications to which the material is manufactured. The Contractor shall furnish in duplicate to the Owner sworn certificates of such tests.
- B. In addition, the Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

- A. The following standards form a part of this work as referenced:

American Society for Testing and Materials (ASTM)

ASTM	D1784	Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
ASTM	D1785	Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM	D2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM	D2464	Specification for Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

ASTM	D2467	Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
ASTM	D2564	Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
ASTM	D2855	Recommended Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Plastic Pipe and Fittings

American Water Works Association (AWWA)

AWWA	C651	Disinfecting Water Mains
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PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS:

- A. Unless specifically designated otherwise, PVC pipe and fittings shall be Schedule 80 with solvent weld joints as specified herein.
- B. PVC Schedule 80 pipe shall conform to ASTM D1785.
- C. PVC Schedule 80 socket fittings shall conform to ASTM D2467 and PVC Schedule 80 threaded fittings to ASTM D2464.
- D. Rigid PVC used in the extrusion of the pipe and fittings shall be Type 1, Grade 1 compound as stated in ASTM D1784 with a cell classification of 12454B.
- E. Both pipe and fittings shall be the product of one manufacturer.
- F. Solvent cements shall conform to ASTM D2564.

PART 3 - EXECUTION

3.01 HANDLING AND CUTTING PIPE:

- A. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring surfaces, and abrasion of the pipe coating.
- B. Any fittings showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work site.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe

used will be perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.

- D. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting PVC pipes.

3.02 INSTALLING PIPE AND FITTINGS:

- A. Unless specifically directed otherwise, all piping shall have not less than 5-feet of cover.
- B. Pipes and fittings shall be subjected to a careful inspection just before being laid or installed.
- C. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
- D. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the complete work.
- E. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required. Care shall be taken to ensure good alignment both horizontally and vertically.
- F. In buried pipelines, each pipe shall have firm bearing along its entire length.
- G. The deflection of alignment at a joint shall not exceed the appropriate permissible deflection as recommended by the manufacturer.
- H. Pipe shall be installed underground in a manner that will ensure that external loads will not subsequently cause a decrease of more than 5 percent in the vertical cross-section dimension (deflection). When installing the pipes, they shall be rotated 180° in order that the upper quadrant of the pipe, which was exposed to direct sunlight, will not be backfilled upon.
- I. Except as specifically designated otherwise, installation shall be in accordance with ASTM D2321.
- J. At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary water-tight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

3.03 JOINTING OF PIPE:

- A. Jointing of pipe shall conform to ASTM D2855.

- B. Except where threaded fittings are required to adapt to metallic pipe, all fittings and pipe shall be solvent welded.
- C. Cementing operations shall not be attempted where the temperature of the pipe, fittings or ambient exceed 100°F. Cementing operations should be done out of direct sunlight.
- D. The following procedures shall be followed:
1. Inspect fitting sockets and pipe ends to make sure there is no chipping, gouging or scratching.
 2. Clean pipe ends and fitting sockets carefully, using clean cotton wiping rags.
 3. Try fitting sockets on pipe to make sure the pipe will penetrate at least one third of socket depth.
 4. Cut pipe to length required. Pipe must be cut at right angle to linear section, deburred on the I.D. and deburred and slightly beveled on the O.D.
 5. Apply a coat of primer to fitting socket using a scrubbing motion to ensure penetration. Repeated applications may be necessary.
 6. Apply a liberal coating of primer to the end of the pipe, using a scrubbing motion to ensure penetration. Extend this coating slightly beyond fitting socket depth. Be sure the entire surface is well softened.
 7. Apply a second coat of primer to fitting socket and without delay apply a coat of cement to pipe end using a scrubbing motion to achieve an even coating.
 8. Without delay, apply a uniform, light coating of cement to fitting socket making sure that cement does not penetrate fitting portion of socket.
 9. Without delay, apply a second coating of cement to pipe end and immediately insert pipe in fitting. Turn the pipe or fitting 1/4 turn during assembly to distribute the cement evenly, but not after the pipe is bottomed in the socket. Remove all excess cement from around pipe and fitting with clean dry rag. Assembly should be completed within 20 seconds after the last application of cement. Do not hammer or pound fittings or pipe during the assembly process. Socket and pipe surfaces must be soft and wet at time of assembly.
 10. Hold socket and pipe in fully bottomed position until cement "sets up." Hold tightly for 30 seconds on sizes up to 4 inches.

11. Assemblies should not be handled excessively until set-up. Allow the following times:

30 minutes	at 60° to 100°F
1 hour	at 40° to 60°F
2 hours	at 20° to 40°F
4 hours	at 0° to 20°F

3.04 PRESSURE AND LEAKAGE TESTS:

- A. Prior to the pressure and leakage tests, the piping shall be thoroughly cleaned of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to the pipe.
- B. Except as otherwise directed, all pipelines shall be given combined pressure and leakage tests in sections of approved length. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner reserves the right to provide separate gages.
- C. Subject to Owner approval, the Contractor may schedule the time to make the tests when he desires.
- D. The section of pipe to be tested shall be filled with water of approved quality and all air shall be expelled from the pipe. The Contractor shall follow established procedures for filling the pipe and expelling trapped air to avoid exposing the piping system to water hammer. If blowoffs are not available at high points for releasing air, the Contractor shall make the necessary excavations and install the necessary taps. If directed, the Contractor shall plug said holes after completion of the test and do the necessary backfilling.
- E. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
- F. The pressure and leakage test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test corrected to the gage location) to the pressure rating of the pipe. If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed to pass the pressure test.
- G. Following or during the pressure test, the Contractor shall make a leakage test by metering the flow of water into the pipe, while maintaining a pressure of 150 pounds per square inch in the section being tested. If the average leakage during a two hour period exceeds 1 gallon per hour per 1,000 feet of pipe or 50 joints, the section shall be considered as having failed the leakage test.

- H. If the section fails to pass the pressure and leakage test, the Contractor shall locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.
- I. If in the judgement of the Owner, it is impracticable to follow the foregoing procedure exactly for any reason, modifications in the procedure shall be made as required and approved, but in any event the Contractor shall be responsible for the ultimate tightness of the line within the above leakage and pressure requirements.

END OF SECTION

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SECTION 02089

DUCTILE IRON GRAVITY AND FORCE MAIN PIPE
AND FITTINGS FOR SEWERS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing, handling, hauling, laying, jointing, and testing of ductile iron pipe used for gravity sewer and force main construction, including fittings and appurtenant work as indicated on the drawings and as specified.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02252, SUPPORT OF EXCAVATION
- C. Section 02532, VALVES AND APPURTENANCES
- D. Section 02631, PRECAST MANHOLES

1.03 QUALITY ASSURANCE

- A. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. The Contractor shall furnish in duplicate to the Owner sworn certificates of such tests.
- B. In addition, the Owner reserves the right to have any or all pipe, fittings and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

- A. The following standards form a part of these specifications as referenced:

American Water Works Association

AWWA C104 Cement-Mortar Lining for Ductile- Iron Pipe and Fittings for Water
Flexible Elastomeric Seals

AWWA C110 Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for
Water and Other Liquids

AWWA	C150	Thickness Design of Ductile-Iron Pipe
AWWA	C116	Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA	C151	Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids
AWWA	C153	Ductile-Iron Compact Fittings, 3 inches through 64 inches for Water Service.
AWWA	C600	Installation of Ductile-Iron Water Mains

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. The Contractor shall use push-on joint type ductile iron pipe unless otherwise indicated on the plans or specified herein.
- B. All ductile iron pipe shall be designed in accordance with AWWA C150 and shall be manufactured in accordance with AWWA C151.
- C. Unless otherwise indicated or specified, ductile iron pipe shall be Thickness Class 52.
- D. All pipe delivered to the job site shall be accompanied by independent testing laboratory reports certifying that the pipe and fittings conform to the above-mentioned specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Owner to apply such of the tests specified, as he may from time to time deem necessary.
- E. All cutting of pipe shall be done with a machine suitable for cutting DI pipe. Cut ends shall be beveled when recommended by the pipe manufacturer.

2.02 FITTINGS:

- A. Fittings shall conform to the requirements of AWWA C110 or C153 as appropriate and shall be of a pressure classification at least equal to that of the pipe with which they are used.
- B. The Contractor shall use ductile iron fittings. Cast-iron, Class 250 fittings may be substituted, upon approval of the Owner, for ductile iron fittings.
- C. Unless otherwise indicated, fittings shall have all bell mechanical joint ends.

2.03 GASKETS, GLANDS, NUTS AND BOLTS:

- A. Gaskets, glands, nuts, bolts and accessories shall conform to AWWA C111 or C153 as appropriate.

- B. Gaskets shall be of plain tipped rubber, suitable for exposure to the liquid within the pipe.
- C. Glands shall be ductile or cast iron.
- D. Bolts and nuts shall be high strength alloy.

2.04 LINING AND COATING:

- A. The inside of pipe and fittings shall have a coating of Protecto 401 Ceramic Epoxy Interior Coating in accordance with coating manufacturers recommendations and applied at a 40 mils nominal thickness to interior surfaces as provided by US Pipe Co.; or a fused calcium aluminate cement combined with a fused calcium aluminate aggregate (SewperCoat®). SewperCoat cement lining of the interior is to be .125" thick for pipe sizes 6"-12" and .1875" thick for pipe sizes 14"-24". This lining provided by Griffin Pipe Co. shall be sealed with the same normal coating applied to the exterior of the pipe; or a fusion bonded epoxy [FBE] primer at 5 mils thickness and a fusion bonded polyethylene [FRP] surface coating. This lining shall be Polybond Plus® as provided by American Cast Iron Pipe Co. or approved equal.
- B. The outside of pipe and fittings shall be coated with the standard asphaltic coating specified under the appropriate AWWA Standard Specification for pipe and fittings.
- C. Machined surfaces shall be cleaned and coated with a suitable rust preventative coating at the shop immediately after being machined.

2.05 FLEXIBLE COUPLINGS:

- A. All sleeve-type couplings and accessories shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.
- B. Couplings shall be cast or ductile iron and shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
- C. Couplings for buried pipe shall be Dresser 153; Smith-Blair Type 441 or 443; Romac Style 501; Ford Style FC1 or FC2; or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Each pipe length shall be inspected before being laid to verify that it is not cracked. Pipe shall be laid to conform to the lines and grades indicated on the drawings or given by the Owner. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

- B. The pipe shall be supported by compacted crushed stone. Crushed stone shall be as specified under Section 02300, EARTHWORK.
- C. The pipe shall not be driven down to grade by striking it with a shovel handle, timber, rammer, or other unyielding object. When each pipe has been properly bedded, enough of the backfill material shall be placed and compacted between the pipe and the sides of the trench to hold the pipe in correct alignment.
- D. Before a joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that inverts are matched and conform to the required line and grade.
- E. For pipe placed on crushed stone, immediately after the joint is made, the jointing area shall be filled with suitable materials so placed and compacted that the ends of either pipe will not settle under backfill load.
- F. No pipe or fitting shall be permanently supported on saddles, blocking, or stones.
- G. Branches and fittings shall be laid by the Contractor as indicated on the drawings, and/or as directed by the Owner. Open ends of pipe and branches shall be closed with DI caps secured in place with premolded gasket joints or as directed by the Owner.
- I. All pipe joints shall be made as nearly watertight as practicable. There shall be no visible leakage at the joints and there shall be no sand, silt, clay, or soil of any description entering the pipeline at the joints. Where there is evidence of water or soil entering the pipeline, connecting pipes, or structures, the defects shall be repaired to the satisfaction of the Owner.
- J. The Contractor shall build a tight bulkhead in the pipeline where new work enters an existing sewer. This bulkhead shall remain in place until its removal is authorized by the Owner.
- K. Care shall be taken to prevent earth, water, and other materials from entering the pipe, and when pipe-laying operations are suspended, the Contractor shall maintain a suitable stopper in the end of the pipe and at openings for manholes.
- L. As soon as possible after the pipe and manholes are completed on any street, the Contractor shall flush out the new pipeline using a rubber ball ahead of the water, and none of the flushing water or debris shall be permitted to enter any existing sewer.

3.02 PUSH ON JOINTS:

- A. Joining of push-on joint pipe shall conform to AWWA C600.
- B. If effective sealing of the joint is not attained, the joint shall be disassembled, thoroughly cleaned, a new gasket inserted and joint reassembled.

3.03 MECHANICAL JOINTS:

- A Assembling of fittings with mechanical joint ends shall conform to AWWA C600.
- B. If effective sealing of the joint is not attained at the maximum torque indicated in the above standard, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be overstressed to tighten a leaking joint.

3.04 QUALITY ASSURANCE

A. LEAKAGE TESTING FOR GRAVITY PIPE:

1. On completion of a section of sewer, including building connections installed to the property line, the Contractor shall install suitable bulkheads as required, dewater and test the sewer for leakage.
2. Unless otherwise approved, the section shall be tested using low-pressure air test procedures. If circumstances permit, the Owner may allow testing by infiltration or exfiltration in lieu of air testing.
3. The air test procedures shall conform to the Uni-Bell Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe, UNI-B-6. The starting air pressure for the test shall be 4 psi. The minimum duration permitted for the prescribed low pressure air exfiltration pressure drop between two consecutive manholes shall not be less than provided in Table I or Table II of UNI-B-6. The two tables are reproduced on the following pages.
4. If either infiltration or exfiltration testing is permitted by the Owner, the test shall be conducted for at least 24 hours. The amount of infiltration or exfiltration shall not exceed 100 gallons per inch-diameter per mile of sewer per 24 hours.
5. The infiltration test measures leakage into a section of sewer and may be used only where the groundwater level is one foot or more above the crown of the section of sewer pipe at its upper end and at least one foot above the top of building connections and chimneys. For making the infiltration tests, underdrains, if used, shall be plugged and other groundwater drainage shall be stopped to permit the groundwater to return to its normal level insofar as practicable. Allowances shall be made for water, which may enter the sewer through pipe connections and inlets during the infiltration test.
6. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the exfiltration test may be used. The sewers shall be subjected to an internal pressure by plugging the pipe at the lower end and then filling the pipelines and manholes with clean water to a height of 2 feet above the highest point in the system to be tested, including main pipeline, service connections and chimneys. When slopes between manholes are steep, the Contractor shall insure that this test can be accomplished without danger of forcing stoppers from wye or tee branches.

7. The rate of exfiltration from the sewers shall be determined by measuring the amount of water required to maintain the water level at the elevation established at the beginning of the test.
8. The Contractor shall construct such weirs or other means of measurements as may be required, shall furnish water and shall do all necessary pumping to enable the test to be properly made.
9. The Contractor shall be responsible for the satisfactory watertightness of the entire section of sewer. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing leaks and retesting as the Owner may require without additional compensation. A plan of the method of repairing any leaks that are found shall be submitted to the Owner for review.

TABLE 1

SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Pipe Diameter (in)	Minimum Time (min:sec)	Length for Min. Time (ft)	Length for Longer Length (sec)	Specification time for length (L) shown (min:sec)							
				<u>100 ft</u>	<u>150 ft</u>	<u>200 ft</u>	<u>250 ft</u>	<u>300 ft</u>	<u>350 ft</u>	<u>400 ft</u>	<u>450 ft</u>
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.52 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	31:09	35:36
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

4. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires.
5. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. The Contractor shall follow established procedures for filling the pipe and expelling trapped air to avoid exposing the piping system to water-hammer. If blowoffs are not available at high points for releasing air, the Contractor shall excavate as required and install the necessary taps. If the Contractor changes the grade of pipe installation, he will be responsible for locating the taps at the correct location in the system for testing. Taps shall be installed at the beginning and end of each run. After completion of the test, if so directed by the Owner, he shall remove corporations used for testing; plug the holes and backfill as necessary.
6. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
7. The pressure shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test corrected to the gage location) to a pressure in pounds per square inch numerically equal to the pressure rating of the pipe (**150 psi, unless otherwise noted**). If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed to pass the pressure test.
8. If the pressure test fails, the Contractor shall make a leakage test by metering the flow of water into the pipe while maintaining in the section being tested a pressure equal to the pressure rating of the pipe. If the average leakage during a two-hour period exceeds a rate of 11.6 gallons per inch of diameter per 24 hours per mile of pipeline, the section shall be considered as having failed the leakage test. For example, if 1,000 feet of 12-inch pipe is to be tested, the allowable leakage is 2.2 gallons over a 2-hour period, calculated as follows:

$$L = \frac{(11.6 \text{ gal}) \times (12") \times (2 \text{ hr.}) \times (1000')}{(1") \times (24 \text{ hr.}) \times (5280')} = 2.2 \text{ gal}$$

9. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

END OF SECTION

SECTION 02230

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall do all required clearing and grubbing herein specified in the area required for construction operations on the Owner's land or in the Owner's permanent or temporary easements and shall remove all debris resulting therefrom.
- B. Unless otherwise noted, all areas to be cleared shall also be grubbed.
- C. The Contractor shall not clear and grub outside of the area required for construction operations.

1.02 RELATED WORK:

Any trees and shrubs specifically designated by the Owner not to be cut, removed, destroyed, or trimmed shall be saved from harm and injury in accordance with Section 01570, ENVIRONMENTAL PROTECTION.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 RIGHT TO WOOD AND LOGS:

The Owner shall have the right to cut and remove logs and other wood of value in advance of the Contractor's operations. All remaining logs and other wood to be removed in the course of clearing shall become the property of the Contractor.

3.02 CLEARING:

- A. Unless otherwise indicated, the Contractor shall cut or otherwise remove all trees, saplings, brush and vines, windfalls, logs and trees lying on the ground, dead trees and stubs more than 1-foot high above the ground surface (but not their stumps), trees which have been partially uprooted by natural or other causes (including their stumps), and other vegetable matter such as shags, sawdust, bark, refuse, and similar materials.
- B. The Contractor shall not remove mature trees (4 inches or greater DBH) in the Owner's temporary easements.

- C. Except where clearing is done by uprooting with machinery or where stumps are left longer to facilitate subsequent grubbing operations, trees, stumps, and stubs to be cleared shall be cut as close to the ground as practicable but not more than 6-inches above the ground surface in the case of small trees, and 12-inches in the case of large trees. Saplings, brush and vines shall be cut close to the ground.

3.03 GRUBBING:

- A. Unless otherwise indicated, the Contractor shall completely remove all stumps and roots to a depth of 18-inches, or if the Contractor elects to grind the stumps, they shall be ground to a minimum depth of 6-inches.
- B. Any depression remaining from the removal of a stump and not filled in by backfilling shall be filled with gravel borrow and/or loam, whichever is appropriate to the proposed ground surface.

3.04 DISPOSAL:

All material collected in the course of the clearing and grubbing which is not to remain shall be disposed of in a satisfactory manner away from the site or as otherwise approved. Such disposal shall be carried on as promptly as possible and shall not be left until the final clean-up period.

END OF SECTION

SECTION 02240

DEWATERING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing of equipment and instrumentation for control of the system.

1.02 RELATED WORK:

- A. Section 01570, ENVIRONMENTAL PROTECTION
- B. Section 02300, EARTHWORK
- C. Section 02252, SUPPORT OF EXCAVATION

1.03 SYSTEM DESCRIPTION:

- A. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture or heaving of the bottom of any excavation; and disposing of pumped water.
- B. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps.

1.04 QUALITY ASSURANCE:

- A. The Contractor is responsible for the adequacy of the dewatering systems.
- B. The dewatering systems shall be capable of effectively reducing the hydrostatic pressure and lowering the groundwater levels to a minimum of 2 feet below excavation bottom, unless otherwise directed by the Engineer, so that all excavation bottoms are firm and dry.
- C. The dewatering system shall be capable of maintaining a dry and stable subgrade until the structures, pipes and appurtenances to be built therein have been completed to the extent that they will not be floated or otherwise damaged.

- D. The dewatering system and excavation support (see Section 02252, SUPPORT OF EXCAVATION) shall be designed so that lowering of the groundwater level outside the excavation does not adversely affect adjacent structures, utilities or wells.

1.05 SUBMITTALS

- A. Contractor shall submit six copies a plan indicating how they intend to control the discharge from any dewatering operations on the project, whether it is discharge of groundwater from excavations or Stormwater runoff during the life of the project.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 DEWATERING OPERATIONS:

- A. All water pumped or drained from the work shall be disposed of in a manner which will not result in undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work. All disposal of pumped water shall conform to the provisions of Section 01570 ENVIRONMENTAL PROTECTION.
- B. Dewatering facilities shall be located where they will not interfere with utilities and construction work to be done by others.
- C. Dewatering procedures to be used shall be as described below:
 - 1. Crushed stone shall encapsulate the suction end of the pump to aid in minimizing the amount of silt discharged.
 - 2. For dewatering operations with relatively minor flows, pump discharges shall be directed into haybale sedimentation traps lined with filter fabric. Water is to be filtered through the haybales and filter fabric prior to being allowed to seep out into its natural watercourse.
 - 3. For dewatering operations with larger flows, pump discharges shall be into a steel dewatering basin. Steel baffle plates shall in used to slow water velocities to increase the contact time and allow adequate settlement of sediment prior to discharge into waterways.
 - 4. Where indicated on the contract drawings or in conditions of excess silt suspended in the discharge water, silt control bags are to utilize in catchbasins.
- D. The Contractor shall be responsible for repair of any damage caused by his dewatering operations, at no cost to the Owner.

END OF SECTION

SECTION 02252

SUPPORT OF EXCAVATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers wood sheeting and bracing for support of excavations. The requirements of this section shall also apply, as appropriate, to other methods of excavation support and underpinning which the Contractor elects to use to complete the work.
- B. The Contractor shall furnish and place timber sheeting of the kinds and dimensions required, complying with these specifications, ordered by the Engineer.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK.
- B. Section 02240, DEWATERING.

1.03 QUALITY ASSURANCE:

- A. This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (454 CMR 10.0 et seq.) Contractors shall be familiar with the requirements of these regulations.
- B. The Contractor is responsible for the adequacy of the excavation support system and shall retain the services of a Professional Engineer registered in the state where the project is located to design the required excavation support systems. The Contractor's Professional Engineer shall practice in a discipline applicable to excavation work, shall have experience in the design of excavation support systems and shall design in conformance with OSHA requirements. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the excavation support system is installed and functions in accordance with his design. Criteria listed herein defining the responsibilities of the Contractor's Professional Engineer are minimum requirements.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Timber sheeting shall be sound spruce, pine, or hemlock, planed on one side and either tongue and grooved or splined. Timber sheeting shall not be less than nominal 2 inches thick.

- B. Timber and steel used for bracing shall be of such size and strength as required in the excavation support design. Timber or steel used for bracing shall be new or undamaged used material which does not contain splices, cutouts, patches, or other alterations which would impair its integrity or strength.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Work shall not be started until all materials and equipment necessary for their construction are either on the site of the work or satisfactorily available for immediate use as required.
- B. The sheeting shall be securely and satisfactorily braced to withstand all pressures to which it may be subjected and be sufficiently tight to minimize lowering of the groundwater level outside the excavation, as required in Section 02240, DEWATERING.
- C. The sheeting shall be driven by approved means to the design elevation. No sheeting may be left so as to create a possible hazard to safety of the public or a hindrance to traffic of any kind.
- D. If boulders or very dense soils are encountered, making it impractical to drive a section to the desired depth, the section shall, as directed, be cut off.
- E. The sheeting shall be left in place where indicated on the drawings or ordered by the Engineer in writing. At all other locations, the sheeting must be removed and disposed off site properly. Steel or wood sheeting permanently left in place shall be cut off at a depth of not less than two feet below finish grade unless otherwise directed.
- F. All cut-off will become the property of the Contractor and shall be removed by him from the site.
- G. Responsibility for the satisfactory construction and maintenance of the excavation support system, complete in place, shall rest with the Contractor. Any work done, including incidental construction, which is not acceptable for the intended purpose shall be either repaired or removed and reconstructed by the Contractor at his expense.
- H. The Contractor shall be solely responsible for repairing all damage associated with installation, performance, and removal of the excavation support system.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall make excavations of normal depth in earth for trenches and structures, shall backfill and compact such excavations to the extent necessary, shall furnish the necessary material and construct embankments and fills, and shall make miscellaneous earth excavations and do miscellaneous grading.

1.02 RELATED WORK:

- A. Section 01570, ENVIRONMENTAL PROTECTION
- B. Section 02230, CLEARING AND GRUBBING
- C. Section 02240, DEWATERING
- D. Section 02324, ROCK EXCAVATION AND DISPOSAL
- E. Section 02252, SUPPORT OF EXCAVATION
- F. Section 02745, PAVING
- G. Section 02920, LOAMING AND SEEDING

1.03 REFERENCES:

American Society for Testing and Materials (ASTM)

- | | | |
|------|-------|--|
| ASTM | C131 | Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine. |
| ASTM | C136 | Method for Sieve Analysis of Fine and Coarse Aggregates. |
| ASTM | C330 | Specification for Lightweight Aggregate for Structural Concrete. |
| ASTM | D1556 | Test Method for Density of Soil in Place by the Sand Cone Method. |
| ASTM | D1557 | Test Methods for Moisture-density Relations of Soils and Soil Aggregate Mixtures Using Ten-pound (10 Lb.) Hammer and Eighteen-inch (18") Drop. |

ASTM D2922 Test Methods for Density of Soil and Soil-aggregate in Place by Nuclear Methods (Shallow Depth).

Commonwealth of Massachusetts Highway Department Standard Specification for Highways and Bridges.

1.04 PROTECTION OF EXISTING PROPERTY:

- A. The work shall be executed in such manner as to prevent any damage to facilities at the site and adjacent property and existing improvements, such as but not limited to streets, curbs, paving, service utility lines, structures, monuments, bench marks, observation wells, and other public or private property. Protect existing improvements from damage caused by settlement, lateral movements, undermining, washout and other hazards created by earthwork operations.
- B. In case of any damage or injury caused in the performance of the work, the Contractor shall, at its own expense, make good such damage or injury to the satisfaction of, and without cost to, the Owner. Existing roads, sidewalks, and curbs damaged during the project work shall be repaired or replaced to at least the condition that existed at the start of operations. The Contractor shall replace, at his own cost, existing benchmarks, observation wells, monuments, and other reference points which are disturbed or destroyed.
- C. Buried drainage structures and pipes, observation wells and piezometers, including those which project less than eighteen inches (18") above grade, which are subject to damage from construction equipment shall be clearly marked to indicate the hazard. Markers shall indicate limits of danger areas, by means which will be clearly visible to operators of trucks and other construction equipment, and shall be maintained at all times until completion of project.

1.05 DRAINAGE:

- A. The Contractor shall provide, at its own expense, adequate drainage facilities to complete all work items in an acceptable manner. Drainage shall be done in a manner so that runoff will not adversely affect construction procedures nor cause excessive disturbance of underlying natural ground or abutting properties.

1.06 FROST PROTECTION AND SNOW REMOVAL:

- A. The Contractor shall, at its own expense, keep earthwork operations clear and free of accumulations of snow as required to carry out the work.
- B. The Contractor shall protect the subgrade beneath new structures and pipes from frost penetration when freezing temperatures are expected.

PART 2 - PRODUCTS

2.01 MATERIAL:

A. GRAVEL BORROW:

Gravel Borrow shall satisfy the requirements listed in MHD Specification Section M1.03.0, Type b.

B. CRUSHED STONE:

Crushed stone shall satisfy the requirements listed in MHD Specification Section M2.01.

C. SAND BORROW:

Sand Borrow shall satisfy the requirements listed in MHD Specification Section M1.04.0.

D. PEASTONE:

Peastone shall be smooth, hard, naturally occurring, rounded stone meeting the following gradation requirements:

Passing 5/8 inch square sieve opening	-	100%
Passing No. 8 sieve opening	-	0%

E. BACKFILL MATERIALS:

1. Class B Backfill:

Class B backfill shall be granular, well graded friable soil; free of rubbish, ice, snow, tree stumps, roots, clay and organic matter; with 30 percent or less passing the No. 200 sieve; no stone greater than two-third (2/3) loose lift thickness, or six inches, whichever is smaller.

2. Select Backfill:

Select backfill shall be granular, well graded friable soil, free of rubbish, ice, snow, tree stumps, roots, clay and organic matter, and other deleterious or organic material; graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
3"	100
No. 10	30-95
No. 40	10-70
No. 200	0-10

F. STATE HIGHWAY TRENCH BACKFILL:

When required by Permit, Controlled Density Fill (CDF) shall be used to backfill trenches. The CDF shall satisfy the requirements listed in MHD Specification Section M4.08.0.

G. SPECIAL PIPE BEDDING MATERIAL

1. The special pipe bedding material shall consist of a filter cloth installed on the trench bottom before backfilling with crushed stone as specified and as shown on the contract drawings.
2. The filter cloth shall be composed of needle punch, stapled fibers thermally bonded together to form a sheet.
3. The filter cloths shall possess the following minimum properties:

Grab strength:	120 lbs	ASTM D 4632.
Elongation:	50%	ASTM D 4632
Burst Strength:	240 psi	ASTM D 3786
Puncture Strength:	65 lbs.	ASTM D 4833
Trapezoid Tear:	40 lbs.	ASTM D 4533
Equivalent opening size:	No. 70 sieve	ASTM D 4751
Permittivity (sec^{-1})	1.8	ASTM D 4491
Flow Rate ($\text{gal}/\text{min}/\text{ft}^2$)	135	ASTM D-4491

4. The filter cloth shall be Mirafi 140N by Mirafi, Inc. Charlotte, NC; Foss-65 by Foss Manufacturing Co., Haverhill, MA; Supac 4NP, Phillips Fibers Corp., Greenville, SC or approved equal.

PART 3 - EXECUTION

3.01 DISTURBANCE OF EXCAVATED AND FILLED AREAS DURING CONSTRUCTION:

- A. Contractor shall take the necessary steps to avoid disturbance of subgrade during excavation and filling operations, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials, dewatering and other acceptable control measures.
- B. All excavated or filled areas disturbed during construction, all loose or saturated soil, and other areas that will not meet compaction requirements as specified herein shall be removed and replaced with a minimum 12-inch layer of compacted crushed stone wrapped all around in non-woven filter fabric. Costs of removal and replacement shall be borne by the Contractor.

- C. The Contractor shall place a minimum of 12-inch layer of special bedding materials and crushed stone wrapped in filter fabric over the natural underlying soil to stabilize areas which may become disturbed as a result of rain, surface water runoff or groundwater seepage pressures, all at no additional cost to the Owner. The Contractor also has the option of drying materials in-place and compacting to specified densities.

3.02 EXCAVATION:

A. GENERAL:

1. The Contractor shall perform all work of any nature and description required to accomplish the work as shown on the Drawings and as specified.
2. Excavations, unless otherwise required by the Owner, shall be carried only to the depths and limits shown on the Drawings. If unauthorized excavation is carried out below required subgrade and/or beyond minimum lateral limits shown on Drawings, it shall be backfilled with gravel borrow and compacted at the Contractor's expense as specified below, except as otherwise indicated. Excavations shall be kept in dry and good conditions at all times, and all voids shall be filled to the satisfaction of the Owner.
3. In all excavation areas, the Contractor shall strip the surficial topsoil layer and underlying subsoil layer separate from underlying soils. In paved areas, the Contractor shall first cut pavement as specified in paragraph 3.02 B.1 of this specification, strip pavement and pavement subbase separately from underlying soils. All excavated materials shall be stockpiled separately from each other within the limits of work.
4. The Contractor shall follow a construction procedure, which permits visual identification of stable natural ground. Where groundwater is encountered, the size of the open excavation shall be limited to that which can be handled by the Contractor's chosen method of dewatering and which will allow visual observation of the bottom and backfill in the dry.
5. The Contractor shall excavate unsuitable materials to stable natural ground where encountered at proposed excavation subgrade, as directed by the Owner. Unsuitable material includes topsoil, loam, peat, other organic materials, snow, ice, and trash. Unless specified elsewhere or otherwise directed by the Owner, areas where unsuitable materials have been excavated to stable ground shall be backfilled with compacted special bedding materials or crushed stone wrapped all around in non-woven filter fabric.

B. TRENCHES:

1. Prior to excavation, trenches in pavement shall have the traveled way surface cut in a straight line by a concrete saw or equivalent method, to the full depth of pavement. Excavation shall only be between these cuts. Excavation support shall be provided as required to avoid undermining of pavement. Cutting operations shall not be done by ripping equipment.
2. The Contractor shall satisfy all dewatering requirements specified in Section 02240 DEWATERING, before performing trench excavations.
3. Trenches shall be excavated to such depths as will permit the pipe to be laid at the elevations, slopes, and depths of cover indicated on the Drawings. Trench widths shall be as shown on the Drawings or as specified.
4. Where pipe is to be laid in bedding material, the trench may be excavated by machinery to, or just below, the designated subgrade provided that the material remaining in the bottom of the trench is not disturbed.
5. If pipe is to be laid in embankments or other recently filled areas, the fill material shall first be placed to a height of at least 12-inches above the top of the pipe before excavation.
6. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed.
7. If, in the opinion of the Owner, the subgrade, during trench excavation, has been disturbed as a result of rain, surface water runoff or groundwater seepage pressures, the Contractor shall remove such disturbed subgrade to a minimum of 12 inches and replace with crushed stone wrapped in filter fabric. Cost of removal and replacement shall be borne by the Contractor.

C. BUILDING AND FOUNDATION EXCAVATION FOR PUMP STATIONS OR GENERATOR HOUSING:

1. Excavations shall not be wider than required to set, brace, and remove forms for concrete, or perform other necessary work.
2. After the excavation has been made, and before forms are set for footings, mats, slabs, or other structures, and before reinforcing is placed, all loose or disturbed material shall be removed from the subgrade. The bearing surface shall then be compacted to meet the requirements of this specification.
3. If, in the opinion of the Owner, the existing material at subgrade elevation is unsuitable for structural support, the Contractor shall excavate and dispose of the unsuitable material to the required width and depth as directed by the Owner. If, in

the opinion of the Owner, filter fabric is required; the Contractor shall place filter fabric, approved by the Owner, as per manufacturer's recommendations. Crushed stone shall then be placed in lifts and compacted to required densities. Backfill shall be placed to the bottom of the proposed excavation.

D. EXCAVATION NEAR EXISTING STRUCTURES:

1. Attention is directed to the fact that there are pipes, manholes, drains, and other utilities in certain locations. An attempt has been made to locate all utilities on the drawings, but the completeness or accuracy of the given information is not guaranteed.
2. As the excavation approaches pipes, conduits, or other underground structures, digging by machinery shall be discontinued and excavation shall be done by means of hand tools, as required. Such manual excavation, when incidental to normal excavation, shall be included in the work to be done under items involving normal excavation.
3. Where determination of the exact location of a pipe or other underground structure is necessary for properly performing the work, the Owner can direct the Contractor to excavate test pits to determine the locations, prior to the installation work.

3.03 BACKFILL PLACEMENT AND COMPACTION:

A. GENERAL:

1. Prior to backfilling, the Contractor shall compact the exposed natural subgrade to the densities as specified herein.
2. After approval of subgrade by the Owner, the Contractor shall backfill areas to required contours and elevations with specified materials.
3. The Contractor shall place and compact materials to the specified density in continuous horizontal layers. The degree of compaction shall be based on maximum dry density as determined by ASTM Test D1557, Method C. The minimum degree of compaction for fill placed shall be as follows:

<u>Location</u>	<u>Percent of Maximum Density</u>
Below pipe centerline	95
Above pipe centerline	92
Below pavement (upper 3 ft.)	95
Embankments	95
Below pipe in embankments	95
Adjacent to structures	92

4. The Owner reserves the right to test backfill for conformance to the specifications and Contractor shall assist as required to obtain the information. Compaction testing will be performed by an Engineer or by an inspection laboratory designated by the Owner, engaged and paid for by the Contractor. If test results indicate work does not conform to specification requirements, the Contractor shall remove or correct the defective Work by recompacting where appropriate or replacing as necessary and approved by the Owner, to bring the work into compliance, at no additional cost to the Owner. All backfilled materials under structures and buildings shall be field tested for compliance with the requirements of this specification.
5. Where horizontal layers meet a rising slope, the Contractor shall key each layer by benching into the slope.
6. If the material removed from the excavation is suitable for backfill with the exception that it contains stones larger than permitted, the Contractor has the option to remove the oversized stones and use the material for backfill or to provide replacement backfill at no additional cost to the Owner.
7. The Contractor shall remove loam and topsoil, loose vegetation, stumps, large roots, etc., from areas upon which embankments will be built or areas where material will be placed for grading. The subgrade shall be shaped as indicated on the Drawings and shall be prepared by forking, furrowing, or plowing so that the first layer of the fill material placed on the subgrade will be well bonded to the subgrade.

B. TRENCHES:

1. Bedding as detailed and specified shall be furnished and installed beneath the pipeline prior to placement of the pipeline. A minimum bedding thickness shall be maintained between the pipe and undisturbed material, as shown on the Drawings.
2. As soon as practicable after pipes have been laid, backfilling shall be started.
3. Unless otherwise indicated on the Drawings, select backfill shall be placed by hand shovel in 6-inch thick lifts up to a minimum level of 12-inches above the top of pipe. This area of backfill is considered the zone around the pipe and shall be thoroughly compacted before the remainder of the trench is backfilled. Compaction of each lift in the zone around the pipe shall be done by use of power-driven tampers weighing at least 20 pounds or by vibratory compactors. Care shall be taken that material close to the bank, as well as in all other portions of the trench, is thoroughly compacted to densities required.
4. Class B backfill shall be placed from the top of the select backfill to the specified material at grade (loam, pavement subbase, etc.). Fill compaction shall meet the density requirements of this specification.

5. Water Jetting:

- a. Water jetting may be used when the backfill material contains less than 10 percent passing the number 200 sieve, but shall be used only if approved by the Owner.
 - b. Contractor shall submit a detailed plan describing the procedures he intends to use for water jetting to the Owner for approval prior to any water jetting taking place.
 - c. Compaction of backfill placed by water jetting shall conform to the requirements of this specification.
 - d. If the Contractor chooses to use water jetting as a compaction method, Contractor would be required a one-year warranty after final completion if any settlement occurs within the limit of excavation. If any repairs are needed, Contractor shall notify the Owner with a plan prior to repair.
6. If the materials above the trench bottom are unsuitable for backfill, the Contractor shall furnish and place backfill materials meeting the requirements for trench backfill, as shown on the drawings or specified herein.
 7. Should the Owner order crushed stone for utility supports or for other purposes, the Contractor shall furnish and install the crushed stone as directed.
 8. In shoulders of streets and road, the top 12-inch layer of trench backfill shall consist of processed gravel for sub-base, satisfying the requirements listed in MHD standard specification M1.03.1.

C. BACKFILLING UNDER BUILDINGS AND FOUNDATIONS:

Material to be used as structural fill under structures shall be special bedding material or gravel borrow, as shown on the Drawings or as directed by the Owner. Where gravel borrow fill is required to support proposed footings, walls, slabs, and other structures, the material shall be placed in a manner accepted by the Owner. Compaction of each lift shall meet the density requirements of this specification.

D. BACKFILLING ADJACENT TO STRUCTURES:

1. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads to which they will be subjected. Excavated material approved by the Owner may be used in backfilling around structures. Backfill material shall be thoroughly compacted to meet the requirements of this specification.

2. Contractor shall use extra care when compacting adjacent to pipes and drainage structures. Backfill and compaction shall proceed along sides of drainage structures so that the difference in top of fill level on any side of the structure shall not exceed two feet (2') at any stage of construction.
3. Where backfill is to be placed on only one side of a structural wall, only hand-operated roller or plate compactors shall be used within a lateral distance of five feet (5') of the wall for walls less than fifteen feet (15') high and within ten feet (10') of the wall for walls more than fifteen feet (15') high.

3.04 DISPOSAL OF SURPLUS MATERIALS:

- A. No excavated material shall be removed from the site of the work or disposed of by the Contractor unless approved by the Owner.
- B. Surplus excavated materials, which are acceptable to the Owner, shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill. Upon written approval of the Owner, surplus excavated materials shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes as indicated by the Owner, within its jurisdictional limits; all at no additional cost to the Owner.
- C. Surplus excavated material not needed as specified above shall be hauled away and disposed of by the Contractor at no additional cost to the Owner, at appropriate locations, and in accordance with arrangements made by him. Disposal of all rubble shall be in accordance with all applicable local, state and federal regulations.

END OF SECTION

SECTION 02324

ROCK EXCAVATION AND DISPOSAL

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall excavate rock, if encountered, to the lines and grades as directed, shall dispose of the excavated material, and shall furnish the required material as specified in Section 02300 EARTHWORK for backfill in place of the excavated rock.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02252, SUPPORT OF EXCAVATION
- C. Section 03302, FIELD CONCRETE

1.03 DEFINITIONS:

- A. The word "rock," wherever used as the name of the excavated material or material to be excavated, shall mean only boulders and pieces of concrete or masonry exceeding one cubic yard in volume, or solid ledge rock which, in the opinion of the Owner, requires for its removal, drilling and blasting, wedging, sledging, barring, or breaking up with a power-operated tool. No soft or disintegrated rock which can be removed by normal earth excavation methods, no loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere, and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed as "rock."
- B. The word "earth," wherever used as the name of an excavated material, or material to be excavated shall mean all kinds of material other than rock as above defined.

1.04 QUALITY ASSURANCE:

- A. The Contractor shall conform to all municipal ordinances and state and federal laws relating to the transportation, storage, handling, and use of explosives. In the event that any of the above mentioned laws, ordinances, or regulations require a licensed blaster to perform or supervise the work of blasting, said licensed blaster shall, at all times, have his license on the work site and shall permit examination thereof by the Owner or other officials having jurisdiction.
- B. The Contractor shall procure all permits required for blasting.

1.05 SUBMITTALS:

- A. At least two weeks before beginning blasting operations, the Contractor shall submit to the Owner for record the following data:
 - 1. Name of Contractor or Subcontractor responsible for blasting and monitoring operations and license number.
 - 2. Name, affiliation, and license number of the person or persons who will be directly responsible for designing each blast, supervising the loading of the shot, and firing it.
- B. Copies of all permits required for blasting.
- C. Results of pre-blast survey.
- D. When blasting is in progress, daily reports on blasting operations and blast monitoring results.

1.06 DELIVERY/STORAGE AND HANDLING:

Delivery, storage and handling of explosives shall conform to all federal, state and local regulations and permits.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 PREPARATION/PRE-BLAST SURVEY

If required, the pre-blast survey shall be conducted in accordance with state regulations and/or local permit requirements.

3.02 EXCAVATION:

- A. The Contractor shall excavate rock to the lines and grades indicated on the drawings or as directed by the Owner. The excavated rock shall be removed and disposed of by the Contractor as specified for surplus excavated materials under Section 02300, EARTHWORK.
- B. Work damaged by blasting shall be repaired or replaced at the Contractor's expense.
- C. If rock is excavated beyond the limits of payment indicated on the drawings, specified, or authorized in writing by the Owner, the excess excavation, whether resulting from overbreakage or other causes, shall be backfilled, by and at the expense of the Contractor, as specified below:

1. In pipe trenches, excess excavation shall be filled with the required material and compacted in the same manner as specified for the material in the zone around the pipe under Section 02300 EARTHWORK.
 2. In excavations for structures, excess excavation in the rock beneath foundations shall be filled with concrete which shall have a minimum 28-day compressive strength of 3000 psi. Other excess excavation shall be filled with Class B backfill compacted to a minimum of 92 percent density (ASTM D1557 Method C) as specified under Section 02300, EARTHWORK.
 3. If the rock below normal depth is shattered due to drilling or blasting operations of the Contractor, and the Owner considers such shattered rock to be unfit for foundations, the shattered rock shall be removed and the excavation shall be backfilled with concrete as required, except that in pipe trenches crushed stone may be used for backfill, if approved. All such removal and backfilling shall be done by and at the expense of the Contractor.
- D. When directed by the Owner, the Contractor shall remove all dirt and loose rock from designated areas and shall clean the surface of the rock thoroughly to determine whether seams or other defects exist.
- E. When concrete is to be placed on rock, the rock shall be free of all vegetation, dirt, sand, clay, boulders, scale, excessively cracked rock, loose fragments, water, ice, snow, and other objectionable substances.

3.03 VIBRATION AND AIR BLAST MONITORING:

- A. The Contractor shall measure air blast and vibration levels of blasting operations to assure compliance with all applicable regulations and local permits.
- B. Records of each day's air blast and vibration measurements shall be submitted to the Owner in writing no later than the start of the next day's work. Records shall include, as a minimum:
- Identification of instrument
 - Name of observer
 - Name of interpreter
 - Distance and direction of recording station from the area of detonation
 - Date and exact time of reading
 - Type of ground at recording station

- Peak particle velocity for all components as well as resultant for all frequencies of vibrations
- Duration of motion with a velocity in excess of one thousandth of an inch per second
- A copy of the photographic record of seismograph readings
- Peak air blast level.

3.04 BLASTING RECORDS:

The Contractor shall prepare and submit to the Owner daily blast reports, including logs of each blast. Reports shall be submitted to the Owner no later than the start of the next day's work. However, during each day of blasting, the Contractor shall review and shall provide access for the Owner to review the data from that day's blasting. Reports after each blast shall include at least the following information for each blast:

- Date, time, and location of blast
- Permit number and expiration date
- Amount and type of explosives used by weight and number of cartridges
- Total number of delays used and number of holes used for each delay
- On a diagram of the blast pattern, indicate total number and depth of holes, maximum charge per delay, maximum charge per hole, and corresponding delay number
- An evaluation of the blast indicating areas of significant overbreak, unusual results, and any recommended adjustments for the next blast.

3.05 POST BLASTING INSPECTIONS:

The Contractor shall examine any properties, structures, and conditions where complaints of damage have been received or damage claims have been filed. Advance notice shall be given to all interested parties so that the parties may be present during the final examination. Records of the final examination shall be signed and distributed to the owner of the property, the head of the local fire department, and the Owner.

END OF SECTION

SECTION 02347

BENTONITE DAMS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers bentonite dams, complete, including bentonite, sand, and equipment necessary to install the clay dams. Dams shall be installed where as indicated by the Owner.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. The bentonite clay shall be granular and high swelling. High swelling is defined as the ability of 2 grams of the base bentonite, when mechanically reduced to 100 mesh, to swell in water to a volume of 16 cc or greater, when added to 100 cc distilled water.
- B. The sand shall be a fine aggregate consisting of natural sand, manufactured sand or combination thereof. The sand shall be free of injurious amounts of organic impurities and shall conform to ASTM C33, Concrete Aggregate.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Prior to placement, the bentonite clay shall be uniformly mixed with sand at a minimum ratio of nine pounds of bentonite clay to each cubic foot of sand. The mixture shall be placed such that the entire length of the dam on either side and the bottom of the trench contacts undisturbed earth. The mixture shall be placed in 8-inch lifts, each lift being compacted to the density required for backfill as stated in Section 02300 EARTHWORK.
- B. The dams shall extend from undisturbed material at the bottom of the trench excavation to three feet below the final finished grade, as shown on the detail sheets or as directed by the Owner. The dam shall extend the full width of the trench excavated by the Contractor and the length of the dam shall be a minimum of 1.5 feet along the laying length of the pipe.

- C. Within areas of contaminated soils or within wetland areas, install the dams at a spacing not more than fifty (50) feet apart. This spacing shall also apply to pipe gradients with over an 8 percent slope.
- D. When the watertable is above the bottom of the pipe and does not meet the criteria of 3.01 C above, the spacing shall not be more than 400 feet apart or as directed by the Owner.
- E. Dams shall be required when the pipe trench passes from one soil type to another or to ledge if the watertable is above the pipe.
- F. Refer to the contract detail drawings for the construction detail of the dams.

END OF SECTION

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SECTION 02441

TELEVISION INSPECTION OF NEW PIPELINES

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall furnish all materials, tools, labor and equipment necessary to visually inspect by means of a closed-circuit television all gravity sewers (except building connections) installed under this Contract, as hereinafter specified. The sewers shall be inspected throughout their entire length.
- B. The Contractor shall repair all defects in the system discovered during the television inspection. Prior to making the repairs, the Contractor shall submit to the Owner a plan for making the repairs.

1.02 RELATED WORK:

- A. Section 02085, POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS

1.03 QUALITY ASSURANCE:

- A. The work described herein shall be performed by a company with not less than five years of experience in providing the required services, employing experienced workers and experienced supervisory personnel. Supervisory personnel shall have not less than three years of experience in providing the required services and shall be present at the jobsite during all work related to the required services.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

- A. VHS video system shall be used which utilizes 1/2-inch recording tapes and the SLP mode.
- B. The television camera used for the inspection shall be a pan and tilt closed circuit color television camera specifically designed and constructed for such inspections. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. The camera shall be operative in 100 percent humidity conditions. The camera, television monitor and other components of the video system shall be capable of producing a minimum 400-line resolution color video picture. Picture quality and definition shall be to the satisfaction of the Owner and, if unsatisfactory, equipment shall be removed and no payment made for the unsatisfactory inspection.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. The inspection shall be done one manhole section at a time and the section being inspected shall be suitably isolated from the remainder of the sewer line as required. No sanitary sewer lines shall be inspected until they have been cleaned. The camera shall be moved through the line in either direction at a uniform slow rate, stopping when necessary to insure proper documentation of the sewer's condition, but in no case will the television camera be pulled at a speed greater than 30 feet per minute.
- B. Manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall reset up his equipment in a manner so that the inspection can be performed from the opposite manhole. The Contractor is required to repeat the TV inspection of areas repaired subsequent to the original TV inspection.
- C. Whenever no remote powered and controlled winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two winches, the pumping unit and the monitor control.
- D. Measurement for location of defects shall be at the ground level by means of a meter device. Marking on cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Measurement meters will be accurate to 0.2 feet. A measuring target (or the sealing packer) in front of the television shall be used as an exact measurement reference point, and the meter reading shall show this exact location of the measurement reference point.

3.02 DOCUMENTATION:

- A. Printed location records shall be kept by the Contractor which will clearly show the exact location, in relation to adjacent manholes, of each infiltration point discovered by the television camera. In addition, other points of significance such as locations of laterals, unusual conditions, collapsed sections, and other discernible features will be recorded and a copy of such records will be supplied to the Owner.
- B. Instant developing 35 mm or other standard size photographs of the television monitor at problem areas shall be taken by the Contractor on the request of the Owner, so long as such photographing does not interfere with the Contractor's operations.
- C. Two (2) video tapes of the entire inspection shall be provided to the Owner upon completion of the inspection. The tape playback shall be at the speed that it was recorded. The Contractor shall be required to have all tapes and necessary playback equipment readily accessible for review by the Owner during the project.

- D. The Contractor shall furnish printed internal inspection logs and two (2) video tapes of the entire inspection to the Owner on completion.

END OF SECTION

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SECTION 02513

INSULATION FOR PIPELINES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing of all material, accessories, labor, and equipment necessary to insulate the pipelines where so directed by the Owner.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02085, POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS

1.03 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM C552 Specification for Cellular Glass Block and Pipe Thermal Insulation

PART 2 - PRODUCTS

2.01 INSULATION: DIRECT BURIED PIPE

- A. Insulation shall be cellular glass type. The insulation shall be a cellular glass product that is made specifically for thermal insulation of piping and is compatible with the piping material. Insulation shall be a minimum of 2 inches thick, unless otherwise shown on the drawings.
- B. Insulation shall be composed of all glass sealed cells having no binders or fillers. The completed product shall be rigid and impermeable, with an ultimate compressive strength of at least 100 psi. The thermal conductivity of the cellular glass shall be no higher than 0.40 BTU/(hr)(sq. ft.)(EF/in).
- C. The cellular glass insulation shall comply with all requirements of ASTM C552. The cellular glass shall be fabricated in half sections whenever possible.
- D. Bands for securing the insulation to the pipe shall be 0.5 inches wide by 0.020 inches thick made of stainless steel.
- E. The jacketing for the insulation shall be one of the following methods:

1. A 125 mil (3mm) thick, heat sealed high polymer asphaltic membrane with an integral glass scrim and integral 1 mil (.02mm) aluminum foil and a thin Mylar film on the surface, equal to Pittwrap Jacketing as manufactured by Pittsburgh Corning or equal.
 2. Mastic - asphalt cutback mastic, equal to Pittcote 300 Finish, as manufactured by Pittsburgh Corning or equal.
 3. Reinforcing fabric - an open mesh polyester fabric with a 6 x 5.5 mesh/inch configuration, equal to PC Fabric 79, as manufactured by Pittsburgh Corning or equal.
- F. The insulation shall be "Foamglass" with jacketing as manufactured by Pittsburgh Corning Corporation, Pittsburgh, PA, or an approved equal. A minimum of 6" layer of fine sand shall surround the insulated pipe before rock free backfill is used in the trench.
- C. The Foamglass and jacketing shall be installed per the manufacturer instructions included in the approved shop drawings.
- G. Tees, valves, and bends shall be covered with form fitting factory made sections.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Cellular glass shall not be applied to the piping until the piping has been wiped clean and supported so that there is adequate space to apply the full thickness of insulation and the covering completely around the pipe. The Contractor must obtain the Owner's approval before the installation begins.
- B. Cellular glass insulation and jacketing shall be applied in accordance with the manufacturers installation procedures included in the approved shop drawings.
- C. There shall be at least three 0.50-inch wide stainless steel bands secured around each joint and these bands shall be placed not over 9 inches on center on straight sections of pipe.
- D. Tees, valves, and bends shall be covered with form fitting factory made sections.
- E. All testing of the piping system, such as hydrostatic, x-ray or other such testing, shall be accomplished prior to application of insulation.

END OF SECTION

SECTION 02518

TRACER TAPE

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing, handling and installation of tracer tape.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

Tracer tape shall be by Lineguard, Inc., Wheaton, IL; Empire Level, Waukesha, WI; Pro-Line Safety Products Co., W. Chicago, IL; or approved equal.

2.02 TRACER TAPE:

- A. Tracer tape shall be at least 3-inches wide.
- B. Tracer tape for non-ferrous pipe or conduit shall be constructed of a metallic core bonded to plastic layers. The metallic tracer tape shall be a minimum 5-mil thick and must be locatable at a depth of 18 inches with ordinary pipe locaters.
- C. Tracer tape for ferrous pipe or conduit shall consist of multiple bonded plastic layers. The non-metallic tracer tape shall elongate at least 500% before breaking.
- D. The tape shall bear the wording: "BURIED DRAIN LINE BELOW" (with "DRAIN" replaced by "WATER", "SEWER", "ELECTRICAL", "GAS", "TELEPHONE", or "CHEMICAL" as appropriate), continuously repeated every 30 inches to identify the pipe.
- E. Tape colors shall be as follows, as recommended by the American Public Works Association (APWA):

Electric	Red
Gas & Oil	Yellow
Communications	Orange
Water	Blue
Sewer & Drain	Green
Chemical	Red (not APWA)

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Tracer tape shall be installed directly above the pipe or conduit it is to identify, approximately 12 inches below the proposed ground surface.
- B. The Contractor shall follow the manufacturer's recommendations for installation of the tape, as approved by the Owner.
- C. For service or lateral connections, Contractor shall install the tracer tape up the face of the foundation, so that a direct connection can be made.

END OF SECTION

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SECTION 02530

BUILDING CONNECTIONS AND
DROP CONNECTIONS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers furnishing of all materials and labor to construct building sewer connections and drop connections as herein specified.
- B. Final location of building connections shall be determined in the field by the Owner.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02324, ROCK EXCAVATION AND DISPOSAL
- C. Section 02631, PRECAST MANHOLES
- D. Section 02531, SEWER CHIMNEYS
- E. Section 02085, POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS
- F. Section 02518, TRACER TAPE
- G. Section 02533, CONNECTIONS TO EXISTING STRUCTURES
- H. Section 03302, FIELD CONCRETE

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Pipe and fittings for drop connections and for gravity building connections shall be as specified under Section 02085 POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS. Adaptors shall be as recommended by the pipe manufacturer.
- B. Concrete for encasement shall be as specified in Section 03302 FIELD CONCRETE.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. BUILDING CONNECTIONS:

1. Building connections shall be installed using the same construction and pipe joining techniques as specified in Section 02085 POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS.
2. Building connections from chimneys to one foot beyond the edge of the mainline trench shall be installed using the same construction and pipe joining techniques as specified in Section 02089 - DUCTILE IRON PIPE AND FITTINGS FOR SEWERS. The DI pipe shall be fitted with a PVC adapter and completed to the property line with PVC pipe.
3. In general, connections shall be carried only to the property line. The end of the pipes shall be closed with PVC stoppers jointed in place to ensure against infiltration into the sewer line.

B. DROP CONNECTIONS:

1. When the invert of a pipe entering a manhole is 24 inches or more above the invert of the lowest pipe leaving the manhole, it shall be connected to the manhole with an outside drop section. The manhole shall be constructed in the normal manner except that a straight-through clean-out pipe shall be connected through the manhole wall.
2. The drop pipe shall be the same diameter, material, and class as the sewer pipe entering the manhole, unless otherwise noted in the drawings. After installation of the outside drop section and pipe connections into the manhole, the entire vertical, outside assembly shall be encased in concrete, as shown on the drawings, using concrete with strength of at least 3000 psi.

END OF SECTION

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SECTION 02531

SEWER CHIMNEYS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers furnishing all equipment, materials and labor to provide and install sewer chimneys and described herein. Final locations of the chimneys shall be as determined in the field by the Owner.

1.02 RELATED WORK:

- A. Section 02058, CONTROL DENSITY FILL
- B. Section 02300, EARTHWORK
- C. Section 02530, BUILDING CONNECTIONS AND DROP CONNECTIONS
- D. Section 02085, POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS

1.03 SYSTEM DESCRIPTION:

The sewer chimney shall be designed and installed such that it provides a direct positive connection from the mainline pipe to the building connection, will withstand the required pressure tests after backfilling, and will not be adversely affected by local settlement after completion and acceptance by the Owner. Cast iron tees shall be used in the mainline at each location of the chimney as indicated in the detail drawings.

1.04 REFERENCES:

- A. The following standards form a part of these specifications, as referenced:

American Society for Testing & Materials (ASTM)

ASTM	D1557	Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb. Rammer and 18-inch Drop.
ASTM	D3034	Specification for Type PSM Poly (Vinyl-Chloride) (PVC) Sewer Pipe and Fittings.

American Water Works Association (AWWA)

SECTION 02532

VALVES AND APPURTENANCES FOR WORK OUTSIDE OF WASTEWATER TREATMENT FACILITY AND PUMP STATIONS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers furnishing and installation of all outside valves and appurtenances as indicated on the drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02631, PRECAST MANHOLES
- C. Section 02085, POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS
- D. Section 03302, FIELD CONCRETE

1.03 REFERENCES:

The following standards form a part of this specification, as referenced:

American Society for Testing and Materials (ASTM)

- | | | |
|------|------|---|
| ASTM | A48 | Gray Iron Castings |
| ASTM | A148 | Steel Castings, High Strength, for Structural Purposes |
| ASTM | D429 | Test Methods for Rubber Property - Adhesion to Rigid Substrates |

American Water Works Association (AWWA)

- | | | |
|------|------|---|
| AWWA | C509 | Resilient Seated Gate Valves for Water and Sewerage Systems |
|------|------|---|

Federal Specifications (FS)

- | | | |
|----|----------|------------------|
| FS | TT-V-51F | Asphalt, Varnish |
|----|----------|------------------|

PART 2 - PRODUCTS

2.01 RESILIENT SEATED GATE VALVES:

- A. Resilient seated, wedge type gate valves shall be manufactured to meet all applicable requirements of AWWA C509. Valves 12 inches and smaller shall be bubble-tight at 200 psi water working pressure, tested in both directions.
- B. Valve bodies shall be of cast iron and shall have nonrising threaded bronze stems acting through a bronze stem nut. Opening nuts shall be 2 inches square and shall open as specified above. All buried valves shall have mechanical joint ends.
- C. Valve wedges shall be of cast iron with resilient seating surfaces permanently bonded to the wedges in strict accordance with ASTM D429 or attached to the face of the wedges with stainless steel screws. Each valve shall have a smooth, unobstructed water way free from sediment pockets.
- D. Valves shall have low friction, torque-reduction thrust bearings. All O-rings and gaskets shall be removable without taking the valves out of service.
- E. Resilient seated gate valves shall be as manufactured by Clow Corporation, Besenville, IL; Mueller Co., Decatur, IL; Dresser Industries, Inc., Bradford, PA; or be an approved equal.
- F. Post indicating valve assemblies shall have a post and indicator as an integral part of the resilient seated gate valve assembly. The unit shall be provided with a detachable crank which OPENS the valve in a counterclockwise direction. Shafts shall be Type 304 stainless steel. Post indicators and valves shall be UL listed, FM approved. Post indicators and valves shall be as manufactured by Pratt, Clow or approved equal.

2.02 POLYVINYL CHLORIDE (PVC) BALL VALVES:

- A. Provide PVC ball valves as manufactured by ASAHI/America, Medford, MA; NIBCO, Inc., Elkhart, IN; or approved equal.
- B. All ball valves shall be of the flanged model with one piece capsules and shall open counterclockwise. Valves shall be rated for 150 psi at 120 degrees F.
- C. Full face gaskets having a 50 to 70 durometer A hardness shall be used.
- D. Ball valve bodies shall be constructed of PVC, with Teflon seats and Viton seals.

2.03 BUTTERFLY VALVES:

- A. Butterfly valves shall be as manufactured by Crane Co., Chicago, IL; ITT Grinell Corporation, Providence, RI; Dezurik, Scartell, MN; or approved equal, and shall be ductile

iron 150 pound body with location index or lugs, suitable for installation between 150 pound ductile iron flanges to form a leak proof seal, without added gaskets.

- B. Valve disc shall be bronze or aluminum bronze, conforming to ASTM A148, Class 9B. The stem shall be 316 stainless steel non-lubricated type completely sealed from the line flow fluid. The valve seat shall be Buna-N bonded to a rigid backing ring and shall form a positive seal on stem, body and seat. The valve seat shall be field replaceable. Valve operators shall provide infinite valve opening settings, shall lock in any position and shall be provided with an indicating index. The valve shall move from full open to full close position with a one-quarter turn. Manual operation shall be provided with operating handles.

2.04 VALVE BOXES:

- A. Each valve shall be provided with a box. Covers shall be close fitting and substantially dirt-tight. The top of the cover shall be flush with the top of the box rim. An arrow and the word OPEN to indicate the direction of the turning to open the valve shall be cast in the top of the cover.
- B. Valve boxes shall be of cast iron and of the adjustable threaded, heavy pattern type. They shall be so designed and constructed as to prevent direct transmission of traffic loads to the pipe or valve. The upper or sliding section of the box shall be provided with a flange having sufficient bearing area to prevent undue settlement. The lower section and stuffing box shall be designed to enclose the operating nut and stuffing box of the valve and rest on the backfill. The boxes shall be adjustable through at least 6 inches vertically without reduction of lap between sections to less than 4 inches.
- C. The inside diameter of boxes shall be at least 4-1/2 inches and the lengths shall be as necessary to suit the ground elevation and the depth of each valve.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. All material shall be carefully inspected for defects in workmanship and material, and all debris and foreign matter shall be cleaned out of valve openings and seats. Operating mechanisms shall be operated to check for proper functioning, and all nuts and bolts shall be checked for tightness.
- B. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.
- C. All valves shall be carefully installed and supported in their respective positions, free from all distortion and strain. Care shall be taken to prevent damage or injury to the valves and appurtenances during handling and installation.

- D. Valve boxes shall be set plumb, flush with the ground or paved surface, and centered directly over the operating nut of the valves. Earth fill shall be carefully tamped around the valve box to a distance of 4 feet on all sides of the box or to undisturbed trench faces if less than 4 feet.
- E. Valves shall be operational and accessible at all times during construction and warranty period. The Contractor shall verify the proper operation of all valves in the presence of the Owner following completion of the project and prior to the acceptance of substantial completion.

3.02 PAINTING:

- A. Interior surfaces of valves and miscellaneous piping appurtenances shall be given a shop finish of an asphalt varnish conforming to Federal Specifications TT-V-51F.
- B. Parts customarily finished at the shop shall be given coats of paint filler and enamel or other approved treatment customary with the manufacturer.
- C. After thorough cleaning, exterior surfaces of various parts of valves and miscellaneous piping appurtenances exposed within the building shall be given one shop coat of an approved rust-inhibitive primer compatible with the field coats and applied in accordance with the instruction of the paint manufacturer.
- D. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-inhibitive resistant coat.

END OF SECTION

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SECTION 02533

CONNECTIONS TO EXISTING STRUCTURES

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish materials, tools, labor and equipment to cut suitable openings into the existing sewer manholes, make connections to existing sewers and all other work necessary to direct the existing sewage flow.

1.02 RELATED WORK:

Section 02631, PRECAST MANHOLES

Section 03302, FIELD CONCRETE

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The Contractor shall provide temporary plugs or provide other suitable means for maintaining the new sewer free of sewage flow until such time as it can be inspected and tested for leakage.
- B. Connections to the new sewer shall be made when directed by the Owner and only after the new pipeline has been inspected and has successfully passed the leakage test.
- C. The Contractor shall modify each existing structure for installation of the necessary piping, but in so doing shall confine the cutting to the smallest amount possible consistent with the work to be done.
- D. All new piping connected to existing structures shall be encased in concrete in a manner satisfactory to the Owner.
- E. All work shall be done with the proper tools and by careful workmen competent to do work.
- F. The Contractor shall cut, reshape and fill the existing manhole tables and plug existing outlets as indicated on the drawings and as directed by the Owner, to accommodate the new connections. Reshaped manhole invert channels shall be smoothly shaped to permit the

flow of sewage. Manhole invert channels shall be reconstructed as specified under Section 02631, PRECAST MANHOLES.

END OF SECTION

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SECTION 02535

PRECAST CONCRETE WETWELL STRUCTURES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section applies to precast concrete wet wells, dry wells and valve vaults as shown on the Drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 11303, PACKAGE PUMP STATIONS

1.03 REFERENCES:

The following standards form a part of this specification as referenced:

A. American Concrete Institute

ACI 308 Standard Practice for Curing Concrete

ACI 318 Building Code Requirements for Structural Concrete and Commentary

ACI350 Environmental Engineering Concrete Structures

B. American Society for Testing and Materials (ASTM)

ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A82 Specification for Steel Wire, Plain, for Concrete Reinforcement

1.04 DESIGN REQUIREMENTS

- A. Design shall be for "Normal Sanitary Exposure" (Z=115) and shall be done by "Alternate Design Method" ACI 318, Appendix B or "Strength Design Method" ACI 318 and as amended by ACI 350R.
- B. Minimum 28 day compressive strength: $f_c' = 5,000$ psi.
- C. Reinforcing Steel: ASTM A615 grade 60 deformed bars.

- D. Concrete cover on reinforcing steel: 1½ inches minimum.
- E. The structures shall have a minimum of 8" thick walls, top slabs and base slabs.
- F. The precast concrete structure shall support its own weight plus the following minimum superimposed loads:
 - 1. Live load on top slab: H-20 vehicular loading.
 - 2. Dead load of soil on top slab: 125 PCF.
 - 3. Equivalent lateral fluid pressure - 90 PCF. The top of the pressure diagram shall be assumed to originate at Finish Grade as shown on the drawings.
 - 4. Uniform live load surcharge of 125 psf applied horizontally to the sides of the precast structure.
- G. Provide an anti-floatation footing. The footing and the base of the structure shall be a monolithic structure. Base footing design on the following requirements:
 - a. Ground water shall be assumed to originate at finish grade.
 - b. Provide a factor of safety of 1.15 against flotation based on weight of structure only (do not include weight of internal piping or equipment) and utilizing only the soil directly over a vertical extension of the footing perimeter.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. Manufacturer's Data:

- 1. Submit manufacturer's specifications and instructions for all manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
- 2. Contractor shall submit the proposed erection procedure for precast units, sequence of erection, and required handling equipment.
- 3. A copy of handling and installation instructions and procedures shall be transmitted to the Erector.

B. Shop Drawings:

- 1. Submit shop drawings showing complete information for the fabrication and installation of precast concrete units.

2. Submit member dimensions and cross section, location, size, type and details of reinforcement, including special reinforcement and lifting devices necessary for handling and erection, joints and waterstops.
3. Submit layout, dimensions, and identification of each precast unit corresponding to the sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at opening in precast units.
4. Submit location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement.
5. Submit calculations for record purposes only demonstrating the structural integrity of all precast concrete units. All calculations must be stamped by a professional structural engineer registered in the state the structure(s) will be installed.
6. Submit buoyancy calculations for record purposes supporting the sizing of the anti-floatation footing. All calculations must be stamped by a professional structural engineer registered in the state the structure(s) will be installed.
7. Submit concrete mix design including product data for concrete accessories and waterproofing materials.

PART 2 - PRODUCTS

2.01 PRECAST SECTIONS:

- A. All precast units shall be tongue and grooved and of shape and section as shown on the Drawings.
- B. Cement for all units shall be Type II Portland cement, ASTM C150.
- C. Minimum compressive strength of concrete 5000 psi at 28 days.
- D. Entrained air content of concrete: $6\% \pm 1\%$.
- E. Reinforcing steel shall conform to ASTM A 615 grade 60 deformed bars.
- F. Cast-in-place plates shall conform to ASTM A 36.

2.02 JOINTS:

A. Joint gaskets to be flexible self seating butyl rubber joint sealant installed according to manufacturer's recommendations. For cold weather applications, use adhesive with joint sealant as recommended by manufacturer.

B. Acceptable Materials:

1. Kent-Seal No. 2, Ram-Nek or equivalent.

C. Joints between precast sections shall conform to related standards and manufacturer's instructions.

D. All structures greater than 6 ft. diameter and all structures used as wet wells, valve pits and other dry-pit type structures shall be installed with exterior joint collars. The joint collar shall be installed according to the manufacturer's instructions. Acceptable materials:

1. MacWrap exterior joint sealer as manufactured by Mar-Mac Manufacturing Company or equivalent.

2.02 DAMP PROOFING:

A. Liquid Asphalt Damp proofing: Non-fibrated asphalt emulsion for below grade wall damp proofing.

1. First coat Sonneborn Building Products - Hydrocide 600 or equal.

2. Second coat Sonneborn Building Products - Hydrocide 700 Mastic, or equal.

2.03 OPENINGS:

A. Provide openings in the risers to receive pipes entering the manhole.

B. Make openings at the manufacturing plant.

C. Size: To provide a uniform annular space between the outside wall of pipe and riser.

D. Location: To permit setting of the entering pipes at the correct elevations.

E. Openings shall have a flexible watertight union between pipe and the manhole base.

1. Cast into the manhole base and sized to the type of pipe being used.

2. Type of flexible joint being used shall be approved by the Owner. Install materials according to the Manufacturer's instructions.

3. Acceptable Manufacturers:

- a. Lock Joint Flexible Manhole Sleeve made by Interpace Corporation.
- b. Kor N Seal made by National Pollution Control System, Inc.
- c. Press Wedge II made by Press-Seal Gasket Corporation.
- d. A-Lok Manhole Pipe Seal made by A-Loc Corporation.

2.04 PRECAST MANUFACTURERS:

- A. Precast sections shall be manufactured by Concrete Systems Inc., Rotondo Precast, Superior Concrete Products or approved equal.

PART 3 - EXECUTION

3.01 FABRICATION AND PLACING REINFORCEMENT

- A. Detailing and fabrication of reinforcement shall conform to details on drawings, and otherwise to the CRSI Code of Standard Practice.
- B. Bars when placed shall be clean and free from loose mill scale and rust and from coatings that reduce bond.
- C. Place reinforcement of structural members on accessory bolsters and chairs as specified in SECTION 03300, for reinforcement of cast-in-place structural members. Accessories shall be stainless steel or have plastic tips.
- D. Specifications for splicing bars given in the ACI Code are applicable to this work.
- E. All reinforcing shall have adequate cover as required by ACI 318 and 350R.

3.02 PRODUCTION AND CURING

- A. Production and curing of the precast units shall in all respects conform to the provisions of ACI Standards.
- B. Each precast unit shall be an integral pour without any construction or cold joints. Floor slabs shall be an integral pour with the wall section where practical.
- C. Structures shall be fabricated from the minimum number of precast sections while keeping with transportation and installation restrictions.

3.03 STORAGE, HANDLING, TRANSPORTATION

- A. Units shall be stored in moist condition for at least 14 days and shall be supported in such a way as to avoid any deformation, discoloration, or permanent set. Handling and transportation shall not produce stresses beyond the allowable stresses or cause cracks and spalls.

3.04 CONDITIONS OF UNITS AND PATCHING

- A. Damaged, cracked, or chipped units shall be satisfactorily repaired and patched if structurally and architecturally acceptable. The Owner shall be sole judge as to acceptability and his decision shall be final if made within these specifications. All exposed to view units to be cleaned to obtain a uniform finish before acceptance is made.

3.05 INSPECTION

- A. Material and workmanship shall be at all times subject to inspection by the Owner and ready access for such inspection shall be permitted to all work during fabrication and erection.
- B. Material and workmanship not in conformity with the provisions of this specification may be rejected at any time defects are found during the progress of the job.

3.06 EMBEDDED AND ATTACHED ITEMS

- A. Pipe sleeves, inserts, bolts, lifting hooks dowels, and all other items required for transportation and erection shall be patched so that they shall have adequate concrete cover in the finished structure. Location to be as shown on Drawings or as required for handling and erection.

3.07 ERECTION

- A. Install all precast structures and/or structure sections level and plumb to the elevations and in the locations shown on the Drawings.
- B. Installation Tolerances: Install precast units without exceeding the following tolerance limits:
 1. Variations from Plumb: 1/4" in any 20' run or story height ; 1/2" total in any 40' or longer run.
 2. Variations from Level or Elevation: 1/4" in any 20' run; 1/2" in any 40' run; total plus or minus 1/2" at any location.
 3. Variation from Theoretical Position in Plan: Plus or minus 1/4" maximum at any location.

4. Offsets in Alignment of Adjacent Members at Any Joint: 1/16" in any 10' run: 1/4" maximum.

- C. Perform jointing in strict accordance with the manufacturer's recommendations.
- D. Make sure all joints are watertight.

3.08 CLEANING, REPAIRING AND PROTECTION

- A. After erection is complete, any chipped or damaged units and any depressions left by removal of lifting devices shall be properly repaired by the erector. Also, all erection dirt incurred during the erection process shall be removed. Muriatic acid or similar products are not to be used without the specific consent of the manufacturer and the Owner.
- B. All finished work in any way exposed shall be protected by the General Contractor against damage. Cutting and patching of any precast concrete shall only be allowed with the express permission of the Owner. Any such work shall only be done by the Erector, either at this own expense should the fault be his, or at the expense of the party responsible for the damage for the additional work required.

3.09 LIQUID ASPHALT DAMPPROOFING APPLICATION

- A. Apply damp proofing to all concrete tank walls below grade in accordance with the manufacturers recommendations and at the thickness recommended.

Do not place backfill for at least 24 to 48 hours after application.

- C. Clean any adjacent materials affected by the application of the penetrating dampproofing with a material recommended by the dampproofing manufacturer.

3.10 TESTING

GENERAL:

1. Perform leakage tests on all precast concrete tanks prior to backfilling.
2. All testing must be performed in the presence of the Owner.
3. Suitably plug all pipes entering precast concrete tank and brace plugs to prevent blow out.

B. VACUUM TEST:

1. The vacuum test shall be conducted in accordance with ASTM C-1277. Test result will be judged by the length of time it takes for the applied vacuum to drop from 10 inches of mercury to 9 inches. If the time is less than 2

minutes, the structure will have failed the test.

2. If the structure fails the initial test, the Contractor shall locate the leaks and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material. If the structure should again fail the vacuum test, additional repairs shall be made, and the structure water tested as specified below.

C. EXFILTRATION TESTS PRIOR TO BACKFILLING:

1. If the groundwater level has risen above the footing of the structure, the Contractor shall lower the groundwater level to a point below the structure footing prior to the start of the test. The Contractor shall maintain a groundwater level below the structure footing for the duration of the test.
2. Fill precast concrete tank with potable water furnished by the Contractor to the top of the cover.
3. A period of up to 2 hours may be permitted, if the Contractor so wishes, to allow for absorption.
4. At the end of the absorption period, refill precast concrete tank with water to the top of the precast concrete tank cover and begin the 4-hour test period.
5. At the end of the 4-hour test period, refill precast concrete tank to the top of the precast concrete tank cover and measure the volume of water added. The leakage for each precast concrete tank shall not exceed 1 gallon per 50 square feet of tank wall per 4-hour period.

3.12 PRECAST CONCRETE TANK REPAIRS

- A. Correct leakage by reconstruction, replacement of gaskets and/or other methods as approved by the Owner.
- B. The use of lead-wool or expanding mortar will not be permitted.
- C. Subsequent to the repair, tanks shall be refilled as previously described and re-tested until such time as the structures can demonstrate compliance with the testing requirements and at no additional cost to the Owner.
- D. The Contractor shall dispose of the water as directed by the Owner.

END OF SECTION

SECTION 02536

PRECAST CONCRETE VAULT AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers precast vaults complete, including, but not limited to, bases, walls, mortar, frames and covers, as specified herein.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02631, PRECAST MANHOLES

1.03 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM	A48	Gray Iron Castings
ASTM	A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM	C32	Sewer and Vault Brick (Made from Clay or Shale)
ASTM	C177	Test Method for Steady - State Heat Flux Measurements and Thermal Transmission Properties by means of the Guarded-Hot-Plates
ASTM	C207	Hydrated Lime for Masonry Purposes
ASTM	C478	Precast Reinforced Concrete Vault Sections
ASTM	C923	Resilient Connectors Between Reinforced Concrete Vault Structures and Pipes
ASTM	C1227	Standard Specifications for Precast Septic Tank - Watertightness. Testing

American Association of State Highway Transportation Officials (AASHTO)

AASHTO M198 Joints for Circular Concrete Sewers and Culvert Pipe Using Flexible Watertight Gaskets

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS:

- A. Precast sections shall conform in shape, size, dimensions, materials, and other respects to the details indicated on the drawings or as ordered by the Owner.
- B. The hatch frame and cover shall be the standard frame and cover as specified. The frame and cover shall be set by the Contractor to conform accurately to the grade of the finished pavement, existing ground surface, or as indicated on the drawings.

2.02 PRECAST CONCRETE SECTIONS:

- A. All precast concrete sections shall conform to ASTM C478 with the following exceptions and additional requirements:

- 1. The wall thickness of precast sections shall be as designated on the drawings, meeting the following minimum requirements:

<u>Section</u>	<u>Minimum Wall Thickness</u>
Roof	8
Walls	6
Floor	6

- 2. Type II cement shall be used except as otherwise approved.
- 3. Sections shall be steam cured and shall not be shipped until at least five days after having been cast.
- 4. Minimum compressive strength of concrete shall be 5000 psi at 28 days.
- 5. No more than two lift holes may be cast or drilled in each section.
- 6. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of the barrel.
- 7. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.

8. Steel reinforcement shall be Grade 60 and conform to ASTM A615 with a minimum of 1-inch cover.
 9. Design loading shall be AASHTO HS-20-44.
 10. The outside surfaces of the vault shall be thoroughly sealed with bituminous coating as herein specified prior to shipping.
- B. Precast sections shall be manufactured to contain wall and roof openings of the minimum size to receive the ends of the pipes and such openings being accurately set to conform with line and grade of the pipelines. Subsequent cutting or tampering in the field, for the purpose of creating new openings or altering existing openings, will not be permitted except as directed by the Owner.
 - C. The Owner reserves the right to reject any precast section and the rejected unit shall be tagged and removed from the job site immediately.
 - D. The Owner may also require the testing of concrete sections as outlined under Physical Requirements in ASTM C478 with the Contractor bearing all testing costs.

2.03 BRICK MATERIALS:

- A. The brick shall be sound, hard, and uniformly burned brick regular and uniform in shape and size, of compact texture, and satisfactory to the Owner. Brick shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.
- B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Owner substituted.
- C. The mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as directed and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; Portland cement to hydrated lime to sand.
- D. Cement shall be Type II Portland cement as specified for concrete masonry.
- E. Hydrated lime shall be Type S conforming to ASTM C207.
- F. The sand shall comply with the specifications for "Fine Aggregate", for concrete masonry except that all of the sand shall pass a No. 8 sieve.

2.04 ALUMINUM VAULT LADDERS:

- A. Aluminum ladders shall be fastened to concrete with stainless steel or aluminum toggle or expansion bolts, and fasteners shall be in the locations shown on the shop drawings.

- B. Ladders shall be solid stock and all-welded construction. Rungs shall be 3/4-inch diameter fitted into holes in 1/4-inch by 2-inch rails and welded all around. Tops of ladder rails shall have rounded corners or vinyl coverings to prevent injury. Aluminum ladders shall include brackets, fasteners, bracing and support.

2.05 EXPANDABLE DRAIN PLUGS:

Expandable drain plugs shall be manufactured of nylon-6 and rubber and shall seal pipe air-tight up to a pressure of 8 psi. Drain plugs shall be equal to Firm Hand Tile Expandable Stopper as supplied by T.E. Toomy Co., Inc., Wakefield, MA.

2.06 BITUMINOUS DAMPPROOFING:

All exterior surfaces of the concrete vault shall be given a minimum of one shop coat of bituminous dampproofing.

2.07 INSULATION:

- A. Insulation shall be polystyrene and shall be supplied in boards of full thickness required, multiple layers of thinner boards shall not be acceptable.
- B. Thickness of perimeter insulation shall be 2 inches and shall produce a minimum thermal resistance, "R" value, of $5.5 \text{ h} \times \text{ft}^2 \times \text{NF/Btu}$ ($1.0 \text{ m}^2 \times \text{K/W}$) as determined in accordance with ASTM C177, at an average mean temperature of 75NF (24NC).
- C. Adhesive for perimeter insulation shall be compatible with materials for which it will be in contact. Adhesive shall be subject to the approval of the Owner. Adhesive shall be that recommended by the manufacturer of the insulation.
- D. In addition to adhesive, expansion bolts shall be provided to securely fasten insulation to the ceiling.

2.08 ACCESSORIES:

- A. Gasket materials shall be top grade (100% solids, vulcanized) butyl rubber and shall meet or exceed AASHTO M-198.
- B. Couplings at the vault -pipe interface shall be of the method detailed on the drawings. The seal system shall be rubber (with or without stainless steel straps) meeting the requirements of ASTM C923 and recommended for this type of connection. Only cast-in-place couplings shall be acceptable for new vaults furnished per this specification; couplings for core-drilled or cast-in-place openings will be rejected except for modifications to existing vaults.
- C. Vent shall be 6-inch diameter ductile iron pipe with rain proof metal hood and noncorrosive screen.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. PRECAST SECTIONS:

1. The precast vault shall be supported on a compacted level foundation of crushed stone, as specified in Section 02300 EARTHWORK, at least 6 inches thick, but to the depth necessary to reach sound undisturbed earth.
2. Precast reinforced concrete sections shall be set so as to be vertical and with sections in true alignment.
3. Butyl rubber joint sealant shall be installed between each concrete section.
4. All holes in sections used for their handling shall be thoroughly plugged with mortar. The mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch (just short of "balling"), hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

B. BRICKWORK:

1. The brick shall be moistened by suitable means, as directed, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
2. Each brick shall be laid as headers in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as directed.

C. CASTINGS:

1. Frames shall be set with the tops conforming accurately to the grade on the drawings or as directed.
2. Frames shall be set as shown on the drawings and in a full bed of mortar so that the space between the top of the concrete section or brick headers and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to be flush with the top of the flange and have a slight slope to shed water away from the frame.
3. Covers shall be left in place in the frames except while work is being performed on them.

D. ACCESSORIES:

Accessories shall be installed in accordance with manufacturer's instructions.

3.02 LEAKAGE TESTS:

A. Leakage tests shall be made by the Contractor and observed by the Owner on each vault. The Owner will decide which test method shall be used, vacuum or water exfiltration as described below:

B. VACUUM TEST:

1. The vacuum test shall be conducted in accordance with ASTM C-1277. Test result will be judged by the length of time it takes for the applied vacuum to drop from 15 inches of mercury to 14 1/2 inches. If the time is less than 2 minutes, the vault will have failed the test.
2. If the vault fails the initial test, the Contractor shall locate the leaks and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material. If the vault should again fail the vacuum test, additional repairs shall be made, and the vault water tested as specified below.

C. WATER EXFILTRATION TEST:

1. After the vault has been assembled in place, all lifting holes shall be filled and pointed with an approved non-shrinking mortar. All pipes and other openings into the vault shall be suitably plugged and the plugs braced to prevent blow out. The test shall be made prior to backfilling the structure. If the groundwater table has been allowed to rise above the bottom of the vault, it shall be lowered for the duration of the test.
2. The vault shall be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the vault, the vault may be considered to be satisfactorily water-tight. If the test, as described above, is unsatisfactory as determined by the Owner or if the vault excavation has been backfilled, the test shall be continued. A period of time may be permitted if the Contractor so wishes, to allow for absorption by the vault. At the end of this period, the vault shall be refilled to the top of the cone, if necessary, and a measuring time of at least 8 hours begun. At the end of the test period, the vault shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour loss rate and the leakage determined on the basis of depth. The leakage for each vault shall not exceed one gallon per vertical foot for a 24-hour period. If the vault fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, repairs by approved methods may be made as directed by the Owner to bring the leakage within the allowable rate of one gallon per foot per day. Leakage due to a defective section or joint or exceeding the 3 gallon per vertical foot per day,

shall be cause for rejection of the vault. It shall be the Contractor's responsibility to disassemble, reconstruct or replace the rejected vault as necessary as directed by the Owner. The vault shall then be retested and, if satisfactory, interior joints shall be filled and pointed.

3. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorption, etc. It shall be assumed that all loss of water during the test is a result of leaks through joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the Owner that the water table is below the bottom of the vault throughout the test.
4. If the groundwater table is above the highest joint in the vault, and there is no leakage into the vault, as determined by the Owner, such a test can serve to evaluate water-tightness of the vault. However, if the Owner is not satisfied with the results, the Contractor shall lower the water table and carry out the test as described hereinbefore.

3.03 CLEANING:

All new vaults shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

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SECTION 02546
ABANDONMENT OF EXISTING WASTEWATER DISPOSAL SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the abandonment of onsite wastewater disposal system, including leaching piping, distribution boxes, duplex pump system, septic tank, cess pools, leaching field, and filter drying bed.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK

1.03 SYSTEM DESCRIPTION:

- A. The abandonment of subsurface disposal system shall conform to the provisions of Title 5 of the DEP State Environmental Code (310 CMR 15) and to all applicable local wastewater codes and standards.

1.04 REFERENCES:

- A. State Environmental Code Title 5 310 CMR 15.354

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.01 ABANDONMENT OF ON-SITE SUBSURFACE WASTEWATER DISPOSAL SYSTEM

- A. All systems shall be abandoned in accordance with Title 5 of the Massachusetts Environmental Code 310 CMR 15.354.
- B. Septic tanks shall be pumped of entire contents by a licensed septage hauler.
- C. Septic tanks shall be excavated and removed from the site, or the bottom of the tank shall be opened or ruptured after being pumped of its content so as to prevent retainage of water and the tank shall be completely filled with clean sand.

END OF SECTION

SECTION 02629

RAISING AND/OR RESETTING OF SEWER MANHOLE FRAME AND COVER

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers raising and/or resetting of sewer manhole frame and cover. The work includes raising, resetting, and/or adjusting of structures to line and grade.

1.02 RELATED WORK

- A. Section 02631, PRECAST MANHOLES

PART 2 - PRODUCT

2.01 SEWER COVER:

- A. The Manhole cover shall be supplied by E.L. Lebaron Foundry Company, Brockton, MA., Catalog Number (frame and cover) LC239-1 or approved equal (approximate weight of frame and cover = 450 pounds).

PART 3 - EXECUTION

3.01 RAISING AND/OR RESETTING OF SEWER MANHOLE FRAME AND COVER:

- A. In areas where bituminous pavement exists, existing sewer manhole castings shall be raised to the proper grade where indicated on the contract drawings or as directed by the Owner.
- B. Cut around manhole castings a minimum of 8-inches from casting. Excavate and remove old masonry to such a depth as directed by the Owner and rebuild masonry below the bottom of the casting. Backfill with mortar or bituminous concrete. Place high, early strength concrete or bituminous concrete collar, as directed, to approximately 1-1/2-inches below the raised casting grade.
- C. Masonry work shall conform to the applicable provisions of Section 02630, BUILD MANHOLE INVERT.
- D. The Contractor shall provide a top course approximately 1-1/2-inches thick and shall match existing surrounding grades and pavement materials. The Contractor shall provide a watertight seal between the masonry work and the casting.

3.02 INSTALLATION OF MANHOLE FRAME AND COVER:

- A. Where necessary, replacement covers and frames shall be furnished and installed in-place by the contractor. The cover and frame shall provide a watertight seal.

END OF SECTION

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SECTION 02630

BUILD MANHOLE INVERT

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all manholes complete, including, but not limited to, bases, mortar, and inverts.

1.02 SYSTEM DESCRIPTION:

- A. Invert channel shall be formed of brick and mortar upon the base.

1.03 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM C32	Sewer and Manhole Brick
ASTM C144	Aggregate for Masonry Mortar
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

PART 2 - INVERT MATERIALS

- 2.01 The invert shall be formed of brick and mortar, as specified in this specification section.

2.02 BRICK MATERIALS:

- A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Bricks shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.

- B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Engineer substituted.
- C. Mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as directed and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand.
- D. Cement shall be Type II portland cement as specified for concrete masonry.
- E. Hydrated lime shall be Type S conforming to ASTM C207.
- F. The sand shall comply with ASTM C144 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. INVERT BRICK WORK:

1. All debris shall be removed from the bottom of the manhole before the invert is constructed.
2. Bricks shall be moistened by suitable means, as directed, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
3. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as directed.
4. The brick inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

3.02 CLEANING:

All manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 02631

PRECAST MANHOLES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all precast manholes complete, including, but not limited to, bases, walls, cones, mortar, inverts, frames and covers.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02745, PAVING
- C. Section 03302, FIELD CONCRETE

1.03 SYSTEM DESCRIPTION:

- A. Precast sections shall conform in shape, size, dimensions, materials, and other respects to the details indicated on the drawings or as ordered by the Owner.
- B. All manholes shall have concrete bases. Concrete bases shall be precast unless otherwise specified. Invert channels shall be formed of brick and mortar upon the base.
- C. Riser and cone sections shall be precast concrete.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM A48	Gray Iron Castings
ASTM C32	Sewer and Manhole Brick
ASTM C144	Aggregate for Masonry Mortar
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C478	Precast Reinforced Concrete Manhole Sections

ASTM C923 Specification for Resilient
Connectors Between Reinforced
Concrete Manhole Structures and Pipes

ASTM C1244 Standard Test Method for Concrete Sewer Manholes by the
Negative Air Pressure (Vacuum) Test.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M198 Joints for Circular Concrete Sewer and Culvert Pipe Using
Flexible Watertight Gaskets

Occupational Safety and Health Administration

OSHA 29 CFR 1910.27 Fall Prevention Protection

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE SECTIONS:

A. All precast concrete sections shall conform to ASTM C478 with the following exceptions and additional requirements:

1. The wall thickness of precast sections shall be as designated on the drawings, meeting the following minimum requirements:

<u>Section Diameter (Inches)</u>	<u>Minimum Wall Thickness (Inches)</u>
48	5
60	6
72	7
84	8

2. Type II cement shall be used except as otherwise approved.

3. Sections shall be steam cured and shall not be shipped until at least five days after having been cast.

4. Minimum compressive strength of concrete shall be 4000 psi at 28 days.

5. No more than two lift holes may be cast or drilled in each section.

6. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.

7. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.
 8. Circumferential steel reinforcement in walls and bases shall be a minimum of 0.12 sq. in./lin. ft. for 4-foot diameter sections and 0.15 sq. in./lin. ft. for 5- and 6-foot diameter sections. Reinforcing shall extend into tongue and groove.
- B. Conical reducing sections shall have a wall thickness not less than 5-inches at the bottom and wall thickness of 8-inches at the top. Conical sections shall taper from a minimum of 48-inches diameter to 24 or 30-inches diameter at the top, as shown on the drawings.
 - C. Except where insufficient depth of cover dictates the use of a shorter base, bases shall be a minimum of 4 feet in height.
 - D. Slab top sections and flat riser sections (Grade Rings) shall conform to the contract drawings, with particular attention focused upon the reinforcing steel and be designed to meet or exceed an H-20 Loading requirement.
 - E. The tops of the bases shall be suitably shaped by means of accurate ring forms to receive the riser sections.
 - F. Precast sections shall be manufactured to contain wall openings of the minimum size to receive the ends of the pipes, such openings being accurately set to conform with line and grade of the sewer or drain. Subsequent cutting or tampering in the field, for the purpose of creating new openings or altering existing openings, will not be permitted except as directed by the Owner.
 - G. "Drop-over" manholes shall be placed where indicated on the drawings. The Contractor shall accurately measure the diameter of the existing outlet pipe and inform the manufacturer of its size, so that the "Drop-over" type opening can be cut into the precast manhole base. The bottom shall be cast in place by the Contractor in accordance with Section 03302, FIELD CONCRETE. The invert channel shall be formed of brick and mortar, as specified in this specifications section. The sub-base shall be a compacted, level foundation of crushed stone, at least 6-inches thick, as specified in Section 02300 EARTHWORK, but shall vary to the depth necessary to reach sound undisturbed earth.
 - H. The exterior surfaces of all precast manhole bases, walls, and cones shall be given a minimum of one shop coat of bituminous dampproofing.
 - I. The Owner reserves the right to reject any unsatisfactory precast section and the rejected unit shall be tagged and removed from the job site immediately.
 - J. The Owner may also require the testing of concrete sections as outlined under Physical Requirements in ASTM C478 with the Contractor bearing all testing costs.

2.02 BRICK MATERIALS:

- A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Owner. Bricks shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.
- B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Owner substituted.
- C. Mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as directed and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand.
- D. Cement shall be Type II portland cement as specified for concrete masonry.
- E. Hydrated lime shall be Type S conforming to ASTM C207.
- F. The sand shall comply with ASTM C144 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

2.03 FRAMES, COVERS AND STEPS:

- A. Castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.
- B. All castings shall be thoroughly cleaned and may be subject to a careful hammer inspection at the Owner's discretion.
- C. Castings shall be ASTM A48 Class 30B or better.
- D. The surface of the manhole covers shall have a diamond pattern with the cast word "SEWER".
- E. Manhole frames with 32-inch covers for 30-inch openings shall be 500 pounds minimum by E.L. LeBaron Foundry Co., No. LC328; Quality Water Products, Style 47; Neenah Foundry Co., R1740B or approved equal.
- F. Watertight type manhole frames with 32-inch diameter covers (bolted and gasketed) shall be 4 bolt, 630 pounds minimum by E.L. LeBaron Foundry Co. No. LCB328; Quality Water Products, Style C47WT; Neenah Foundry Co., R-17550-H or approved equal.

- G. Manhole frames with 26-inch covers for 24-inch openings shall be 475 pounds minimum by E.L. LeBaron Foundry Co., No. LK110; Neenah Foundry Co. R1720; Quality Water Products, Style 40; or approved equal.
- H. Watertight type manhole frames with 26-inch diameter covers (bolted and gasketed) shall be 4 bolt, 475 pounds minimum, and shall be E.L. LeBaron Foundry Co. No. LBB268; Mechanics Iron Foundry Type A2073; Quality Water Products, Style 40WT; or approved equal.
- I. Frostproof manhole frames, with covers and inner lids shall be R-1758 series by Neenah Foundry Co., Neenah, WI; LBF series by E.L. LeBaron Foundry Co., Brockton, MA; B-3045 (or similar) by Mechanics Iron Foundry, Boston, MA; or approved equal.
- J. 2-inch thick polystyrene insulation shall be firmly adhered to all frostproof inner lids.
- K. Manhole steps shall conform to ASTM C478 requirements and shall be fabricated of either extruded aluminum or steel reinforced plastic. Steps shall be uniformly spaced at a maximum of 12-inches unless otherwise shown on the drawings.

2.04 SEWER MANHOLE ACCESSORIES:

- A. Gasket materials shall be top grade (100% solids, vulcanized) butyl rubber and shall meet or exceed AASHTO M-198.
- B. Couplings at the manhole-pipe interface shall be made with a rubber seal system (with or without stainless steel straps) meeting the requirements of ASTM C923 and recommended for this type of connection.
- C. Stubs installed as specified and indicated on the drawings shall be short pieces of the same class pipe as that entering the manhole and shall have either stoppers or end caps as shown on the drawings. Stoppers or end caps shall be especially designed for that application.

2.05 MANHOLE FALL PREVENTION SYSTEMS:

- A. Where manholes exceed 20 vertical feet from the proposed rim elevation to the invert, and where called for on the drawings manholes shall be provided with a fall prevention system. Fall prevention systems shall be in accordance with OSHA requirement 29 CFR 1910.27 and as described herein and as indicated on the contract drawings.
- B. Carrier rail assembly shall be 1-5/16-inch O.D. by 1-inch ID Type 6061-T6 aluminum notched .875-inches by .875-inches by 5/32-inches at 6-inch centers; tapped 3/8-inches at 9-inch centers opposite notches.
- C. Manhole rung clamp assembly shall be constructed from 6061-T6 aluminum 11-inches long by 1.25-inches wide with 2 slots 7/16-inches by 1.25-inches at 9-inch centers and serrated on one side.

- D. Safety locking mechanism shall be cast of manganese bronze with stainless steel springs, and drop forged links and snap-locking pawl shall be minimum tensile strength of 110,000 psi. Roller bearing shall be killian type. Stainless steel springs shall comply with Military Specification QQ-W-423B.
- E. Safety harness shall be adjustable to fit waists 30-inch to 48-inch. Belt shall be nylon web equipped with 3 stainless steel 'D' rings.
- F. Fall preventions systems shall be manufactured by DBI/SALA, Safe Approach or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. PRECAST SECTIONS:

1. Precast bases shall be supported on a compacted level foundation of crushed stone, as specified in Section 02300 EARTHWORK, at least 6-inches thick, but shall vary to the depth necessary to reach sound undisturbed earth.
2. Precast reinforced concrete sections shall be set vertical and with sections in true alignment.
3. Butyl rubber joint sealant shall be installed between each concrete section.
4. All holes in sections used for handling the sections shall be thoroughly plugged with non-shrink mortar. Mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch (just short of "balling"), hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

B. BRICK WORK:

1. Bricks shall be moistened by suitable means, as directed, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
2. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as directed.
3. The brick inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

C. CASTINGS:

1. Cast iron frames, grates and covers shall be as specified. The frames and covers shall be set by the Contractor to conform accurately to the grade of the finished pavement, existing ground surface, or as indicated on the drawings. Frames shall be adjusted to meet the street surface. The castings shall only be raised to final grade within 30 days of final paving.
2. Cast iron manhole frames and covers not located in paved areas shall be set 6-inches above finished grade, at a height as directed by the Owner, or as indicated on the drawings. The top of the cone shall be built up with a minimum of 1 course and a maximum of 5 courses of brick and mortar used as headers for adjustment to final grade.
3. Frames shall be set concentric with the top of the concrete section and in a full bed of mortar so that the space between the top of the concrete section or brick headers and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to be flush with the top of the flange and have a slight slope to shed water away from the frame.
4. Covers and/or grates shall be left in place in the frames, for safety reasons, except while work is being performed.

D. ACCESSORIES:

1. Accessories shall be installed in accordance with manufacturer's instructions.
2. Stubs shall be set accurately to the dimensions indicated on the drawings. Stubs shall be sealed with suitable watertight plugs.

E. MANHOLE FALL PREVENTION SYSTEM:

Carrier rail shall extend from the manhole invert shelf to within 18-inches of finish grade. The rail and manhole rung clamp assembly shall be rigidly connected utilizing 3/8-inch stainless steel bolts. Assembly shall be clamped to manhole steps at 2-foot centers or as recommended by the manufacturer.

3.02 LEAKAGE TESTS:

- A. Leakage tests shall be made by the Contractor and observed by the Owner on each manhole. The test shall be by vacuum or by water exfiltration as described below:

B. VACUUM TEST:

1. The vacuum test shall be conducted in accordance with ASTM C1244. Test results will be judged by the length of time it takes for the applied vacuum to drop from 10 inches of mercury to 9 inches. If the time is less than that listed in Table 1 of ASTM C1244, the manhole will have failed the test. Test times from Table 1 are excerpted below.

TABLE 1

Minimum Test Times for Various Manhole Diameters

<u>Depth (Feet)</u>	<u>Diameter (Inches)</u>		
	48	60	72
	<u>Times (Seconds)</u>		
0-12	30	39	49
12-16	40	52	67
16-20	50	65	81
20-24	59	78	97
26-30	74	98	121

2. If the manhole fails the initial test, the Contractor shall locate the leaks and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material. If the manhole should again fail the vacuum test, additional repairs shall be made, and the manhole water tested as specified below.

C. WATER EXFILTRATION TEST:

1. After the manhole has been assembled in place, all lifting holes shall be filled and pointed with an approved non-shrinking mortar. All pipes and other openings into the manhole shall be suitably plugged and the plugs braced to prevent blow out. The test shall be made prior to placing the shelf and invert. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test.
2. The manhole shall be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole may be considered to be satisfactorily water-tight. If the test, as described above, is unsatisfactory as determined by the Owner or if the manhole excavation has been backfilled, the test shall be continued. A period of time may be permitted if the Contractor so wishes, to allow for absorption by the manhole. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and a measuring time of at least 8 hours begun. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour loss rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed one gallon per vertical

foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, repairs by approved methods may be made as directed by the Owner to bring the leakage within the allowable rate of one gallon per foot per day. Leakage due to a defective section or joint or exceeding the 3 gallon per vertical foot per day, shall be cause for rejection of the manhole. It shall be the Contractor's responsibility to uncover the rejected manhole as necessary and to disassemble, reconstruct or replace it as directed by the Owner. The manhole shall then be retested and, if satisfactory, interior joints shall be filled and pointed.

3. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorption, etc. It shall be assumed that all loss of water during the test is a result of leaks through joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the Owner that the water table is below the bottom of the manhole throughout the test.
4. If the groundwater table is above the highest joint in the manhole, and there is no leakage into the manhole, as determined by the Owner, such a test can serve to evaluate water-tightness of the manhole. However, if the Owner is not satisfied with the results, the Contractor shall lower the water table and carry out the test as described hereinbefore.

3.03 CLEANING:

All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

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SECTION 02745

PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish all labor, materials and equipment and shall replace the pavements as herein specified.

1.02 RELATED WORK:

- A. Section 01562, DUST CONTROL
- B. Section 02300, EARTHWORK
- C. Section 02631, PRECAST MANHOLES

1.03 SYSTEM DESCRIPTION:

- A. Unless otherwise directed by the Owner, areas shall be paved with permanent trench binder course pavement, 2 inches thick, in lieu of temporary pavement. Permanent trench binder course pavement shall be installed flush with the existing pavement and maintained until such time as the permanent curb-to-curb top course pavement, 1-1/2 inches thick, is installed. The permanent curb-to-curb top course pavement shall not be installed until the following year or, at a minimum, until the temporary pavement or the trench binder pavement has been in place not less than 90 days, as approved by the Owner.
- B. For streets identified as major or minor arterial roads, binder course pavement shall have a minimum thickness of 4 inches but shall not be less than the existing pavement thickness up to 6 inches.

PART 2 - PRODUCTS

2.01 GRAVEL SUBBASE:

- A. Gravel subbase shall consist of inert material that is hard durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials.
- B. Gradation requirements for gravel subbase shall be as specified in Section 02300, EARTHWORK for Gravel Borrow.

2.02 BITUMINOUS CONCRETE PAVEMENT:

- A. Bituminous concrete pavements shall consist of Class I Bituminous Concrete, Type I-1.

- B. Bituminous concrete mixtures shall be within the composition limits of base courses, binder courses, top courses and surface treatment, in accordance with MHD M3.11.03, with constituents that conform to Table A, below.

TABLE A

PERCENT BY WEIGHT PASSING SIEVE DESIGNATION

Standard Sieves (in.)	Base Course	Binder Course	Top Course	Surface Treat.	Low Permeability Pavement	
					Dense Binder Course	Dense Top Course
2 in	100					
1 in	55-80	100			100	
¾ in		80-100			80-100	
5/8 in			100			
½ in	40-65	55-75	95-100		65-80	100
3/8 in			80-100	100		80-100
No.4	20-45	28-50	50-76	80-100	48-65	55-80
No.8	15-33	20-38	37-54	64-85	37-51	48-63
No.16			26-40	46-68		36-49
No.30	8-17	8-22	17-29	26-50	17-30	24-38
No.50	4-12	5-15	10-21	13-31	10-22	14-27
No.100*			5-16	7-17	6-18	6-18
No.200	0-4	0-5	2-7	3-8	0-6	4-8
Bitumen	4-5	4.5-5.5	5.5-7.0	7-8	5-6	7-8

* Percentages shown for aggregate sizes are stated as proportional percentages of total aggregate for the mix.

Unless authorized by the Owner, no Job-Mix Formula will be approved which specifies:

Less than 4% passing No. 200 for Top Course.

Less than 6% bitumen for Top Course.

- C. The joint sealant shall be a hot poured rubberized emulsified asphalt sealant meeting the requirements of Federal Specifications SS-S-1401 or SS-S-164.

- D. The tack coat shall be an asphalt emulsion, RS-1 if required, conforming to MHD Section M3.03.0.

2.03 SEAL COAT:

- A. Seal coats shall be within the composition limits for protective seal coat emulsion in accordance with MHD M3.03.3.

- B. Silica sand when blended with seal coat emulsion shall be No. 30 silica sand.

2.04 PAVEMENT MARKINGS:

- A. Pavement markings shall conform to the requirements of MHD 860.
- B. The mixture of the marking material shall be within the composition limits for reflectorized pavement markings as described in the MHD Specifications as follows:
 - 1. Thermoplastic reflectorized pavement markings - M7.01.03/04.
- C. Application of the glass beads to be used as reflector material on the striping shall conform to Sections 860.62 and M7.03.07 of the MHD Specifications.

PART 3 - EXECUTION

3.01 GENERAL:

Paving courses required for the project shall be as shown on the drawings and as specified herein. Pavement thicknesses specified are measured in compacted inches. If a pavement course thickness exceeds 2-1/2 compacted inches, the course shall be installed in multiple lifts with each lift not exceeding 2-1/2 compacted inches in thickness.

3.02 STATE HIGHWAY TRENCH REPAIR

- A. The Contractor shall construct and repair trenches in state highways in accordance with the state highway permit. Trench shall be backfilled with Controlled Density Fill or with earth, as stipulated in the permit.

3.03 GRAVEL SUBBASE:

- A. The gravel subbase to be placed under pavement shall consist of 12-inches of gravel evenly spread and thoroughly compacted.
- B. The gravel shall be spread in layers not more than 4-inches thick, compacted measure. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by ASTM D1557 Method C at optimum moisture content.

3.04 TEMPORARY BITUMINOUS PAVEMENT:

- A. On major and minor arterial roads as specified herein, and where directed by the Owner and after placement of the gravel subbase, the Contractor shall place temporary bituminous pavement above the trench, between the edges of the existing pavement. It shall consist of Class I Bituminous Concrete Pavement, Type I-1, 2-inches thick, in accordance with MHD 460.

- B. The temporary pavement shall be repaired as necessary to maintain the surface of the pavement until replaced by permanent pavement. When so directed by the Owner, the Contractor shall remove the temporary pavement and install or regrade the subbase for installation of permanent pavement.

3.05 PERMANENT BITUMINOUS PAVEMENT:

- A. The bituminous paving mixture, equipment, methods of mixing and placing, and the precautions to be observed as to weather, condition of base, etc., shall be in accordance with MHD 460.

- B. BASE COURSE AND BINDER COURSE PAVEMENT:

1. Immediately prior to installing the base and/or binder course, the trimmed edges shall be made stable and unyielding, free of loose or broken pieces and all edges shall be thoroughly broomed clean. Contact surfaces of trench sides, curbs, manholes, catch basins, or other appurtenant structures in the pavement shall be painted thoroughly with a uniform coating of asphalt emulsion (tack coat), just before any mixture is placed against them.
2. The binder course shall be repaired as necessary to maintain the surface of the pavement until placement of the permanent overlay. If required, the Contractor shall place a leveling course before placing the permanent overlay.

- C. TOP COURSE OR SURFACE TREATMENT PAVEMENT (PERMANENT OVERLAY):

1. Top course or surface treatment shall be placed over the trench or full width as shown on the drawings or as specified.
2. Prior to placement of the top course or surface treatment, the entire surface over which the top course or surface treatment is to be placed shall be broom cleaned and tack coated.
3. Top course or surface treatment pavement placed over trenches may be feathered to meet existing paved surfaces, if approved by the Owner.
4. Prior to placing full width top course or surface treatment pavements, keyways shall be cut in all intersecting streets.

3.06 PAVEMENT PLACEMENT:

- A. Unless otherwise permitted by the Owner for particular conditions, only machine methods of placing the pavement shall be used. The equipment for spreading and finishing shall be mechanical, self-powered pavers, capable of spreading and finishing the mixture true to line, grade, width and crown. The mixtures shall be placed and compacted only at such times as to permit proper inspection and checking by the Owner.

- B. After the paving mixtures have been properly spread, initial and intermediate compaction shall be obtained by the use of steel wheel rollers having a weight of not less than 240 pounds per inch width of tread.
- C. Final rolling of the top course or surface treatment pavement shall be performed by a steel wheel roller weighing not less than 285 pounds per inch width of tread at a mix temperature and time sufficient to allow for final smoothing of the surface and thorough compaction.
- D. Immediately after placement of top course or surface treatment pavement, all joints between the existing and new top course or surface treatment pavements shall be sealed with hot poured rubberized asphalt sealant meeting the requirements of Federal Specification SS-S-1401 or SS-S-164.
- E. Where there is no backing for the edges of the curb-to-curb pavement, the Contractor shall provide a gravel transition. The gravel transition shall be installed immediately after the pavement is placed, shall be feathered and extend a minimum of 18 inches, and shall be compacted using the same equipment as for pavement compaction. The gravel shall be uniformly graded material with a maximum size of 3/8 to 1/2 inch.
- F. When directed by the Owner, the Contractor shall furnish and install additional paving to provide satisfactory transition for driveways and walkways impacted by a new curb-to-curb pavement installation. The transition installation will be considered incidental to the curb-to-curb pavement installation.

3.07 ADDITIONAL PAVING:

- A. If the Owner determines that the existing bituminous concrete pavement on local streets is thicker than the permanent pavement specified herein, the Contractor may be required to install additional Type I-1 bituminous concrete to obtain the depth of the existing pavement.
- B. If for the installation of full width paving, the Owner determines that the existing road surface requires additional leveling pavement, then the Contractor shall install additional Type I-1 bituminous concrete to bring the section to proper line and cross section. Additional paving required to restore the proper line and cross section of binder course installed by the Contractor which has become rough and uneven shall be furnished and installed at the expense of the Contractor.

3.08 PARKING LOTS AND DRIVEWAYS:

- A. Pavement shall consist of a 2-inch binder course and a 1-1/2-inch top course on a 12-inch gravel sub-base. All thicknesses are compacted thicknesses.

- B. Adjacent concrete work, slate work, sidewalks, structures, etc., shall be protected from stain and damage during the entire operation. Damaged or stained areas shall be replaced or repaired to equal their original condition.
- C. All joints between binder and top course shall be staggered a minimum of 6-inches.
- D. After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened sufficiently to prevent distortion and loss of fines, and in no case in less than 6 hours.
- E. Smoothness of all areas of the finished surface shall not vary more than 1/4-inch when tested with a 16 foot straight-edge, applied both parallel to and at right angles to the centerline of the paved area. At building entrances, curbs, and other locations where an essentially flush transition is required, pavement elevation tolerance shall not exceed plus or minus 1/8-inch. Irregularities exceeding these amounts, or which retain water on the surface, shall be corrected by removing the defective work and replacing or repairing it to the satisfaction of the Owner.
- F. The surface area to be seal coated, as shown on the drawings, shall be swept and air cleaned. The first coat shall be applied with eight (8) pounds of #30 silica sand blended with each gallon of emulsion applied at a rate of 0.15 gallons per square yard. The second coat shall be a straight sealer applied at the rate of 0.1 gallons per square yard.
- G. Parking lot line painting shall be in accordance with Section 09900, PAINTING.

3.09 RAISING AND ADJUSTING CASTINGS:

- A. In areas of permanent top course paving, existing municipally-owned catch basin and manhole castings and valve boxes shall be raised to the proper grade where directed by the Owner.
- B. Castings owned by private utilities shall be raised by their own forces. The Contractor shall be responsible for coordinating this work.
- C. The method of adjusting these castings shall be as follows: Cut around catch basin or manhole castings a minimum of 8-inches from casting. Excavate and if required rebuild up to 12-inches of masonry below the bottom of the casting. Backfill with suitable material and compact to bottom of casting. Place high, early strength cement or bituminous concrete collar, as directed, to approximately 1½-inches below the raised casting grade. Masonry work shall conform to Section 02631, PRECAST MANHOLES.
- D. In some areas, raising of castings may not be required. Where directed by the Owner, castings not to be raised shall have at least 12-inches of bituminous concrete pavement chipped and removed around the casting. New bituminous concrete pavement shall be placed and compacted around such castings to approximately 1-1/2-inches below the top of the casting. The overlay course shall then be sloped down to the level of the casting.

- E. The method of raising valve boxes shall be as follows: Cut around valve box a minimum of 8-inches from valve box. Excavate as required and raise the valve box. Pour high early strength cement or bituminous concrete collar, as directed, to approximately 1-1/2-inches below the top of the valve box.
- F. Castings which need to be raised or adjusted to complete permanent curb to curb paving shall be done immediately prior to paving.

3.10 PAVEMENT MARKINGS:

- A. The Contractor shall replace all pavement markings removed or covered-over in carrying out the work, and as directed by the Owner, no sooner than 48 hours after completion of permanent pavement. The markings shall be 4-inches wide, white or yellow, single or double lines as required.
- B. When directed by the Owner, the Contractor shall provide temporary markings at no additional cost to the Owner.

3.11 PAVEMENT REPAIR:

- A. If required in the contract or if permanent pavement becomes rough or uneven, permanent pavement patches and trenches shall be repaired and brought to grade utilizing "infrared" paving methods following completion of the construction.
- B. The Contractor performing the work shall use care to avoid overheating the pavement being repaired.
- C. Pavement repair shall extend a minimum of 6-inches beyond all edges of the pavement patch to assure adequate bonding at the pavement joints.

END OF SECTION

SECTION 02771

CURBING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section covers furnishing and installation of granite curb, bituminous concrete curb and precast parking curb, herein specified.
- B. This section also covers replacement of curbing removed during construction.

1.02 RELATED WORK:

- A. Required earthwork is specified under Section 02300 EARTHWORK.
- B. Section 02745, PAVING.
- C. Section 02775, SIDEWALK REPLACEMENT

1.03 REFERENCES:

The following standards form a part of these specifications, as referenced:

Massachusetts Highway Department

MHD: Standard Specifications for Highways and Bridges

PART 2 - PRODUCTS

2.01 GRANITE CURBING:

- A. Granite curbing shall be Type VAI conforming to Subsection M9.04.1 of the latest edition of the MHD Standard Specifications for Highways and Bridges.
- B. Special shapes and corners shall be supplied as required.

2.02 GRANITE EDGING:

- A. Granite edging shall be Type SB conforming to Subsection M9.04.2 of the latest edition of the MHD Standard Specifications for Highways and Bridges.
- B. Special shapes and corners shall be supplied as required.

2.03 BITUMINOUS CONCRETE CURB

Bituminous concrete curb shall be Type 2 conforming to Subsection M3.12.0 of the latest edition of the MHD Standard Specifications for Highways and Bridges.

2.04 PRECAST PARKING LOT CURB:

- A. Precast parking lot curb shall be formed with concrete rated at 3500 psi at 28 days.
- B. The manufacturer shall maintain at the manufacturing site a record of material used and their sources, and a copy of concrete mix designs.
- C. Precast parking lot curb shall be the Standard Precast Bumper Curb as manufactured by Durastone Co., Lincoln, RI, or approved equal.

PART 3 - EXECUTION

3.01 GRANITE CURBING:

- A. Removal and resetting and/or removal and replacing of granite curbing shall be in accordance with Section 580 of the latest edition of the Standard Specifications for Highways and Bridges of the Department of Public Works of the Commonwealth of Massachusetts and all amendments thereto. The curbing shall have a 7-inch reveal unless otherwise directed by the Owner.
- B. Except as modified herein or on the drawings, installation of curbing shall conform to Section 500 of the MHD Standard Specifications for Highways and Bridges.
- C. Excavation shall be made to the bottom of the 6-inch gravel base below the curbing, the trench being sufficiently wide to permit thorough tamping. The base shall be compacted to a firm, even surface and shall be approved by the Owner.
- D. The curbing shall be set on edge and settled into place with a heavy wooden hand-rammer, to the line and grade required, straight and true for the full depth. The joints of the stone curbing shall be pointed with mortar for the full depth of the curbing. At approximately 50-foot intervals, a 1/2-inch joint shall not be filled with mortar but left free for expansion. The ends of the stone curbing at driveways and intersections shall be cut at a bevel or rounded as directed by the Owner.
- E. The trench for the stone curbing shall be backfilled with approved material; the first layer to be 4 inches in depth, thoroughly rammed; the other layers to be more than 6 inches in depth and thoroughly rammed until the trench is filled.
- F. Where indicated on the plans, or as directed, drainage openings shall be made through the curbing at the elevations and of the size required.

3.02 GRANITE EDGING:

- A. Except as modified herein and on the drawings, installation of granite edging shall conform to Section 500 of MHD Standard Specifications for Highways and Bridges.
- B. The cement concrete base shall be placed on a well tamped sub-base acceptable to the Owner, and shall be constructed of 3000 psi concrete, minimum, as shown on the drawings.
- C. The edging shall be set to the proper lines and grades on the concrete base and on a well-tamped sloping gravel surface.

3.03 BITUMINOUS CONCRETE CURB:

- A. Replacement of bituminous concrete curbs shall be in accordance with Section 500 of the latest edition of the Standard Specification for Highways and Bridges of the Department of Public Works of the Commonwealth of Massachusetts and all amendments thereto. The curbing shall have a 6-inch reveal unless otherwise directed by the Owner.
- B. Unless modified herein, installation shall conform to Section 501.64 of the MHD Standard Specifications for Highways and Bridges.
- C. When indicated on the plans, or as directed, drainage openings shall be made through the curb at the elevations and of the size required.

3.04 PRECAST PARKING LOT CURBING:

- A. Precast parking lot curbing shall be furnished and installed as indicated on the drawings.
- B. Any units which are cracked, chipped, spalled, or otherwise damaged shall be removed and replaced with units meeting the specified requirements.

END OF SECTION

SECTION 02775

SIDEWALK CONSTRUCTION AND REPLACEMENT

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish all labor, materials, equipment and incidentals required to restore gravel sidewalks and/or construct new or replacement bituminous or cement concrete sidewalks where directed or where existing sidewalks are disturbed by the Contractor, as shown on the drawings and described herein. The Contractor shall also furnish all materials and install wheelchair ramps where shown on the drawings or as directed by the Owner.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02771, CURBING

1.03 SYSTEM DESCRIPTION:

A. GRAVEL SIDEWALKS:

Gravel sidewalks shall be restored to a condition at least equal to that existing immediately before the work was started.

B. BITUMINOUS AND CEMENT CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS:

1. Except as otherwise indicated, bituminous and cement concrete sidewalks and wheelchair ramps shall be constructed in accordance with the requirements of Section 701, Sidewalks, Wheelchair Ramps and Driveways, of the latest edition of the Standard Specifications for Highways and Bridges of the Massachusetts Highway Department (MHD), and all amendments thereto.
2. Wheel chair ramps shall be installed in new sidewalks at intersections in accordance with 521 CMR. When curbs or sidewalks are constructed or reconstructed on one side of the street, curb cuts shall also be installed on the opposite sides of the street, where there is a pedestrian path of travel. Curb cuts shall be located within the crosswalk and/or the pedestrian path of travel.

- C. Water boxes, manhole frames, and all other castings shall be carefully set to the proposed finished grade.

PART 2 - PRODUCTS

2.01 BITUMINOUS CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS:

- A. Bituminous concrete sidewalks and wheelchair ramps shall consist of Class I Bituminous Concrete.
- B. Bituminous concrete shall conform to the requirements of MHD M3.11.

2.02 CEMENT CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS:

- A. Cement concrete sidewalks shall be constructed with air entrained Cement Concrete with a minimum compressive strength of 4000 psi at 28 days.
- B. Cement concrete shall conform to the requirements of MHD M4.02.

PART 3 - EXECUTION:

3.01 BITUMINOUS CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS:

- A. The subgrade for the bituminous concrete sidewalks and wheelchair ramps shall be shaped parallel to the proposed surface of the sidewalks and shall be thoroughly rolled and tamped. All depressions occurring shall be filled with suitable material and again rolled or tamped until the surface is smooth and hard in order for a gravel foundation to be placed upon it.
- B. The bituminous concrete sidewalk shall be a minimum of 2½ compacted inches thick, laid in two equal courses. The sidewalk pitch shall be 3/16 inch per foot of width or shall match the existing sidewalk.

3.02 CEMENT CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS:

- A. Concrete for sidewalks and wheelchair ramps shall be a minimum of 4 inches thick. At driveways, the sidewalks shall be 6 inches thick.
- B. The subgrade for the walk or driveway shall be shaped to a true surface conforming to the proposed slope of the walk, thoroughly rolled at optimum moisture content and tamped with a power roller weighing not less than one ton and not more than 5 tons. All depressions occurring shall be filled with suitable material and again rolled or tamped until the surface is smooth and hard.
- C. After the subgrade has been prepared as hereinbefore specified, a subbase of gravel borrow at optimum moisture content shall be placed, thoroughly rolled by a power roller, and tamped. The gravel borrow shall be a minimum of 8 inches in thickness.
- D. The forms for sidewalks shall be smooth, free from warp, strong enough to resist springing out of shape, and deep enough to conform to the thickness of the proposed walk. All

mortar or dirt shall be completely removed from forms that have been previously used. The forms shall be well staked, thoroughly braced, and set to the established lines with their upper edge conforming to the grade of the finished walk. The finished walk shall have sufficient pitch from the outside to the edge of the walk to provide for surface drainage. This pitch shall be 1/4 of an inch per foot unless otherwise directed by the Owner. Before the concrete is placed, the subbase for sidewalks shall be thoroughly dampened until it is moist throughout but without puddles of water.

- E. Concrete shall be conveyed from the place of mixing to the place of deposit in such a manner that no mortar will be lost, and the composition of the mix shall be uniform, showing neither excess nor lack of mortar in any one place. The consistency shall be such that water will float to the surface under heavy tamping. The concrete shall be placed as close to its final position as practicable and thoroughly consolidated, with precautions taken not to overwork it while it is still plastic. The concrete shall be thoroughly spaded along the forms or screeds to eliminate voids and honeycombs at the edges. Retempering of concrete will not be permitted.
- F. Concrete shall be placed in alternate slabs not exceeding 30 feet in length. Slabs shall be separated by transverse preformed expansion joint filler 1/2 inch thick. The surface of all concrete sidewalks shall be uniformly scored into block units of not more than 40 square feet. The depth of the scoring shall be at least one quarter of the thickness of the sidewalk.
- G. When concrete sidewalks are constructed adjacent to curbing, building foundations, retaining walls, light pole bases or fixed structures, 1/2 inch thick preformed joint filler shall be used between the newly constructed sidewalk and the structure.
- H. Finishing of the concrete surface shall be done by experienced and competent cement finishers as soon as is practicable. Finishing shall be delayed until all bleed water and water sheen has left the surface and the concrete has begun to stiffen. The concrete surface shall be finished as directed with a steel trowel or wood float to give a smooth, uniform and attractive surface finish and uniformly scored into block units or areas of not more than 36 square feet. Following this, the Contractor shall draw a nylon push broom lightly over the surface to produce a non-slip surface. Application of neat cement to the surface to hasten hardening is prohibited.
- I. The Contractor shall protect the newly placed concrete surface against vandalism and marking or defacing and must stand ready to replace any blocks which, in the opinion of the Owner, are excessively marked or defaced, at no additional cost to the Owner. When completed the walks shall be kept moist and protected from traffic and weather for at least 3 days.
- J. Adequate protection shall be provided where temperatures of 40°F or lower occur during placing of concrete and during the early curing period. The minimum temperature of fresh concrete after placing and for the first 3 days shall be maintained above 55°F. In addition to the above requirements, an additional 3 days of protection from freezing shall be maintained.

END OF SECTION

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SECTION 02920

LOAMING AND SEEDING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers all labor, materials, and equipment necessary to do all loaming, seeding and related work as herein specified. All lawns disturbed by the Contractor's operations shall be repaired as herein specified.

1.02 RELATED WORK:

- A. Section 02931, LANDSCAPING

1.03 QUALITY ASSURANCE:

- A. For a particular source of loam, the Owner may require the Contractor to send approximately 10 pounds of loam to an approved testing laboratory and have the following tests conducted:
 - 1. Organic concentration
 - 2. pH
 - 3. Nitrogen concentration
 - 4. Phosphorous concentration
 - 5. Potash concentration
- B. These tests shall be at the Contractor's expense. Test results, with soil conditioning and fertilizing recommendations, shall be forwarded to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. LOAM:

- 1. Loam shall be a natural, fertile, friable soil, typical of productive soils in the vicinity, obtained from naturally well-drained areas, neither excessively acid nor alkaline, and containing no substances harmful to grass growth. Loam shall not be delivered to the site in frozen or muddy condition and shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than 1 inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter.

2. The loam shall contain not less than 4 percent nor more than 20 percent organic matter as determined by the loss of weight by ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F.

B. LIME:

Lime shall be standard commercial ground limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide), and 50 percent of the material must pass through a No. 100 mesh sieve with 98 percent passing a No. 2 mesh sieve.

C. FERTILIZER:

Fertilizer shall be commercial fertilizer, 10-10-10 fertilizer mixture containing at least 40 percent of organic nitrogen. It shall be delivered to the site in the original sealed containers, each showing the manufacturer's guaranteed analysis. Fertilizer shall be stored so that when used it will be dry and free flowing. No fertilizer shall be used which has not been marketed in accordance with State and Federal Laws, relating to fertilizers.

D. MULCH:

1. Materials to be used in mulching shall conform to the following requirements:
2. Hay Mulch - Hay Mulch shall consist of mowed and properly cured grass, clover or other acceptable plants. No salt hay shall be used.
3. Straw Mulch - Straw Mulch shall consist of stalks or stems of grain after threshing.
4. Wood Fibre Mulch - Wood Fibre Mulch shall consist of wood fibre produced from clean, whole uncooked wood, formed into resilient bundles having a high degree of internal friction and shall be dry when delivered to the project.

E. SEED:

1. Seed shall be of an approved mixture, the previous year's crop, clean, high in germinating value, a perennial variety, and low in weed seed. Seed shall be obtained from a reliable seed company and shall be accompanied by certificates relative to mixture purity and germinating value.

2. Grass seed for lawn areas shall conform to the following requirements:

	Proportion by Weight	Germination Purity	Purity Minimum
Chewing's Fescue	30%	70%	97%
Kentucky 31 Fescue	30%	90%	98%
Kentucky Blue Grass	20%	80%	85%
Domestic Rye Grass	20%	90%	98%

Grass seed for cross-country areas, slopes and other areas not normally mowed shall conform to the following requirements:

	Proportion by Weight	Germination Minimum	Purity Minimum
Creeping Red Fescue	50%	85%	95%
Kentucky 31	30%	85%	95%
Domestic Rye	10%	90%	98%
Red Top	5%	85%	92%
Ladino Clover	5%	85%	96%

F. TEMPORARY COVER CROP:

1. Temporary cover crop shall conform to the following requirements:

	% Weight	Germination Minimum
Winter Rye	80 min.	85%
Red Fescue (creeping)	4 min.	80%
Perennial Rye Grass	3 min.	90%
Red Clover	3 min.	90%
Other Crop Grass	0.5 max.	
Noxious Weed Seed	0.5 max.	
Inert Matter	1.0 max.	

G. SLOPE EROSION PROTECTION:

1. Erosion control blanket shall be 100% degradable plastic mesh with 100% degradable straw or straw/coconut fill. Fill shall be held together by degradable fastening. Weight shall be 0.50 lb/sq. yd. Erosion control blankets shall be applied parallel to direction of water flow. The erosion control blankets shall be by North American Green, Evansville, IN or approved equal. For slopes 2:1 or greater, Model SC150 shall be used. For slopes less than 2:1, Model S150 shall be used.
2. Six inch wire staples shall be placed according to manufacturers recommendations to anchor the mesh material. Staples shall be designed to decompose.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. After approval of rough grading, loam shall be placed on areas affected by the Contractor's operations. Loam shall be at least 6 inches compacted thickness.
- B. Lime shall be applied to bring the pH to 6.5 or, without a soil test, at the rate of 2-3 tons of lime per acre.
- C. Fertilizer shall be applied according to the soil test, or without a soil test, at the rate of 1000 pounds per acre.
- D. Loam shall be worked a minimum of 3 inches deep, thoroughly incorporating the lime and fertilizer into the soil. The loam shall then be raked until the surface is finely pulverized and smooth and compacted with rollers, weighing not over 100 pounds per linear foot of tread, to an even surface conforming to the prescribed lines and grades. Minimum depth shall be 6-inches after completion.

3.02 SEEDING:

- A. Seeding shall be done when weather conditions are approved as suitable, in the periods between April 1 and May 30 or August 15 to October 1, unless otherwise approved.
- B. If there is a delay in seeding, during which weeds grow or soil is washed out, the Contractor shall remove the weeds or replace the soil before sowing the seed, without additional compensation. Immediately before seeding is begun, the soil shall be lightly raked.
- C. Seed shall be sown at the approved rate, on a calm day by machine.
- D. One half the seed shall be sown in one direction and the other half at right angles. Seed shall be raked lightly into the soil to a depth of 1/4 inch and rolled with a roller weighing not more than 100 pounds per linear foot of tread.

- E. The surface shall be kept moist by a fine spray until the grass shows uniform germination over the entire area. Wherever poor germination occurs in areas larger than 3 sq. ft., the Contractor shall reseed, roll, and water as necessary to obtain proper germination.
- F. The Contractor shall water, weed, cut and otherwise maintain and protect seeded areas as necessary to produce a dense, healthy growth of perennial lawn grass.
- G. If there is insufficient time in the planting season to complete the fertilizing and seeding, permanent seeding may be left until the following planting season, at the option of the Contractor or on order of the Owner. In that event, a temporary cover crop shall be sown. This cover crop shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the area shall be fertilized and the permanent seed crop shall be sown as specified.

3.03 PLACING MULCH:

- A. Hay or Straw Mulch shall be loosely spread to a uniform depth over all areas designated on the plans, at the rate of 4-1/2 tons per acre, or as otherwise directed.
- B. Hay or Straw Mulch may be applied by mechanical apparatus, if in the judgment of the Owner the apparatus spreads the mulch uniformly and forms a suitable mat to control slope erosion. The apparatus shall be capable of spreading at least 80 percent of the hay or straw in lengths of 6-inches or more, otherwise it shall be spread by hand without additional compensation.
- C. Wood Fibre Mulch shall be uniformly spread over certain selected seeded areas at the minimum rate of 1,400 pounds per acre unless otherwise directed. It shall be placed by spraying from an approved spraying machine having pressure sufficient to cover the entire area in one operation.

3.04 SEEDING AND MULCHING BY SPRAY MACHINE:

- A. The application of lime, fertilizer, grass seed and mulch may be accomplished in one operation by the use of an approved spraying machine. The materials shall be mixed with water in the machine and kept in an agitated state in order that the materials may be uniformly suspended in the water. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of lime, fertilizer, grass seed and mulch shall be equal to the specified quantities.
- B. A certified statement shall be furnished, prior to start of work, to the Owner by the Contractor as to the number of pounds of limestone, fertilizer, grass seed and mulch per 100 gallons of water.
- C. This statement should also specify the number of square yards of seeding that can be covered with the solution specified above. If the results of the spray operation are

unsatisfactory, the Contractor will be required to abandon this method and to apply the lime, fertilizer, grass seed and mulch by other methods.

3.05 INSPECTION AND ACCEPTANCE:

At the beginning of the planting season following that in which the permanent grass crop is sown, the seeded areas will be inspected. Any section not showing dense, vigorous growth at that time shall be promptly reseeded by the Contractor at his own expense. The seeded areas shall be watered, weeded, cut and otherwise maintained by the Contractor until the end of that planting season, when they will be accepted if the sections show dense, vigorous growth.

END OF SECTION

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SECTION 02931

LANDSCAPING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers landscaping, complete.
- B. The schedule of trees and shrubs is indicated on the Drawings.

1.02 SYSTEM DESCRIPTION:

The Contractor shall furnish all plants and shrubs as specified. No substitutes will be permitted. All plants shall be nursery grown in local nurseries.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Plants shall be in accordance with the USA Standard for Nursery Stock of the American Association of Nurserymen.
- B. All plants shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. All plants shall have been grown under climatic conditions similar to those in the locality of the site of the project under construction or have been acclimated to such conditions for at least two years.
- C. All plants shall be moved with the root systems as solid units with balls of earth firmly wrapped with burlap. The diameter and depth of the balls of earth shall be sufficient to encompass the fibrous root feeding system necessary for the healthy development of the plant. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during the process of planting or after the burlap, staves, ropes, or platform required in connection with its transplanting have been removed. The plants and balls shall remain intact during all operations. All plants that cannot be planted at once shall be heeled in by setting the ground and covering the balls with soil and then watering.
- D. The height of the trees (measured from the crown of the roots to the tip of the top branch) shall be not less than the minimum size designated on the drawings. The "Diameter Breast High" (measured with calipers) related to the height of the tree shall conform to accepted nursery standards. The trunk of each tree shall be a single trunk growing from a single unmutilated crown of roots, unless indicated as clump plant material. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sun-scald, frost cracks, or wounds resulting from abrasions, fire, or

other causes. No pruning wounds shall be present having a diameter exceeding 2 inches, and such wounds shall show vigorous bark on all edges.

- E. Shrubs shall be a minimum of 2-feet in height and spaced 4 feet by 4 feet apart, or as directed by the Owner. The measurement for height shall be taken from the ground level to the average height of the shrub and not to the longest branch. The thickness of each shrub shall correspond to the trade classification "No. 1". Single stemmed or thin plants will not be accepted. The side branches shall be generous, well-twiggged, and the plant as a whole well-branched to the ground.
- F. The plants shall be in a moist, vigorous condition free from dead wood, bruises, or other root or branch injuries.
- G. Ground cover plants shall be of size, age, and/or condition listed above. Plants shall be healthy, free of insects, and diseases. Ground cover plants shall be potted or in sod.
- H. Humus shall be ground or shredded peat which has been stockpiled for at least one year prior to its use.
- I. Manure shall be well-rotted, unleached, stable manure not less than eight months and not more than two years old. It shall be free from sawdust, shavings, or refuse of any kind and shall not contain over 25 percent straw. The Contractor shall furnish information as to the kind of disinfectant or chemicals, if any, that may have been used in storage of the manure.
- J. A composition of peat moss or peat humus to which has been added dehydrated manure (such as bovung) in the proportion of 100 pounds of dehydrated manure per cubic yard of peat may be substituted for manure as specified above.
- K. Stakes for supporting small trees under 8 feet tall shall be 1-1/2-inch square and not less than 8 feet in length. They shall be of sound wood of uniform size, reasonably free of knots, and capable of standing in the ground at least two years. Trees larger than 8 feet tall shall be wired and staked in three equally spaced locations.
- L. Hose to encase wires shall be new or used two-ply reinforced rubber garden hose not less than 1/2-inch diameter.
- M. Drive anchors and guy wire assemblies shall be suitable for protecting the trees and shall be sized in accordance with the manufacturers' specifications and recommendations.
- N. Mulch materials shall be softwood shredded pine bark mulch or medium grade wood chips. Mulch shall be 98 percent organic matter with the pH range of 3.5 to 4.5. Moisture content of packaged material shall not exceed 35 percent.
- O. Woodchips shall be obtained from sound, green wood, and shall be 1/8 inch nominal thickness with not less than 50 percent of the chips having an area of not less than one (1) square inch, nor more than six (6) square inches. The material shall be free from rot,

leaves, twigs, shavings, debris, and material injurious to plant growth. The material may be checked by the Owner for suitability. If the material is rejected, it shall be removed promptly from the site and replaced by suitable material at the Contractor's expense.

- P. Fabric underlying wood chips shall be non-biodegradable, permeable landscaping fabric especially designed to inhibit weed growth and prevent mixing the wood chip cover with the underlying soil.
- Q. Wrapping material shall be first quality, heavy waterproof crepe paper manufactured for this purpose. Strips shall be 8 to 10 inches wide. Twine for tying shall be lightly medium or coarse sisal yarn.

PART 3 - EXECUTION

3.01 PLANTING:

- A. The furnishing and planting of any plant material includes the digging of the holes, provision for fertilizer, loam, furnishing the plants of specified size with roots in the specified manner, the labor of planting and mulching and guying where called for.
- B. The trees and shrubs shall be planted in strict accordance with the supplier's specifications, utilizing the proper fertilizers and soil conditioners.
- C. Seasons for planting shall be as specified below:
 - 1. Spring

Deciduous materials shall be planted between March 21 and May 1. Evergreen materials shall be planted between April 15 and June 1.
 - 2. Fall

Deciduous materials shall be planted between October 1 and December 1. Evergreen materials shall be planted between August 15 and October 15.
- D. No trees or shrubs shall be planted until approval of the Owner is obtained.
- E. Location for all plants and outlines for planting areas shall be staked on the ground as shown on the drawings for approval by the Owner. The Owner may make minor adjustments. Maintain at all times during the planting operations one or more loam stockpiles of approved quality loam.
- F. Plant pits shall be excavated with vertical sides. Holes for trees shall be at least 2 to 3 times the diameter of the rootball and the hole shall be dug exactly as deep as the rootball. Holes for shrubs shall be at least 2 times the diameter of the rootball and dug exactly as deep as the rootball.

- G. Loam for backfill shall have thoroughly incorporated with it well rotted manure in the proportion of 1 cubic yard of manure to 7 cubic yards of topsoil, or equivalent of dehydrated manure.
 - H. All plant roots and earth balls shall be damp and thoroughly protected from sun and wind from the beginning of the digging operation, during transportation, and on the ground until the final planting. The plants shall be planted in the center of the holes and at the same depth as they previously grew. Loam shall be backfilled in layers of not more than 9 inches and each layer watered sufficiently to settle before the next layer is put in place. Enough topsoil shall be used to bring the surface to finished grade when settled. A saucer shall be formed around each plant to a depth of 6 inches for trees and 4 inches for shrubs.
 - I. Plants shall be flooded with water twice within the first 24 hours of the time of planting.
 - J. All trees shall be wrapped immediately after planting. Trunks shall be wrapped spirally from ground to height of second branches overlapping by approximately 2 inches.
 - K. A 2-inch thick (after settlement) layer of mulch shall be applied to the entire area of each saucer or planting bed.
 - L. In the event that rock or underground construction work or obstructions are encountered in any plant pit or bed excavation work to be done under this Contract, alternate locations may be selected by the Owner.
 - M. No debris shall be left at the site. Excavated material shall be removed as directed. Any damage to site or structures shall be repaired.
 - N. Each tree and shrub shall be pruned in accordance with the American Nurserymen Association Standards to preserve the natural character of the plant. All dead wood or suckers and all broken and badly bruised branches shall be removed. Pruning shall be done with clean sharp tools.
 - O. Cuts shall be painted with an approved asphaltic tree paint. Paint shall cover all exposed living tissue.
 - P. All shrubs that are "pot bound"; whereas their roots are tightly wrapped around each other after the pot is removed, shall have three (3) vertical cuts sliced into the roots spaced evenly around the root ball from the top of the root ball to the bottom. If this does not loosen the root sufficiently, manually loosen the interwoven roots by hand.
- 3.02 PLANT MAINTENANCE AND GUARANTEE:
- A. Maintenance shall begin immediately after each plant is planted and shall continue for 30 days.

- B. Maintenance shall include watering (equivalent to 1½" of rain twice a week for the first eight (8) weeks), weeding, cultivating, mulching, tightening and repairing guys, removal of dead material, resetting plants to proper grades or upright position, and maintaining the planting saucer.
- C. After the 30-day maintenance period, the Contractor shall request the Owner for an inspection to determine whether the plant material is acceptable. If the plant materials and workmanship are acceptable, written notice will be given by the Owner to the Contractor stating that the guarantee period begins from the date of inspection.
- D. Plants shall be guaranteed for a period of one year after inspection. At the end of the guarantee period, inspection will be made again. Any plant that is dead or unsatisfactory shall be removed from the site. These shall be replaced during the normal planting season until the plants live through one year. A plant may be considered unsatisfactory if there is evidence of disease, or if the plant has dead leaves or limbs, and insufficient growth when compared to normal standards.
- E. All replacements shall be plants of the same kind and size specified hereinbefore. The cost shall be borne by the Contractor, except for possible replacements due to vandalism or neglect on the part of others.

END OF SECTION

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all concrete and all related items necessary to place and finish the concrete work.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 09900, PAINTING
- C. Section 15408, PLUMBING
- D. Items furnished under other Sections and installed under this Section include, but are not limited to:

Items embedded in concrete, including anchors, sleeves, floor drains, castings, frames for hatches, angles, nosings, and other miscellaneous metals.

1.03 REFERENCES:

- A. The following standards form a part of these specifications:

American Concrete Institute (ACI)

- ACI 301 Structural Concrete for Buildings
- ACI 302 Recommended Practice for Concrete Floor and Slab Construction
- ACI 304 Recommended Practice for Measuring, Mixing, Transporting, and Replacing Concrete
- ACI 305 Recommended Practice for Hot Weather Concreting
- ACI 306 Recommended Practice for Cold Weather Concreting
- ACI 318 Building Code Requirements for Reinforced Concrete
- ACI 347 Recommended Practice for Concrete Formwork
- ACI 350 Concrete Sanitary Engineering Structures

American Society for Testing and Materials (ASTM)

ASTM	C33	Concrete Aggregates
ASTM	C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM	C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM	C87	Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM	C94	Ready-Mixed Concrete
ASTM	C143	Standard Method for Slumps of Portland Cement Concrete
ASTM	C150	Portland Cement
ASTM	C171	Sheet Materials for Curing Concrete
ASTM	C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM	C260	Air-Entraining Admixtures for Concrete
ASTM	C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM	C494	Chemical Admixtures for Concrete
ASTM	D1751	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM	D1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of shop drawings of the materials specified herein shall be submitted to the Owner for review.
- B. Six copies of the statement of materials constituting the design of mixes which satisfy the specified strength for each size aggregate as required by ASTM C94 shall be submitted to the Owner within one week following award of the contract.
- C. Provide one copy of the "Certificate of Delivery" for each load of concrete as it arrives on the site, under the provisions of ASTM C94.

PART 2 - PRODUCTS

2.01 CONCRETE:

- A. Concrete conforming to the requirements listed below shall be used where indicated on the drawings. Unless otherwise indicated, concrete used as fill under foundations, and elsewhere approved by the Owner, shall be the 3,000 psi mix.

TABLE

Minimum Comp. Strength at 28 days (psi)	Maximum Water/Cement ratio (gallons per bag of cement)*	Cement Factor: 94 lb. Bags per cubic yard minimum**
3000	0.59 (6.9)	5.5
4000	0.48 (5.6)	6.5
5000	0.40 (4.7)	7.4

* Based on air-entrained concrete. If non-air-entrained concrete is called for, the listed maximum water/cement ratios may be increased slightly, as approved by the Owner. The water is the total water in the mix, including free water on the aggregate.

** These are minimum amounts; increase as necessary to meet mix requirements.

- B. Concrete shall conform to ASTM C94. One copy of the Certificate of Delivery required by ASTM C94 shall be delivered to the Owner immediately upon arrival of each load of concrete at the site. The Contractor shall be responsible for the design of the concrete mixtures.
- C. Standard compression tests of all proposed mixes shall be made by the testing laboratory or other satisfactory evidence shall be presented that the design mixes will attain the minimum strengths listed on the design drawings or called for herein, within the limitations of the ACI Code. No concrete shall be delivered to the job site until the Owner has approved the design mixes.
- D. All concrete (unless otherwise directed) shall contain an air-entraining agent. Air entrained concrete shall have an air content by volume of 3 to 6 percent for 1-1/2-inch aggregate and 4 to 8 percent for 3/4-inch aggregate. The air content shall be the responsibility of the testing laboratory and in accordance with ASTM C231.
- E. All concrete shall contain a mid-range water reducer to minimize cement and water content of the mix, at the specified slump, in accordance with ASTM C494.
- F. Slump for all concrete shall be from 3-inch to 4-inch, except for concrete using a superplasticizer, when the maximum slump shall be 8 inches. Any concrete having a slump

greater than 4 inches (8 inches with superplasticizer) shall be promptly removed from the site.

- G. No calcium chloride or admixtures containing calcium chloride shall be added to the concrete. No admixture other than those specified shall be used in concrete without the specific written permission of the Owner in each case.
- H. No additional water, except for the amount indicated by the design mix shall be added to the concrete without the prior permission of the Owner.

2.02 CEMENT:

- A. The cement shall be an approved brand of American manufactured Portland Cement, Type IIA conforming to ASTM C150. The brand name and type of cement proposed for use shall be submitted to the Owner for approval immediately following award of contract. Only one color of cement, all of the same manufacture, shall be used for the work.
- B. When the use of high-early-strength Portland cement (Type IIIA) is permitted by the Owner the same strength requirements shall apply, but the indicated strengths shall be attained in 7 days instead of 28 days.

2.03 ADMIXTURES:

- A. Air entraining agent shall be in accordance with ASTM C260.
- B. Water reducing agent shall be a mid-range water reducer meeting ASTM C494, Type A.
- C. Water reducing agent-retarder shall be in accordance with ASTM C494, Type D.
- D. Superplasticizer agent shall be in accordance with ASTM C494, Type F or Type G and contain no more than 0.1% chloride ions. Product may be plant added or field added based on the best application considering distance, temperature and time.

2.04 AGGREGATES:

- A. Except as otherwise noted, aggregate shall conform to the requirements of ASTM C33.
- B. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM C33.
- C. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33.
- D. The following designated sizes of aggregate shall be the maximum employed in concrete.

2-inch for mass concrete

1½-inch for reinforced sections 18-inch and over in thickness
3/4-inch for reinforced and unreinforced sections less than 18-inch thickness.

2.05 WATER:

Water for concrete shall be potable, free from injurious amounts of oil, acid, alkali, organic matter and other deleterious substances.

2.06 GROUT:

Grout shall be mixed in the proportions of one part Portland Cement to 2 parts sand, by volume. Only sufficient water shall be used to enable grout to barely hold its shape when squeezed into a ball in the hand. Aggregate for grout shall conform to the requirements of the reference specification for concrete. Prior approval of the Owner shall be obtained for the use of proprietary grouts, and the instructions of the Owner shall be followed in their use.

2.07 CURING MATERIALS:

- A. Curing compound shall be a curing/hardener compound such as Acurion by AntiHydro, Sikaguard Cure/Hard by Sika, Super Diamond Clear by Euclid or approved equal.
- B. Curing paper shall be a fiber-reinforced laminated Kraft bituminous product conforming to the requirements of ASTM C171.

2.08 JOINT FILLER:

- 1. Preformed joint filler strip shall conform to ASTM D1751 or D1752, having a thickness as indicated on the drawings.
- 2. Fillers shall be provided in pieces of the full thickness required. Use of multiple layers of thin pieces to make-up the full thickness will not be permitted.

2.09 JOINT SEALANT:

Joint sealant for construction and control joints shall be a two-part polysulfide base sealant conforming to Thiokol's Building Trade Performance Specification, Class A (self-leveling), Type II (hardness: 35-45 Shore A).

PART 3 - EXECUTION

3.01 GENERAL:

Under no circumstances shall concrete which has set or partially set before placing be used; and no retempering of concrete or grout will be permitted.

3.02 PREPARATION:

- A. Before placing concrete, forms and the space to be occupied by the concrete shall be thoroughly cleaned, and reinforcing steel and embedded metal shall be free from dirt, oil, mill scale, loose rust, paint or other material which would tend to reduce the bond.
- B. Unless otherwise indicated, a moisture barrier shall be used under all slabs placed on the ground. The moisture barrier shall be fungi-resistant and shall have a vapor permeance rating not exceeding 0.5 perm. The moisture barrier shall be asphalt-saturated waterproof reinforced Kraft paper, clear polyethylene sheeting 0.006-inch thick, polyethylene coated asphalt-saturated reinforced Kraft paper, two layers of 30-pound asphalt-saturated felt solidly mopped with hot bitumen, or other similar material meeting the requirements for fungi-resistance and vapor permeance. Sheets shall be lapped 6-inches at joints and sealed with 2-inch wide tape.
- C. When no moisture barrier is used, the earth, concrete, masonry, or other water-permeable material against which concrete is to be placed shall be thoroughly saturated with water immediately before concrete is placed. No concrete shall be placed until the consolidation of the ground and the arrangement and details of forms and reinforcing have been inspected and approved by the Owner.
- D. When joining fresh concrete to concrete which has attained full set, the latter shall be cleaned by chipping and washing off all dirt and scum and laitance. It then shall be moistened prior to placing new concrete.
- E. Concrete surfaces which act as a seat for structural members (other than those resting on grout) shall be troweled to an extremely flat and level surface. If necessary, such surfaces shall be ground off to achieve the required flatness and level.
- F. Fill concrete on top of concrete shall be placed in the locations indicated on the drawings or designated by the Owner. Before fill concrete is placed, the following procedures shall be used to prepare surfaces; all dirt, scum and laitance shall be removed by chipping and washing. The clean, roughened base surface shall be saturated with water, but shall have no free water on the surface. A coat of 1:2 cement-sand grout, approximately 1/8-inch thick, shall be well scrubbed into the thoroughly dampened concrete base. The concrete fill shall be placed immediately, before grout has dried or set. Fill concrete shall be brought to the lines and grades shown on the drawings or approved by the Owner.
- G. Concrete for thrust and anchor blocks shall be placed against undisturbed earth and wooden side forms shall be used to provide satisfactory lines and dimensions. Felt roofing paper shall be placed to protect joints. No concrete shall be placed so as to cover joints, bolts or

nuts, or to interfere with the removal of the joints. Minimum bearing areas and dimensions shall be as shown on the drawings.

3.03 MIXING:

- A. Concrete shall be ready-mixed, or transit-mixed, as produced by equipment acceptable to the Owner. No hand-mixing will be permitted. Adding water in controlled amounts during the mixing cycle shall be done only with the express approval of, and under the direction of, the Owner.
- B. Ready-mix or transit-mixed concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities for the respective conditions as stated on the name plate. Discharge at the site shall be within 1-1/2 hours after cement was first introduced into the mix. Central mixed concrete shall be plant-mixed a minimum of 1-1/2 minutes per batch and then shall be truck-mixed or agitated a minimum of 8 minutes. Agitation shall begin immediately after the pre-mixed concrete is placed in the truck and shall continue without interruption until discharge. Transit-mixed concrete shall be mixed at mixing speed for at least 10 minutes immediately after charging the truck, followed by agitation without interruption until discharged.
- C. All central plant and rolling stock equipment and methods shall conform to the latest Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers' Bureau of the National Ready-Mixed Concrete Association, as well as ACI 304 and ASTM C94.
- D. Attention is called to the importance of dispatching trucks from the batching plant so that they shall arrive at the site of the work just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.

3.04 INSTALLATION/APPLICATION/ERECTION:

A. PLACING:

- 1. No concrete shall be placed by pumping methods without the prior written approval of the Owner. Should the Contractor be allowed to place concrete by pumping methods, procedures, mix design of concrete, and all other precautions shall be in accordance with ACI 304.2R and as approved by the Owner.
- 2. Concrete shall be placed in alternate areas, as defined by the construction and control joints indicated on the design drawings. A minimum of 3 days shall elapse between placement of adjacent sections.

3. Segregation of the concrete shall be prevented during handling; should any segregation occur, the concrete shall be remixed before it is placed. Concrete shall be placed in the forms in horizontal layers not over 1 to 2 feet thick. Concrete shall not be allowed to drop freely more than 4 feet. If the free drop to the point of placement must exceed 4 feet, the Contractor shall obtain the approval of the Owner for the proposed method of depositing the concrete. The concrete shall not be required to flow over distances greater than 3 feet in any direction in the forms or on the ground, unless otherwise permitted by the Owner.
4. Unless otherwise noted, the work begun on any day shall be completed in daylight of the same day.
5. "Cold Joints" are to be avoided, but if they occur, they are to be treated as bonded construction joints.
6. Chutes for conveying concrete shall be of U-shaped design and sized to insure a continuous flow of concrete. Flat (coal) chutes shall not be employed. Chutes shall be metal or metal-lined, and each section shall have approximately the same slope. The slope shall not be less than 25 nor more than 45 degrees and shall be such as to prevent segregation of the ingredients. The discharge end of the chute shall be provided with a baffle plate or spout to prevent segregation. If the discharge end of the chute is more than 5 feet above the surface of the concrete in the forms, a spout shall be used and the lower end maintained as near the surface of deposit as practicable. When the operation is intermittent, the chute shall discharge into a hopper. Chutes shall be thoroughly cleaned before and after each run, and the debris and any water shall be discharged outside the forms. Concrete shall not be allowed to flow horizontally more than 5 feet.
7. Concrete during and immediately after depositing shall be thoroughly compacted by means of suitable tools. Internal type mechanical vibrators shall be employed to produce the required quality of finish. Vibration shall be done by experienced operators under close supervision and shall be carried on long enough to produce homogeneity and optimum consolidation without permitting segregation of the solid constituents or "pumping" or migration of air. All vibrators shall be supplemented by proper wooden spade puddling adjacent to forms to remove included bubbles and honeycomb. This is essential for the top lifts of walls. All vibrators shall travel at least 10,000 rpm and be of adequate capacity. At least one vibrator shall be used for every 10 cubic yards of concrete per hour. In addition, one spare vibrator in operating condition shall be on the site.
8. Concrete slabs on the ground shall be well-tamped into place and foundation material shall be wet, tamped, and rolled until thoroughly compacted prior to placing concrete.
9. Concrete shall be deposited continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section. If a section cannot be placed

continuously, construction joints may be located at points as provided for in the drawings or approved by the Owner.

10. Chutes, hoppers, spouts, adjacent work, etc., shall be thoroughly cleaned before and after each run, and the water and debris shall not be discharged inside the form.

B. CONCRETE PLACING DURING COLD WEATHER:

1. Concrete shall not be placed on frozen ground, and no frozen material or material containing ice shall be used. Materials for concrete shall be heated when concrete is mixed, placed, or cured when the mean daily temperature is below 40°F, or is expected to fall to below 40°F, within 72 hours, and the concrete after placing shall be protected by covering, heat, or both. No accelerant shall be used to prevent freezing.
2. The temperature of concrete surfaces shall not be permitted to drop below 50°F. for at least 7 days after placement of the concrete.
3. All details of Contractor's handling and protecting of concrete during freezing weather shall be subject to the approval and direction of the Owner. All procedures shall be in accordance with provisions of ACI 306.

C. CONCRETE PLACING DURING HOT WEATHER:

1. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placing shall be sprinkled with cold water. The Contractor shall make every effort to minimize delays which will result in excessive mixing of the concrete after arrival on the job.
2. During periods of excessively hot weather (90°F, or above) ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels all in accordance with the provisions of ACI 305. Any concrete with a temperature above 90°F, when ready for placement will not be acceptable, and will be rejected.
3. Temperature records shall be maintained throughout the period of hot weather giving air temperature, general weather conditions (calm, windy, clear, cloudy, etc.) and relative humidity. The record shall include checks on temperature of concrete as delivered and after placing in forms. Data should be correlated with the progress of the work so that conditions surrounding the construction of any part of the structure can be ascertained.

D. PIPES AND EMBEDDED METALS:

1. Special care shall be taken to bring the concrete into solid contact with pipes and iron work embedded in the walls and floors, particularly underneath and around all pipes where a head of water exists, making watertight joints.
2. In general, such embedded items are not shown on the structural design drawings. Design drawings of the other trades shall be consulted for their location and details.
3. Anchor bolt location, size and details shall be verified with the equipment manufacturer's certified drawings before installation.
4. Anchor bolts, reglets, sleeves, edge angles and similar embedded items will be provided, delivered to the site under other Sections of the specification, for installation under this Section.
5. Where edge angles, etc., have nuts welded on to receive machine screws, the threads of the nuts shall be protected from concrete, and the concrete shall be excluded from the space to be occupied by the screw, by the use of wood plugs or other effective means.
6. Inserts required for hanging mechanical and electrical items will be provided and installed in the forms under the mechanical and electrical Sections of the specification.
7. Should the Contractor be allowed to leave openings in the concrete for pipes or ironwork, to await the arrival of items which would delay the prosecution of the work, the openings shall be subject to the approval of the Owner. Appropriate construction joints shall be provided. In filling any such openings with concrete, a mixture of 1: 1-1/2 : 3 shall be used and a watertight bond shall be secured between the old and new concrete.
8. In bolting miscellaneous items to concrete after the concrete has set, expansion bolts of an approved pattern and type shall be used. The Contractor shall submit to the Owner, for approval, the types of expansion bolts. Expansion bolts shall not be used until they are approved.

E. CURING:

1. Concrete curing shall be performed as specified in ACI 301 and as stated herein. All curing procedures shall have prior approval of the Owner.
2. Concrete Floors

Concrete floors which are to receive paint, concrete fill, mortar setting beds, grout fill, or any other subsequent finish shall be cured by one of the following procedures immediately after completion of placement and finishing:

- a. Ponding or continuous sprinkling.
 - b. Application of absorptive mats or fabric kept continuously wet.
 - c. Application of sand kept continuously wet.
 - d. Application of waterproof sheet materials conforming to ASTM C171.
 - e. Application of curing compounds conforming to ASTM C309, if it can be demonstrated to the Owner's satisfaction that the compound is applicable and that it will not prevent bonding of the subsequent finish to be received. Compound shall be placed at a rate of 200 square feet per gallon, in two applications perpendicular to each other.
3. Curing procedure shall be continued for at least 7 days.
- a. Moisture loss from surface placed against metal or wood forms shall be minimized by keeping forms wet until removal.
 - b. Curing shall be continued for at least 7 days. When forms are removed during the curing period, surfaces shall be cured by spraying or by the use of a curing compound as previously specified.
 - c. Surfaces shall be protected from traffic or damage until surfaces have hardened sufficiently. If necessary, 1/2-inch thick plywood sheets shall be used to protect the exposed surface.

F. BRACING AND SUPPORTS:

1. All concrete members shall be adequately and safely supported and braced until the permanent supports and braces are installed.
2. Backfilling against exterior walls shall not be done until supporting slabs are in place and have attained 70 percent of design strength, otherwise walls shall be braced against earth lateral pressure, using a system approved by the Owner.
3. Backfilling against retaining walls shall not commence until the wall concrete has reached its 28 day strength.

G. REMOVING FORMS AND SUPPORTS:

1. Removal of forms shall take place in accordance with ACI 347, Section 3.6. Except as otherwise specifically authorized by the Owner, forms shall not be removed until the concrete has aged for the following number of day-degrees or attained 50 percent strength. (Day-degrees equals the total of number of days times the average daily air

temperature at the surface of concrete. For example, 5 days at a daily average temperature of 60°F. equals 300 day-degrees.)

<u>Location</u>	<u>Day-Degrees</u>
Beams and Slabs	500
Walls and Vertical Surfaces	200

2. Shores under beams and slabs shall not be removed until the concrete has attained at least 70 percent of the specified cylinder strength and also sufficient strength to support safely its own weight and the construction loads upon it.

H. PATCHING:

1. Defective concrete and honeycombed areas as determined by the Owner shall be chipped down reasonably square and at least one-inch deep to sound concrete by means of hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly imbedded in the parent concrete, subject to Owner's final inspection. If honeycomb exists around reinforcement, chip to provide a clear space at least 1-inch wide all around the steel. For areas less than 1-1/2 inches deep, the patch may be made following the procedure for filling form tie holes, described in the subsection below, using adequately dry (non-trowelable) mixtures to avoid sagging. Thicker repairs will require build-up in 1-inch layers on successive days. Unless otherwise indicated, thicker repairs shall be made with Vertipatch mortar mixture blended with Acryl-Set, both by Master Builders, Inc., Cleveland, Ohio, or approved equal.
2. For concrete areas exposed to serious abrasion and/or impact forces, the Owner may order the use of grout with a non-shrink metallic aggregate (Embeco by Master Builders, Inc.; Ironite by Fox Industries, Madison, IL; or approved equal) as an additive in the proportions listed below:

Material	Small Patches		Large Formed Patches	
	Volumes	Weights	Volumes	Weights
Cement	1.0	1.0	1.0	1.0
Metal Aggregate	0.15	0.25	0.2	0.33
Sand	1.5	1.5	1.5	1.0
Pea Gravel	--	--	1.5	1.5

I. FINISHING OF FORMED SURFACES:

1. All concrete which is to be left exposed to view shall be scraped to remove projecting imperfections left by voids in the forms.

2. In addition to scraping, exterior exposed concrete shall be covered with a cement-base plaster mix. The mix shall consist of Thoroseal Plastic Mix and Acryl 60, as manufactured by Standard Drywall Products, Miami, FL, or approved equal. It shall be mixed and applied in accordance with the manufacturer's recommendations.
3. In addition to scraping, interior concrete surfaces which will be exposed to view and concrete surfaces which are to be prepared and painted as specified in Section 09900, PAINTING, shall receive a smooth rubbed finish, in accordance with ACI 301 and as described below.
4. To permit satisfactory finishing, forms shall be removed from the vertical faces of the concrete as early as is possible without damaging the surface. Immediately after stripping forms, any fins or projections left by the forms shall be chipped off, and the surfaces rubbed smooth.
5. Form tie holes and other voids and faults shall be patched. Voids shall be cleaned out, roughened, thoroughly wetted, coated with neat cement paste, and filled with mortar of cement and sand in the same proportions, materials, and color as used in the concrete. The surface of the patch shall be flush with the surrounding surface after finishing operations are complete. Surface shall be kept continuously damp until patches are firm enough to be rubbed without damage.
6. Rubbing shall be performed while the surface is wet using a carborundum or cement sand brick, to achieve a smooth uniform, even textured finish. Patched and chipped areas shall be blended to match as closely as possible the appearance of the rest of the surface. No cement wash or plastering will be permitted, and no mortar shall be used except as required above.
7. Where finishing is performed before the end of the curing period, concrete shall under no circumstances be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.

J. CONCRETE FLOOR FINISHING REQUIREMENTS:

Unless designated otherwise, concrete floors shall have a troweled finish as specified in Section 11.7 of ACI 301. Troweled finishes shall conform to the requirements of "Class A Tolerances," Section 11.9 as specified in ACI 301.

K. MONOLITHIC FLOOR FINISH:

1. Monolithic floor finish shall be applied to areas designated on the drawings.
2. A curing compound, of a type and color as recommended by the manufacturer, shall be applied to the surface to receive the monolithic floor finish.

3. Metallic aggregate hardener for monolithic floor finish shall be "Durpolate" manufactured by Castle Chemical Corp., "Proplate" manufactured by Protex Industries, Inc., "Hydroment" manufactured by USM Corporation, or approved equal. The aggregate shall include an inorganic pigment with color to be selected by the Owner.
4. The dry shake shall be applied with not less than 80 pounds per 100 square feet, proportioned and installed in accordance with the recommendations of the manufacturer. The dry shake shall be distributed uniformly over the surface of freshly floated concrete, floated in, troweled over and cured in the normal manner.
5. All areas with a monolithic finish shall be completely protected during construction with a plywood cover.

L. TESTING:

1. The Contractor shall provide all field testing and inspection services, and shall pay for all such services. The Owner shall approve the testing laboratory and shall inform the Contractor when samples are to be taken for testing. The Contractor shall forward all test results to the Owner as soon as they are available.
 - a. The Testing Laboratory shall conform to the requirements of ASTM E-329 as modified in 780-CMR R1 in the State Building Code. They shall be licensed by the State Board of Building Regulations and Standards.
2. At least one slump test shall be performed from each truck load of concrete. The sample for slump shall be taken from the middle third of a truck load. Air content tests shall be made at the discretion of the Owner. If the measured slump or air content falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed the requirements of the specification and shall be immediately removed from the jobsite to be discarded.
3. The Contractor shall advise the Owner of his readiness to proceed with concrete placement at least one working day prior to each placement. The Owner will inspect the preparations for concrete, including the preparation of previously placed concrete, the reinforcing, and the alignment and tightness of formwork. No placement shall be made without the prior approval of the Owner.
4. A minimum of four standard compression test cylinders shall be made and tested for each 100 cubic yards or fraction thereof for each type and design strength of concrete from each day's placement of concrete. One cylinder shall be tested at 7 days and two cylinders at 28 days. The fourth cylinder from each set shall be kept until the 28 day test report on the second and third cylinders in the same set has been received. The Owner reserves the right to require test cylinders to be made for each truckload

of concrete if the nature of the project or project experience indicates such additional tests are required for proper control of concrete quality.

5. The strength level shall be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength f'_c , and no individual strength test (average of two cylinders) result falls below the specified strength f'_c by more than 500 psi.
6. In the event the average compressive strength of the two 28 day cylinders do not achieve the required level, the Owner may elect to test the fourth cylinder immediately or test it after 56 days.

M. FAILURE TO MEET REQUIREMENTS:

1. The Owner shall have the right to reject concrete represented by low strength tests or to agree to further testing of the concrete. Rejected concrete shall be promptly removed and replaced with concrete conforming to the specification. The decision of the Owner as to whether substandard concrete is to be accepted or rejected or additional tests shall be conducted shall be final. All direct and indirect costs associated with further curing and testing of the concrete shall be at the Contractor's expense. All costs associated with removing rejected concrete, placing new concrete, and conducting tests on new concrete shall be at the Contractor's expense.
2. If the Owner agrees to consider further curing and/or testing of the concrete before making a final decision, the Contractor shall submit a detailed plan to the Owner, including proposed criteria for acceptance of the concrete. The plan may include additional curing of the concrete, drilling and testing of cores, load testing of the structure, or a combination.
3. If additional curing is permitted before further inspection and testing, the Contractor shall provide any necessary materials and labor to further cure the suspect concrete.
4. If drilling and testing of cores is permitted, the Contractor shall be responsible for obtaining the cores, including provision of ladders, scaffolding, and such incidental equipment as may be required. If additional curing is permitted, cores shall be drilled after the curing period, and shall be in accordance with ASTM Methods C39 and C42. The Contractor shall repair all core holes to the satisfaction of the Owner.
5. The burden of proof, including, but not limited to the work of cutting and testing the cores, inspection, evaluation, engineering, repair of the holes, or removal and replacement of the concrete in question, and all associated costs therefor, shall be at the expense of the Contractor.

6. If load testing of the concrete is permitted, and if not otherwise indicated, slabs or beams under load test shall be loaded with their own weights plus a superimposed load of 2 times the design live load. The load shall be applied uniformly over the portion being tested in the approved manner and left in position for 24 hours. The structure shall be considered satisfactory if deflection "D" in feet, at end of 24-hour period, does not exceed the following value:

$$D \text{ equals } 0.001 (L \times L)/t$$

in which "L" is span in feet, "t" is depth of slab, or beam in inches. If deflection exceeds "D" in the above formula, the concrete shall be considered faulty unless within 24 hours after removal of the load, the slab, or beam under test recovers at least 75 percent of the observed deflection.

7. If the suspect concrete still fails to meet specification requirements, the Owner shall have the right to reject the concrete, have it removed and replaced, in accordance with paragraph 5 above, or to require mechanical strengthening of the concrete to satisfy project requirements. The Contractor shall submit a removal and replacement plan for review by the Owner.

N. TEST FOR WATERTIGHTNESS:

1. All concrete shall be watertight against leakage or groundwater infiltration. Special care shall be taken in the construction joints and any noticeable leakage or seepage causing wet spots on the concrete walls or slabs shall be repaired by and at the expense of the Contractor and by methods approved by the Owner.
2. All liquid holding concrete structures shall be tested for leakage before backfilling and after the concrete has attained the specified minimum 28-day design strength, as indicated by test cylinders.
3. The structure shall be filled with water to the overflow level, allowed to stand for at least 24-hours, and refilled to overflow to begin the test. After 72 hours, the liquid loss per 24 hour period shall be determined, either by measuring the amount required to refill the tank to overflow, by measuring the drop in water level, or by an equivalent procedure approved by the Owner. Evaporative losses shall be calculated and deducted from the measured loss to determine net liquid loss (leakage). If the leakage per 24 hour period exceeds the allowable, the structure shall be repaired and retested until the leakage falls within the allowable limit.
4. For structures designed to hold water, one twentieth of one percent leakage will be allowed during a 24 hour period. No leakage (zero leakage) will be permitted for structures designed to hold liquid chemicals or fuels.

5. The Contractor shall pay all costs (including water) incurred in the testing for watertightness.
6. The Owner shall be given a minimum notice of 48 hours prior to commencement of the leakage test.

END OF SECTION

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SECTION 03302

FIELD CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers concrete and all related items necessary to place and finish the concrete work.
- B. Concrete thrust, and anchor blocks, to be provided at all water main bends, tees, plugs and wyes and at other locations required by the Owner shall be installed in accordance as specified in this section.
- C. Concrete encasement for piping with shallow cover and for encasement of telephone, and electrical duct bank shall be installed as specified in this section.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02089, DUCTILE IRON GRAVITY PIPE AND FITTINGS FOR SEWERS

1.03 REFERENCES:

- A. The following standards form a part of this specification:

American Concrete Institute (ACI)

- | | |
|---------------|---|
| ACI 304 | Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete. |
| ACI 305 | Recommended Practice for Hot Weather Concreting |
| ACI 306 | Recommended Practice for Cold Weather Concreting |
| ACI SP-66 ACI | Detailing Manual |
| ACI 318 | Building Code Requirements for Reinforced Concrete |

American Society for Testing and Materials (ASTM)

- | | |
|-----------|---|
| ASTM A615 | Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| ASTM C33 | Concrete Aggregates |

ASTM C94	Ready-Mixed Concrete
ASTM C143	Test for Slump of Portland Cement Concrete
ASTM C150	Portland Cement
ASTM C260	Air Entraining Admixtures for Concrete
ASTM C494	Chemical Admixtures for Concrete

PART 2 - PRODUCTS

2.01 CONCRETE:

- A. All concrete, reinforced or non-reinforced shall have a 28 day compressive strength of 3000 psi unless otherwise noted on the design drawings. A minimum of 5.5 sacks of cement per cubic yard and a maximum water cement ratio of 6.9 gallons per sack shall be used.
- B. Concrete shall conform to ASTM C94. The Contractor shall be responsible for the design of the concrete mixtures. Slump shall be a maximum of 4-inches and a minimum of 2-inches, determined in accordance with ASTM C143.
- C. Admixtures shall be as specified in subsection 2.05. No additional admixtures shall be used unless approved by the Owner.
- D. No additional water, except for the amount indicated by the design mix shall be added to the concrete without the prior permission of the Owner.

2.02 CEMENT:

The cement shall be an approved brand of American manufactured Portland Cement, Type II conforming to the applicable requirements of ASTM C150.

2.03 AGGREGATES

- A. Except as otherwise noted, aggregate shall conform to the requirements of ASTM C33.
- B. Maximum size aggregate shall be 3/4-inch.

2.04 ADMIXTURES:

- A. All concrete (unless otherwise directed) shall contain an air entraining agent. Air entrained concrete shall have air content by volume of 4 to 8 percent for 3/4-inch aggregate.

- B. Air entraining agent shall be in accordance with ASTM C260 and shall be Darex AEA, as manufactured by W.R. Grace & Company; Placewel (air entraining Type), as manufactured by Johns Manville; Sika AER as manufactured by Sika Chemical Company; or an approved equal product.
- C. Water reducing agent shall be WRDA, as manufactured by W.R. Grace & Company; Placewel (non-air entraining Type), as manufactured by Johns Manville; Sika Plastiment as manufactured by Sika Chemical Company; or an approved equal product.
- D. Water reducing agent-retarder shall be "Daratard," as manufactured by W.R. Grace & Company; Sika Plastiment as manufactured by Sika Chemical Company; or an approved equal product.

2.05 WATER:

- A. Water for concrete shall be potable, free of deleterious amounts of oil, acid, alkali, organic matter and other deleterious substances.

2.06 CONCRETE FORMS:

- A. Forms for exterior and interior surfaces which will be exposed to view after the work is completed, whether such surfaces are painted or unpainted, shall be new plywood stock, steel, tempered masonite, or other materials which will provide smooth concrete surfaces without subsequent surface plastering. Plastic or plastic-faced forms shall not be used, except with the prior approval of the Owner.
- B. Form ties shall be cone type or equal, with waterstop, which leaves no metal closer than 2-inches to finished face of concrete.
- C. Form release agent shall be a non-staining, non-yellowing, non-toxic liquid free from kerosene and resins of the type recommended by the manufacturer of the forming system being used such as EZ strip by L&M Construction Chemicals, Omaha, NB and "Magic Kote" by Symons Corp., Des Plaines, IL or approved equal.
- D. Where steel adjacent to vertical faces of forms cannot be otherwise secured, mortar doughnuts shall be used to prevent steel from lying too close to the finish vertical faces of the concrete

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Before placing concrete, forms and the space to be occupied by the concrete shall be thoroughly cleaned, and reinforcing steel and embedded metal shall be free from dirt, oil, mill scale, loose rust, paint or the material which would tend to reduce the bond.

- B. Earth, concrete, masonry, or other water permeable material against which concrete is to be placed shall be thoroughly saturated with water immediately before concrete is placed.
- C. No concrete shall be placed until the consolidation of the ground and the arrangement and details of forms and reinforcing have been inspected and approved by the Owner.

3.02 THRUST AND ANCHOR BLOCKS:

- A. Minimum bearing areas for thrust blocks and dimensions of anchor blocks shall be as shown on the drawings.
- B. Concrete for thrust and anchor blocks shall be placed against undisturbed earth, and wooden side forms shall be used to provide satisfactory lines and dimensions. Felt roofing paper shall be placed to protect joints. No concrete shall be placed so as to cover joints, bolts or nuts, or to interfere with the removal of the joints.

3.03 FILL CONCRETE:

- A. Fill concrete shall be placed in those locations as indicated on the design drawings. Fill concrete shall consist of materials as previously specified, with a minimum 28-day compressive strength of 3000 psi.
- B. Before fill concrete is placed, the following procedures shall be used to prepare surfaces; all dirt, scum and laitance shall be removed by chipping and washing. The clean, roughened base surface shall be saturated with water, but shall have no free water on the surface. A coat of 1:2 cement-sand grout, approximately 1/8-inch thick, shall be well scrubbed into the thoroughly dampened concrete base. The concrete fill shall be placed immediately, before grout has dried or set.
- C. Fill concrete shall be brought to lines and grades as shown on the design drawings.

3.04 CONCRETE PLACING DURING COLD WEATHER:

- A. Concrete shall not be placed on frozen ground, and no frozen material or material containing ice shall be used. Materials for concrete shall be heated when temperature is below 40°F, or is expected to fall to below 40°F, within 73 hours, and the concrete after placing shall be protected by covering, heat, or both.
- B. All details of Contractor's handling and protecting of concrete during freezing weather shall be subject to the approval and direction of the Owner. All procedures shall be in accordance with provisions of ACI 306.

3.05 CONCRETE PLACING DURING HOT WEATHER:

- A. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placing, shall be sprinkled with cold water. The Contractor shall

make every effort to minimize delays, which will result in excessive mixing of the concrete after arrival on the job.

- B. During periods of excessively hot weather (90°F or above), ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels all in accordance with the provisions of ACI 305. Any concrete with a temperature above 90°F, when ready for placement, will not be acceptable, and will be rejected.

3.06 FIELD QUALITY CONTROL:

- A. Concrete inspection and testing shall be performed by the Owner or by an inspection laboratory, designated by the Owner, engaged and paid for by the Owner. Testing equipment shall be supplied by the laboratory, and the preparation of samples and all testing shall be performed by the laboratory personnel. Full assistance and cooperation, concrete for samples, and such auxiliary personnel and equipment as needed shall be provided by the Contractor.
- B. At least 4 standard compression test cylinders shall be made and tested and 1 slump test from each day's placement of concrete. A minimum of four compression test cylinders shall be made and tested for each 100 cubic yards of each type and design strength of concrete placed. One cylinder shall be tested at 7 days, and two at 28 days. The fourth cylinder from each set shall be kept until the 28 day test report on the second and third cylinders in the same set has been received. If the average compressive strength of the two 28 day cylinders do not achieve the required level, the Owner may elect to test the fourth cylinder immediately or test it after 56 days. If job experience indicates additional cylinder tests or other tests are required for proper control or determination of concrete quality, such tests shall be made.
- C. The Owner shall have the right to reject concrete represented by low strength tests. Rejected concrete shall be promptly removed and replaced with concrete conforming to the specification. The decision of the Owner as to whether substandard concrete is to be accepted or rejected shall be final.

END OF SECTION

SECTION 05500
MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers all miscellaneous metal items required for the work, except as specified elsewhere.
- B. All miscellaneous metalwork shall be fabricated as detailed or approved and shall be installed complete with all necessary anchors, anchor bolts, eye bolts, guides, bolts and other accessories.
- C. In general, site and shop fabricated items are included under this section, and factory fabricated items excluded. This section includes but is not limited to: lintels, louvers, stairs, railings and posts, grating, hatches, frames and covers, loose metal frames, nosings, edgings, ladders, vents, protective grilles and frames, and all other site or shop fabricated metal items.

1.02 RELATED WORK:

- A. Section 03300, CAST-IN-PLACE CONCRETE
- B. Section 09900, PAINTING

1.03 QUALITY ASSURANCE:

- A. The drawings show the character and extent of the work required, but do not attempt to show all methods, materials, and details of construction, fastening, etc. Supplementary parts customarily necessary to complete an item, though such parts are not definitely shown or specified, shall be included as part of the item.
- B. Details of construction of the various items shall be submitted on the shop drawings. High quality construction with a neat, finished, and workmanlike appearance will be required.
- C. The size and spacing of screws, connectors, anchors, and similar items, and the size and dimensions of metal items stated herein shall apply in general; specific sizes and spacing of fasteners and dimensions of metal items listed on the drawings shall take precedence.
- D. Items supplied hereunder which are required to be built into the concrete, masonry, etc., shall be delivered to the site at locations as directed, and as required by the overall construction schedule.

- E. Manufacturers of other products comparable in quality and type to those specified will be acceptable if satisfactory data on past performance and other required information is furnished by the Contractor, and if approved by the Owner.
- F. Color galvanized system shall be guaranteed by manufacturer for 20 years.
- G. Contractor shall submit an affidavit to Owner that materials used are protected from or will not be subject to galvanic action.

1.04 REFERENCES:

- A. The following standards from a part of these specifications, and indicate the minimum standards required:

American Institute of Steel construction (AISC)

AISC Spec Design, Fabrication, and Erection of Structural Steel for Buildings

American Society for Testing and Materials (ASTM)

ASTM	A36	Structural Steel
ASTM	A53	Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
ASTM	A123	Zinc (Hot-Dip-Galvanized) Coatings on Iron and Steel Products
ASTM	A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	A239	Test for Uniformity of Coating by the Preece Test (Copper Sulfate Dip) on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM	A307	Carbon Steel Externally and Internally Threaded Standard Fasteners
ASTM	A366	Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
ASTM	A525	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements
ASTM	A569	Steel Carbon (0.15 Maximum Percent) Hot-Rolled Sheet and Strip, Commercial Quality
ASTM	B221	Aluminum-Alloy Extruded Bars, Rods, Shapes and Tubes
ASTM	B308	Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

ASTM C478 Precast Reinforced Concrete Manhole Sections

American Welding Society (AWS)

AWS Code Standard Code for Arc and Gas Welding in Building Construction

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Before fabricating or assembling any aluminum or stainless steel items, samples indicating full range of finish, color, and texture to be supplied shall be submitted to the Owner for review.
- B. Shop drawings for all metalwork included in this section shall be submitted to the Owner for review.
- C. The shop drawings shall be complete and checked, showing sizes, layout, method of assembly, fastenings, anchorage or connection with other work, finish, and coatings, etc. Shop drawings for aluminum work shall indicate alloys, temper and finish to be used.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. STEEL:

- 1. Materials, fabrication, and erection of miscellaneous steel sections shall conform to the applicable requirements of the AISC Specification.
- 2. Steel shapes, plates and bars shall conform to ASTM A36.
- 3. Sheet steel shall be cold-rolled or hot-rolled carbon sheet steel conforming to ASTM A366 or ASTM A569 as appropriate.
- 4. Steel pipe shall conform to ASTM A53.
- 5. Stainless steel shall be Type 304 unless otherwise indicated or specified.

B. ALUMINUM:

- 1. Aluminum shall be fabricated of plates, rolled or extruded shapes, sheets or castings conforming to the specific aluminum alloy and temper designation of the Aluminum Association as specified for the item.
- 2. Aluminum work shall be fabricated in a shop where the quality of work is of the highest standard for work of this type. All work shall be executed by mechanics

skilled in the fabrication of aluminum, and shall be true to detail with sharp clean profiles, fitted with proper joints and intersections, and with finishes as specified.

3. The Contractor shall furnish the Owner with mill certificates and a signed statement from the fabricator that all aluminum work furnished is of the proper alloys as specified.

C. FASTENERS:

1. Metalwork shall be complete, with all bolts, anchors, plates, washers, clamps, screws, studs and other such devices for proper securing and anchoring. Where positions of anchorages can be predetermined, they shall be shop-installed on the item; otherwise the material or equipment to be fastened shall be expansion bolted, toggle bolted, screwed, or otherwise fastened as shown on the drawings or called for herein.
2. Bolts and nuts for general anchorage and for miscellaneous ferrous metal assemblies and fasteners shall be galvanized, unfinished bolts conforming to ASTM A307 unless otherwise noted on the drawings.
3. Expansion bolts for use in concrete and masonry shall be of one manufacturer and shall be approved. Bolts shall be Kwik Bolt concrete anchors manufactured by McCulloch Industries, Phillips Red Head manufactured by Phillips Drill Company, Wej-it manufactured by Wej-it Expansion products or an approved equal product.
4. The centerline of expansion shields shall not be closer than 3 inches to the edge of any concrete or masonry in which they are placed.
5. Material for fasteners shall match or be galvanically compatible with the materials fastened. Washers, nuts and other accessories shall match the bolts.
6. Where the specific type, material, size and spacing of fasteners has not been called for on the drawings or in specifications, the fasteners proposed by the Contractor shall be reviewed by the Owner. If, in the opinion of the Owner, they are not in accordance with good safety practices, the contractor shall revise and resubmit appropriate fasteners.

D. ALUMINUM TUBES, ANGLES, CHANNELS, AND CLOSURE PLATES:

1. All aluminum tubes, structural shapes such as angles, channels, beams, etc., closure plates, and other aluminum items not usually furnished as integral parts of a system (stairs, hatches, etc.) shall conform to this specification. They shall be formed of aluminum alloy at least equal to 6063-T5, minimum yield strength 16 ksi and minimum tensile strength of 22 ksi.
2. The sizes and thickness of materials shall be designated on the drawings or as required for adequate structural strength.

3. All items shall be accurately machined, filed and fitted, and rigidly connected at all joints, corners and miters. All burrs or rough edges shall be removed. Exposed surfaces shall be free from tool marks, scratches, or blemishes that would materially affect their appearance.
4. All items shall be installed plumb, level, and true and accurately fit with the existing building construction and/or the system (curtain wall, etc.) for which they are intended.
5. Fasteners shall be of 300 series stainless steel for fastening aluminum to aluminum or aluminum to steel. Bolts and expansion anchors used to fasten aluminum to masonry shall also be 300 series stainless steel.

E. LOOSE LINTELS:

1. Loose lintels shall have a minimum bearing of 8 inches at each end, unless otherwise shown. All lintels in exterior walls shall be galvanized. Openings and recesses in masonry walls and partitions for ducts, grilles, louvers, cabinets, panels, pressed metal frames etc., with a clear masonry opening, shall have steel angle lintels conforming to the following schedule of sizes unless otherwise indicated on the design drawings:

Wall Thickness (in.)	Opening Size	No. of Angles	Angle Size
4	to 33'-0"	1	3-1/2 x 3-1/2 x 5/16
4	3'-1 to 6'-0"	1	4 x 3-1/2 x 5/16
6	to 3'-0"	2	2-1/2 x 2-1/2 x 5/16
6	3'-1" to 6'-0"	2	3-1/2 x 2-1/2 x 5/16
8	to 3'-0"	2	3-1/2 x 2-1/2 x 5/16
8	3'-1" to 7'-6"	2	4 x 3-1/2 x 5/16
10	to 3'-0"	3	3 x 3 x 5/16
10	3'-1" to 7'-6"	3	4 x 3 x 5/16
12	to 3'-0"	3	3-1/2 x 3-1/2 x 5/16
12	3'-1" to 7'-6"	3	4 x 3-1/2 x 5/16
14	to 3'-0"	3	4 x 3-1/2 x 5/16
14	3'-1" to 7'-6"	3	4 x 3-1/2 x 5/16

F. ALUMINUM GRATING:

1. Aluminum grating shall be a rectangular pattern grating made in accordance with industry standards. The grating shall be extruded from aluminum alloys 6063-T5 and/or 6061-T6.
2. The bearing bars shall be double locked together under pressure so that the joints are neat and do not loosen under heavy traffic and vibration.
3. Aluminum grating shall be furnished with a mill finish.
4. Loading and structural requirements shall be checked by the grating manufacturer to determine its stability. The grating shall be designed for 250 pounds per square foot live load.
5. The grating shall be securely bolted or clipped in place so that it will not rock or vibrate in service. Bolts and clips shall be made of stainless steel and may be of the saddle, harness, plate, or bolt type, unless otherwise shown on the drawings.
6. Bearing bars shall not be less than 1-inch by 3/16-inch and shall be sized so that a deflection of 1/4-inch or less is produced when a uniform load of 250 pounds per square foot is applied.

G. STEEL GRATING:

1. Steel grating shall be rectangular pattern grating made in accordance with industry standards. The grating shall be made from structural carbon steel conforming to ASTM A36 and shall be galvanized. The bars shall be welded together prior to galvanizing and the completed grating shall be free from imperfections or irregularities which would cause warping or camber when the grating is in use.
2. Loading and structural requirements shall be checked by the grating manufacturer to determine its stability. Unless otherwise indicated, the grating shall be designed for a live load of 250 pounds per square foot.
3. The steel grating shall have positive anchorage when in place, such as bolting, or clipping.

H. STEEL OR ALUMINUM HATCHES, FRAMES AND COVERS:

1. Exterior hatches, frames and covers shall be fabricated from steel materials. Interior hatches, frames and covers shall be fabricated from aluminum materials.
 - a. Handrails shall be provide around roof and floor hatches in accordance with OSHA requirement 1910.23(e), as manufactured by TriStar, Santa Ana, CA; Nesea Corp., Mt. Laurel, NJ or approved equal.

- b. Fall through prevention system webbing consisting of Dupont Type 728 high tenacity system shall be provided for all access hatches and shall be "The Hatch Net 120" as manufactured by Safe Approach, Inc. of Auburn, ME or approved equal. Webbing shall be secured access hatches as per manufacturers specifications.
2. Steel or aluminum floor hatches, covers and frames shall be 1/4-inch steel or extruded aluminum with built-in neoprene cushion and connectors bolted or welded to the exterior.
3. Door leaf shall be 1/4-inch steel or aluminum checkered plate reinforced with steel or aluminum stiffeners as required.
4. Hinges shall be heavy bronze or stainless steel pintle hinges, compression spring operators enclosed in telescopic tubes, with positive snap latch with turn handles.
5. The doors shall open to 90 degrees and lock automatically in that position.
6. A vinyl grip handle shall be provided to release and close the cover with one hand. A removable key wrench shall be provided.
7. Doors shall be built to withstand a minimum live load of 250 pounds per square foot and be equipped with a snap lock and removable wrench lift handle.
8. Hardware shall be cadmium plated or stainless steel and factory finish shall be a prime coat of red oxide applied to steel doors and frames, or aluminum mill finish with bituminous coating shall be applied to the exterior of the aluminum frames or stainless steel for corrosive or explosive atmosphere areas.
9. Hatches shall be fabricated in accordance with the details shown on the drawings. Hatch covers and frames shall be manufactured by Bilco Co., New Haven, Connecticut; Inryco/Milnor, Lima, Ohio; or an approved equal.
10. Hatches shall be equipped with a channel and drain type frame to prevent penetration of raw water into the system.
11. The manufacturers shall guarantee against defects in material or workmanship for a period of five years from date of Owner's acceptance.

I. CLEARWELL AND HOLDING TANK STEPS:

1. Clearwell and holding tank steps shall conform to ASTM C478 and shall be fabricated of either extruded aluminum or steel-reinforced plastic.
2. A spring-balanced, extending safety post shall be installed in the entrances to the tanks. The safety post shall be Model 2 (hot dip galvanized) LadderUP as manufactured by the Bilco Company, New Haven, Connecticut, or approved equal.

The post shall have adjustable mounting brackets to fit manhole step rung spacing, and reversible clamp brackets to fit 3/4 inch to 1-3/4 inch rungs. The tubular post shall be manufactured of high strength steel and shall lock automatically when fully extended. Upward and downward movement of the safety post shall be controlled by a special alloy spring balancing mechanism intended for use in highly corrosive atmospheres. Finish shall be special hot-dip galvanized with black enamel.

J. ALUMINUM HANDRAILS, RAILINGS AND POSTS:

1. Fixed handrails, railings and posts shall be in accordance with OSHA and the Commonwealth of Massachusetts standards and be capable of withstanding a load of 200 pounds applied at any point, in any direction on the top rail. Unless otherwise indicated on the drawings, pipe rails and posts shall be 1-1/2-inch ID Schedule 80, 6061-T6 aluminum alloy pipe. Interior reinforcement shall be provided in posts and/or rails as required to resist the 200 pound load.
2. Bends in pipe shall be machine-bent, or made with manufactured elbows. Rail ends which are not continuous with posts or bolted to the wall shall have self-returns to solid walls, or shall have rounded end caps where there is no adjacent wall.
3. Except as otherwise indicated on the drawings, maximum post spacing shall be 5 feet. Arrangement and spacing of secondary rails, balusters, etc., shall be as shown on the drawings.
4. Unless otherwise indicated, railings shall be set in wrought iron or galvanized steel pipe sleeves set 6 inches into concrete and anchored with molten lead completely filling space between sleeve and post. Lead wool may be used if it is so thoroughly rammed into place that rail is rigidly held and no air spaces remain. The lead shall extend 1/8-inch above the top of sleeve at the rail post and shall be pitched down to the top of the sleeve. Sleeve shall be flush with the top of the surrounding concrete and shall be cut at a level to exactly match the slope of stair stringers and other sloping surfaces.
5. Removable railing shall be Schedule 80, 6061-T6 aluminum alloy pipe with attached aluminum kick plate. Interior reinforcement shall be provided in posts and/or rails as required to resist the 200 pound load.
6. Removable railings shall be provided with removable caps for the pipe sleeves and provisions on the railings section to store the caps when not in use.
7. Submit certification by a professional engineer licensed in the state where the project is located, stating load capacity.

K. STEEL RAILINGS:

1. Steel railings shall be in accordance with OSHA and the Commonwealth of Massachusetts standards and be capable of withstanding a load of 200 pounds applied at any point, in any direction on the top rail. Unless otherwise indicated on the drawings, pipe rail posts shall be 1-1/2-inch ID Schedule 80 black welded steel pipe conforming to ASTM A53, color galvanized with an epoxy primer and finish coat. Interior reinforcement shall be provided in posts and/or rails as required to resist the 200 pound load.
2. Bends in pipe shall be made with manufactured elbows. Rail ends which are not continuous with posts or bolted to the wall shall have self-return to solid walls, or shall have rounded end caps where there is no adjacent wall. Posts shall be approximately 5 feet on centers, or as noted on the drawings.
3. Connections shall be welded, with welds ground smooth. Railings shall be fabricated in panels which are as long as can be conveniently handled, to eliminate as much field welding as possible.
4. Exterior removable railing shall be set in 2" I.D. galvanized pipe sleeves set per J.5 above and fastened at ends as shown on the drawings.
5. Submit certification by a professional engineer licensed in the state where the project is located, stating load capacity.

L. ALUMINUM STAIRS:

1. Stringers and other structural members of aluminum stairs shall conform to ASTM B308 and be made of 6061-T6 alloy. Aluminum stairs shall be designed by the fabricator for a minimum live load of 150 pounds per square foot. Treads and risers shall be rigidly attached to the stringers to serve as lateral bracing. Where necessary to achieve satisfactory rigidity, separate lateral bracing shall be added.
2. Stringers of aluminum stairs shall be of aluminum, with angle brackets. Stringer channels shall be bolted or welded to adjacent construction at both ends. All exposed ends of channel stringers shall have aluminum closure plates welded on. Closure plates shall in all cases be at least as thick as the stringer web. Corners and arises shall be ground to eliminate burrs and sharp projections.
3. Cast aluminum stair platforms shall be equal to Type 100 as made by Wooster Products, Inc., Wooster, Ohio, or approved equal. Platforms shall have nosings to match the nosing on the treads.
4. Cast aluminum stair treads shall be equal to Type 107-A as made by Wooster Products, Inc., Wooster, Ohio, or approved equal. They shall be fastened to carrier angles on the stringers.

5. Submit certification by professional engineer licensed in the state where the project is located, stating load capacity.

M. STEEL STAIRS:

1. Stairs shall be designed by the fabricator for a minimum live load of 150 pounds per square foot. Treads and risers shall be rigidly attached to the stringers to serve as lateral bracing; where necessary to achieve satisfactory rigidity, separate lateral bracing shall be added. All steel stair components shall be color galvanized with an epoxy primer and finish coat.
2. Stringers of steel stairs shall be steel channels with angle brackets. Stringer channels shall be bolted or welded to adjacent construction at both ends. All exposed ends of channel stringers shall have steel closure plates welded on. Closure plates shall in all cases be at least as thick as the stringer web. Corners and arises shall be ground to eliminate burrs and sharp projections.
3. Treads, risers and platforms shall be cast iron, and platforms shall be reinforced as required. Platforms shall have nosings to match the nosings on treads.
4. Submit certification by a professional engineer licensed in the state where the project is located, stating load capacity.

N. ALUMINUM NOSINGS, EDGINGS, AND TREADS CAST IN CONCRETE:

1. Cast aluminum nosings to be embedded in concrete steps or landings which are joined by aluminum stairs shall match the cast abrasive nosing on the stairs. The nosings shall be angle backed and contain sufficient anchors for concrete embedment.
2. Aluminum nosings for stairs which are made completely of concrete shall be as manufactured by Wooster Products Inc., or an approved equal. Nosings shall be provided in single pieces of full length required; no spliced or jointed pieces shall be used. Nosings shall have metal anchors spaced at not over 15 inches o.c., with an anchor at not more than 4 inches from each end. Nosings shall be 6 inches shorter than the tread, notched as required to clear post sleeves, etc. Nosings shall be centered on the centerline of the flights. Each tread and each stair landing shall have a nosing. Nosings shall be an abrasive cast aluminum Type 250 - 2-1/2-inch x 2-1/2-inch x 1/2-inch thick curb bar as manufactured by Wooster Products Inc., Wooster, OH, or an approved equal.
3. Cast aluminum nosings to be installed in concrete curbs or other areas designated on the drawings shall be the same as the curb bar specified above.
4. Aluminum edge angles to be installed in areas shown on the drawings such as pits, sumps, wells, etc., shall be fabricated of 6061-T6 alloy.

O. STEEL EDGE ANGLES, CURBS, PLATES:

Steel angle nosings, guards, and frames shall have steel strap anchors for embedment in concrete.

P. ALUMINUM LADDERS:

1. Aluminum ladders shall be in the locations shown on the drawings and shall be fastened to concrete or masonry with stainless steel or aluminum toggle or expansion bolts, except where other fasteners are indicated on the drawings. Ladders shall be capable of supporting 350 pounds on any rung.
2. Ladders shall be all-welded construction. Rungs shall be fitted into holes in rails and welded all around. Tops of ladder rails shall have rounded corners or vinyl coverings to prevent damage. Aluminum ladders shall include brackets, fasteners, bracing and support.
3. Where ladders abut hatches at top, provide extension safety bars per code.

Q. EMBEDDED LADDER RUNGS:

Embedded ladder rungs shall be fabricated of either extruded aluminum or steel-reinforced plastic. The rungs shall comply with OSHA requirements and shall be configured as shown on the drawings or an approved equal.

R. ALUMINUM LOUVERS:

1. Louvers shall be of extruded aluminum, with frames and blades fabricated from 6063-T5 aluminum alloy of the depth and sizes indicated on the drawings. Louver blades shall be the stormproof type. Louvers with gravity operating dampers or manually operated blades shall be furnished as shown on the drawings or as specified under other sections of these specifications. The head, sill, and jamb members shall be fabricated from identical structural members and shall be provided with an integral caulking slot and retaining head. Extruded sill extensions shall be furnished and installed with the louvers. All fastenings shall be stainless steel or aluminum.
2. The frame and blades of the fixed louvers shall be a minimum thickness of 0.081 inches and shall be provided with reinforcing bosses.
3. All louvers shall have insect screens attached to the interior. Insect screen shall be 18 x 14 mesh aluminum screening, 0.0123 diameter and 0.5056 clad. Frames shall be rolled aluminum with mitered corners secured with corner clips. Insect screens shall be manufactured by Construction Specialties, Inc., Cranford, NJ, or an approved equal.

4. Fixed louvers shall have heavy duty bird screen attached to interior of louver, as indicated on the drawings. Screening shall be intercrimp aluminum wire secured in 10 B&S gage extruded frames. Mesh shall be 0.1 inch 0.092 intercrimp wire. Frames shall be rewireable. Heavy duty bird screens shall be manufactured by Construction Specialties, Inc., Cranford, NJ, or an approved equal.

S. STEEL LOUVERS:

1. The louvers shall be steel angle iron blades with steel channel frames of the depth and sizes as indicated on the drawings. Louvers shall be fixed.
2. The head, sill, and jamb members shall be fabricated from structural steel channel frames. The frame and blades shall be continuously welded and color galvanize coated. All abrasions shall be touched up with color galvanize paint, color to match.
3. All louvers are to have attached insect screens. Insect screen shall be 18 x 14 mesh aluminum screen, 0.0123 diameter and 0.5056 clad. Frames shall be rolled aluminum with mitered corners secured with corner clips. Insect screens shall be manufactured by Construction Specialties, Inc., Cranford, N.J., or an approved equal.
4. Fixed louvers shall have heavy duty bird screen attached to interior, as indicated on the drawings. Screening shall be intercrimp aluminum wire secured in 10 B&S gauge extruded frames. Mesh shall be 0.1 inch 0.092 intercrimp wire.
5. Frames shall be rewireable. Heavy duty bird screens shall be manufactured by Construction Specialties, Inc., Cranford, N.J., or an approved equal.
6. Unused portions of louvers shall be blocked with a 12 gauge prefinished backup panel. All operating portions of louvers shall have operating dampers per Division 15 and the drawings.

T. BRICK VENTS:

1. The brick vents shall be cast aluminum sized as shown on the drawings, as manufactured by Construction Specialties, Inc.; Arrow United Dampers; Hohmann & Barnard, Inc., or an approved equal. The brick vent shall be furnished with 8 x 8 mesh, 0.020-inch diameter aluminum wire screening, preformed and fitted behind the louver. The vent shall be provided with 0.040-inch thick sheet aluminum duct extension from the back of the vent to the metal duct.

PART 3 - EXECUTION

3.01 GALVANIZING:

NOTE TO SPECIFIER: Retain Paragraph 3.01 A if galvanizing required without primer or finish coatings. Retain Paragraph 3.01 A and B if galvanizing and primer required (for field-applied finish). Retain Paragraph 3.01 A, B and C if galvanizing, primer and shop-applied finish coating required.

- A. HOT-DIP GALVANIZING:
1. Provide a coating for iron and steel fabrication applied by the hot-dip process. The galvanizing bath shall contain .05-.09% nickel. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet kettle process is prohibited. Comply with ASTM A-123 for fabricated products and ASTM A-153 for hardware. Provide thickness of galvanizing specified in referenced standards. Provide coating by Duncan galvanizing or approved equal.
- B. FACTORY-APPLIED PRIMER OVER HOT-DIP GALVANIZING:
1. Provide a factory-applied polyamide epoxy coating primer, 2.0 mils dry film thickness minimum. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations, and as recommended by coating manufacturer. Provide primer coating by Duncan Galvanizing or approved equal.
- C. FACTORY-APPLIED ARCHITECTURAL FINISH OVER PRIMER AND HOT-DIP GALVANIZING:
1. Provide a factory-applied polyurethane color coating, 2.5 mils dry film thickness minimum. Apply coating at the galvanizer's plant, immediately after application of the prime coat, in a controlled environment meeting applicable regulations, and as recommended by the coating manufacturer. Provide finish coating by Duncan Galvanizing or approved equal.
- D. Items noted as "color galvanized" shall have an architecturally compatible factory finish formulated to be applied over galvanized members, suitable for use in harsh environments, and applied by the galvanizer at the factory. Finish shall be formulated to be used in adverse environments and shall be guaranteed for 20 years. Engage a galvanizing facility, which will assume a single source responsibility for galvanizing, priming and finish coating.
- E. The Contractor shall be responsible for determining if any fabricated items are not suitable to be hot-dip galvanized and shall notify the Owner in writing.
- F. Surfaces of metal to be galvanized shall be free from all dirt, grease, rust and moisture. Burrs and sharp projections shall be removed from edges, holes, etc., before galvanizing. Fabricated items shall be galvanized after fabrication.

3.02 WELDING OF STEEL:

Welding of steel shall be done in accordance with the AWS Code. Welds shall be continuous along entire line of contact, except where plug or tack welding is noted. Exposed welds shall be ground smooth.

3.03 WELDING OF ALUMINUM:

Welding of aluminum shall be done in accordance with the AWS "Welding Aluminum" as reprinted from the Welding Handbook. Aluminum shall be fusion welded by the inert gas-shielded-arc method. Where appearance is not a factor and anodizing is not required, alloy 4043 rods may be used. For appearance match, rods shall be of an alloy similar to the alloy being welded.

3.04 FABRICATION AND ERECTION:

- A. Metalwork shall be complete, with all necessary bolts, nuts, washers, anchors, plates, fastenings, and other fittings. To the extent possible, holes for attachment of blocking, clip angles, etc. shall be shop punched. Where shop punching is impracticable, holes shall be field drilled. Burned holes will not be permitted.
- B. Material shall be straight, accurately fabricated with joints neatly framed, square, and well-riveted, bolted, or welded.
- C. Metalwork to receive hardware shall have all cutouts and attachments accurately made using the hardware itself or templates where necessary.
- D. Metalwork shall be accurately set and secured in position, with lines plumb and level and surfaces flush and square, or as otherwise required to conform to the structure as shown on the drawings.
- E. Wherever possible, all metalwork shall be built into the masonry work and shall have sufficient anchors, well-fastened. Anchors shall be welded to steelwork and shall be staggered where attached to structural shapes. Metalwork impracticable to set before masonry is built shall be anchored to it with approved expansion bolts set in solid masonry units or in concrete.
- F. Miscellaneous metalwork shall be plainly marked to indicate its location in the structure.

3.05 ALUMINUM WORK PROTECTION:

- A. Aluminum surfaces which after erection are to be in contact with wood or treated wood shall be given a heavy brush coat of aluminum-pigmented bituminous paint or two (2) coats of aluminum metal and masonry paint.
- B. Aluminum surfaces which after erection are to be in contact with masonry or concrete shall be given a heavy brush coat of alkali-resistant bituminous paint.
- C. Aluminum surfaces which after erection are to be in contact with dissimilar metals, other than zinc or stainless steel, shall receive a heavy brush coat of zinc chromate primer, followed by two (2) coats of aluminum metal and masonry paint, or shall receive a heavy brush coat of alkali-resistant bituminous paint.
- D. Aluminum surfaces which are to be exposed to the weather, including anodized surfaces, shall receive two sprayed-on shop coats of water-white methacrylate lacquer, capable of withstanding the action of lime mortar for at least one week in an atmosphere of 100 percent humidity at room temperature. Surfaces shall be perfectly clean and dry before lacquering.
- E. Prior to the application of any of the above coatings, any and all areas where the paint has been damaged by abrasion or other cause shall be cleaned and repainted as directed so that the aluminum will have a complete protective paint film when brought into contact with the material against which it is being protected.
- F. Before application of any coating, the surface shall be cleaned of all dirt, heavy deposits of grease or oil, and other foreign substances such as paint, lacquer, tape, moisture, or other material which might interfere with the adhesion of the coating to be applied. Aluminum shall be left in a clean condition. Cleaning methods shall employ steam, mild soaps, mild detergents, or solvents such as kerosene, or naphtha. Lacquered surfaces may be cleaned with a mineral solvent or turpentine. Thorough rinsing with clean water and drying with clean, soft cloths shall follow any of the above cleaning methods. No other cleaning method may be used without the specific permission of the Owner.
- G. After suitable cleaning, all aluminum work shall be given an approved shop coating of methacrylate lacquer to protect the surface from stain. The protective coating of lacquer on all aluminum work worn off due to handling or erection shall be replaced by a new coating of lacquer of the same type.
- H. During construction, precautions shall be taken to prevent damage to the aluminum work from splashing or the accumulation of paint, concrete, mortar, or other similar materials, or from staining adjacent surfaces during cleaning operations. Any staining or damage that does occur shall be immediately and completely removed.
- I. Each piece of aluminum in transit and in storage shall be individually wrapped with a non-scratching material, with the joints securely sealed. Wrapping shall completely cover and protect each item. Storage shall be out of the weather, protected from moisture, and with adequate ventilation around each piece of aluminum.

3.06 PAINTING:

- A. Ferrous metals of this section, except for galvanized or stainless steel shall be shop primed in accordance with the following:
1. Submerged service components shall be sandblasted clean in accordance with SSPC-SP-10, Near White, immediately prior to priming.
 2. Non-submerged service components shall be sandblasted clean in accordance with SSPC-SP-6, Commercial Grade, immediately prior to priming.
 3. Shop primer, except as otherwise noted, shall be one spray applied coat with dry film thickness of 3.5 to 4.5 mils of Tnemec 66 Boston Gray Primer by Tnemec Co.; or Aquapun by PPG, Inc; or approved equal.
 4. Portions of ferrous metals to be embedded in concrete or masonry shall be given a heavy brush coat of alkali resistant bituminous paint.
 5. Scratches or abrasions in the shop coat and areas at field welds, bolts, nuts and other unpainted areas shall be touched up after erection with the paint specified for the shop coat. Cold galvanized paint shall be used for touch up of galvanized surfaces. Paint shall be one of the following; Sealube Co., ZRC; Galvicon Corp., Galvicon; Stanley Chemical Div., Zinc Shield; Duncan Galvanizing Corp., ZIRP; or an approved equal.
 6. Shop and field prime paint systems shall be compatible with finish coat.
- B. Aluminum louvers shall be finished with polyvinylidene fluoride (PVDF) colored opaque fluorocarbon coating. PVDF resins shall be "Kynar 500" or "Hylar 5000."

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers field painting and coating of surfaces, complete. Shop painting of metal items is specified under the applicable item.
- B. A schedule listing the various types of surfaces to be painted and the types of paints to be applied is included herein.
- C. Unless otherwise indicated, the following items shall not be painted:
 - 1. Labels on equipment, such as Underwriters' Laboratories and Factory Mutual, equipment identification, performance rating, and name or nomenclature plates.
 - 2. Moving parts of operating units, exposed bolt threads, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts.
 - 3. Electrical conduit unless mounted on painted or finished surfaces or exposed in a finished room.
 - 4. Structural steel not exposed to view, and other parts of buildings also not exposed to view.
 - 5. Stainless steel.
 - 6. Concrete.
 - 7. Plumbing fixtures.
 - 8. Fiberglass and polyethylene storage tanks.
 - 9. Uninsulated PVC piping (to be banded only)
 - * 10. Factory prefinished architectural components.
 - * 11. Electrical panels and cabinets factory finish painted.

* Except for touch-up painting when required

1.02 SYSTEM DESCRIPTION:

- A. The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, whether used as prime, intermediate, or finish coats.
- B. The Contractor shall do a complete painting job throughout the work in accordance with generally approved modern practices for work of high quality. Unless otherwise specified, all materials and surfaces customarily painted shall be given not less than one shop coat and two field coats or one prime coat and two finish coats, regardless of whether or not the surface to be painted is specifically mentioned.
- C. Paints containing lead shall not be used.
- D. To ensure a satisfactory painting job it is essential that the paints applied in the shop and in the field be mutually compatible. The Contractor shall determine what shop paints have been used and shall verify that field applied paints are compatible therewith.
- E. The colors of finish coatings shall be selected by the Owner from color chips submitted by the Contractor for review. The color selection shall be in the form of a schedule indicating the colors to be used on the various surfaces. The colors used in the final work shall be in accordance with the color schedule and shall match the selected color chips.
- F. All coating systems used for potable water applications shall be previously approved by the National Sanitation Foundation (N.S.F.) in accordance with Standard 61. Evidence of such approval shall be an approval letter from N.S.F. listing the submitted materials.
- G. Paints submitted shall meet all Federal and State E.P.A. regulations pertaining to volatile organic compounds (VOC) compliance.

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL CONDITIONS, SUBMIT THE FOLLOWING:

- A. Six (6) sets of manufacturers literature of proposed paints shall be submitted to the Owner for review.
- B. Six (6) sets of the painting schedule shall be submitted to the Owner for review.
- C. Three (3) sets of color chips shall be submitted to the Owner for selection of colors.

1.04 DELIVERY AND STORAGE:

- A. Paint shall be delivered to the site in the manufacturer's sealed containers. Each container shall bear the manufacturer's label, listing the brand name, type and color of paint, and instructions for thinning. Thinning shall be done only in accordance with directions of the

manufacturer. Job mixing or job tinting may be done when approved by the Owner and for preparing sample colors.

- B. Painting materials shall be stored and mixed in a single location designated by the Owner for this purpose. The Contractor shall not use any plumbing fixture or pipe for mixing or for disposal of any refuse. He shall carry all necessary water to his mixing room, and shall dispose of all waste outside of the building in a suitable receptacle. The Contractor will be held responsible for any damage done due to failure to observe these precautions.
- C. The paint storage area shall be kept clean at all times, and any damage thereto or to its surroundings shall be repaired. Any oily rags, waste, etc., shall be removed from the building every night, and every precaution shall be taken to avoid danger of fire.
- D. Heat must be provided in the storage area if paints are to be stored during winter months. The temperature shall be maintained above 40 degrees F. at all times.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. PAINT SCHEDULE:

Except as otherwise indicated, all paint used shall be of the type listed in the schedule below, by Tnemec Company, Inc., or equivalent paints by Sherwin-Williams Company, International Paints, or other approved paint fully equal to paint manufactured by the above named companies. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following painting schedule are submitted in writing to the Owner, along with sufficient data supported by certified tests.

PAINT SCHEDULE

<u>Key</u>		<u>Tnemec</u>	<u>Note 1</u>
AGE	Aklyd Gloss Enamel	2H Tneme-Gloss	3.5
APE	Acrylic Polyurethane	74 Endura-Shield IV Enamel	3.0
ABF	Cementitious Block Filler	130 Envirofill	80-100 s.f./gal
BO	Bleaching Oil	Note 5	
CEE	Catalyzed	69 H.B. Epoxoline II 66 H.B. Epoxoline II (Tank Exteriors)	4.0
CEM	Catalyzed Epoxy Mastic	135 Chembuild	Note 3
CEP	Catalyzed Epoxy Primer	69-1211 H.B. Epoxoline II Primer	3.0

<u>Key</u>		<u>Tnemec</u>	<u>Note 1</u>
EP	Epoxy-Polyamide (thinned 30% #4 thinner)	20 Pota-pox	3.0-5.0
EPW	Water-based Epoxy Primer	151 Elasto-Grip	1.0-1.5
HGV	High Gloss Varnish		Note 2
HSE	High Solids Epoxy (Minimum 80%)	104 H.S. Epoxy	6.0
MA	Modified Alkyd	16 Uni-bond	3.0
MAE	Modified Acrylic Elastomer	156 Envirocrete	6.0-8.0
MP	Modified Polyurethane (sprayable)	264 Elasto-shield (NSF) 265 Elastoshield (NSF) (Trowel Grade)	7.5
PEF	Polyamine Epoxy Finish	280 Tneme-Glaze	6.0-8.0
PEP	Polyamine Epoxy Primer	201 Epoxoprime	6.0-8.0
PVA	PVA Sealer	51-792 PVA Sealer	1.5
PWC	Potable Water Coating	140 Potapox-Plus	7.0
SA	Silicone Aluminum	39-1261 (Note 4)	1.5
VE	Vinyl Ester Coating	120 Vinester	12.0
WP	Wood Primer	Note 2	-
WS	Wood Sealer	Note 2	-
Z	Zinc-Rich Primer	90-97 Tneme-Zinc	2.5

Notes

- 1: Minimum Dry Film Thickness/Coat (mils)
- 2: Furnished by reputable manufacturer and acceptable to the Owner.
- 3: Shall be used as a tie-coat between incompatible paints @ 4.0 mils.
- 4: This paint is suitable for temperatures up to 1200°F and must be final cured at 400°F for one hour.
- 5: Bleaching oil is a translucent gray paint stain with a chemical additive to enhance the natural bleaching tendencies of cedar shingles.

B. PAINTING SCHEDULE:

Paint shall be applied in accordance with the paint key listed on the following schedule and defined in the preceding Paint Schedule:

<u>Item</u>	<u>Field Coats</u>			
	1st	2nd	3 rd	
<u>Walls:</u>				
Interior concrete masonry units	ABF	HSE	HSE	
Exterior concrete masonry units (if sprayed, backroll first coat)***	MAE	MAE	--	
Exterior wood shingles	BO	BO	--	
Plaster & gypsum wallboard	PVA	HSE	HSE	
<u>Floors:</u>				
Concrete floors designated to be painted	PEP	PEF	PEF	
<u>Ceilings and Walls:</u>				
Exposed galvanized metal deck/bar joists	MA	--	--	
Exposed galvanized wall panel	CEE	CEE	--	
Plaster & gypsum wallboard	PVA	HSE	HSE	
<u>Equipment Items:</u>				
With shop prime coat, including machinery and pumps (non-submerged and submerged)	Interior	*CEP	CEE	--
	Exterior	*CEP	APE	
With shop finish coat (when designated be painted)	Interior to	*CEM	CEE	--
	Exterior	*CEM	APE	
<u>Tanks:</u>				
Exterior of steel tanks	*Z	CEE	APE	
<u>Potable Water Coatings (immersion service):</u>				
<u>Metals:</u>				
Interior miscellaneous galvanized and non-ferrous metals and piping	CEE	CEE	--	
Exterior miscellaneous galvanized and non ferrous metals and piping (SP7 required)	CEE	APE	--	

Miscellaneous interior ferrous piping, metalwork, ferrous parts or operating devices, valve handles, levers, pumps, and ferrous hangers and supports (exterior exposure)	CEP	CEE	--
	CEP	CEE	APE
Exposed electrical conduit, conduit fittings, outlet boxes	Same as adjacent wall or ceiling		
Hot ferrous metal surface	SA	SA	--
<u>Wood and Carpentry Items:</u>			
Wood trim (natural finish)	WS	HGV	HGV
Wood trim (unprimed)	WP	AGE	AGE
<u>Doors and Frames:</u>			
Interior hollow metal doors, frames and panels	CEE	CEE	--
Exterior hollow metal doors	CEE	CEE	--
Interior wood doors (painted)	WP	AGE	AGE
Interior wood doors (natural)	HGV	HGV	--
<u>Piping:</u>			
PVC Piping designated to be painted (SP7 or hand sand)	CEE	CEE	--
Pipe insulation (plastic or metal sheathed paint as scheduled for plastic or metal surface)	PVA	CEE	CEE
Other piping (see metals)			

* Spot Prime

** Apply CEM only in severe moisture or chemical exposure if factory finish coat is unknown

*** For existing, painted masonry walls, use EPW primer, followed by two coats of MAE.

B. SPARE PAINT:

1. Furnish to the Owner one unopened gallon of each type and color of paint used on the work.
2. Furnish both components for each type and color of epoxy paints used on the work.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Before any surface is painted, it shall be cleaned carefully of all dust, dirt, grease, loose rust, mill scale, old weathered paint, efflorescence, etc. All necessary special preparatory treatment shall then be applied. Where required, imperfections and holes in surfaces to be painted shall be filled in an approved manner.

- B. Cleaning and painting shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surfaces which have been cleaned, pretreated, or otherwise prepared for painting, shall be painted with the first field coat as soon as practicable after such preparation has been completed, but in any event prior to any deterioration of the prepared surface.
- D. Wood shall be sanded to a smooth and even surface and then dusted off. Before priming wood which is to be painted, shellac shall be applied to all knots, pitch and sapwood. After priming or stain coat has been applied, nail holes and cracks shall be thoroughly filled with plastic wood or putty. For natural finish work, putty shall be colored to be imperceptible in the finished work.
- E. Exposed nails and other ferrous metal or surfaces to be painted with water-thinned paint shall be spot primed with aluminum.
- F. Cracks and holes in masonry and concrete surfaces to be painted shall be filled with portland cement mortar. Surfaces shall be clean and dry before painting. All efflorescence, grease, oil, etc., shall be removed before painting, and all loose, crumbling material shall be removed by vigorous wire brushing over entire surface, followed by removal of all dust. All high areas on masonry and concrete surfaces such as mortar daubs, mortar ridges at joints, and ridges at form joints in concrete shall be removed.
- G. All holes in plaster shall be filled with plaster of paris and all cracks shall be cut out and filled. No sandpaper shall be used on plastered surfaces. Prior to painting, surfaces shall be tested with a moisture detecting device, such as Kaydel Plaster Tester, Type CP-48, as manufactured by Hard Moisture Gauges, Inc. No sealer or paint shall be applied when the moisture content of the plaster exceeds 8 percent, as determined by the test. Testing shall be done in the presence of the Owner's representative, and in as many locations as directed. Plaster shall be thoroughly dry-brushed before painting or sealing.
- H. All nonferrous metal surfaces to be painted shall be cleaned of all dirt, grease, oil and other foreign substances per SSPC SP 7.
- I. All galvanized surfaces to be painted shall be brush blasted per SSPC SP7.
- J. Before application of the +full field coat, abraded areas of all non-galvanized ferrous metal items having shop coats shall be touched up with paint of the type indicated on the Painting Schedule.
- K. All items of equipment such as motors, pumps, instrumentation panels, electrical switchgear, and similar items, that have been given shop coats, paint filler, enamel or other treatment customary with the manufacturer, shall have, after installation, all scratches and blemishes touch up prior to application of the first field coat. Factory prefinished items not to be field painted shall be touched up with matching paint to repair any areas damaged during installation.

- L. All submerged concrete surfaces which are to receive an epoxy coating shall be brush blasted to remove surface laitance and provide a uniform surface profile. Surface preparation may commence one week after the concrete has been pronounced cured. The curing period is defined as that length of time during which the concrete is fully hydrated (28 day cure).
- M. Concrete floors that are to receive epoxy coating shall be brush blasted or shot blasted (Blastrack).
- N. Hardware accessories, machine surfaces, plates, lighting fixtures, and similar items in place prior to cleaning and painting, and not intended to be painted, shall be removed during painting operations and repositioned upon completion of each area or shall otherwise be protected.
- O. All PVC pipe to be painted shall be brush blasted per SSPC SP7 or shall be sanded to provide a uniform surface profile.

3.02 APPLICATION:

- A. Paint shall be used and applied as recommended by the manufacturer without being extended or modified, and with particular attention to the correct preparation and condition of surfaces to be painted.
- B. Paint shall be applied only within the temperature range recommended by the manufacturer. Painting of surfaces when they are exposed to the sun shall be avoided.
- C. Paint shall not be applied to wet or damp surfaces and shall not be applied in rain, snow, fog, or mist, or when the relative humidity exceeds 85 percent.
- D. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 40°F within 18 hours after the application of paint. Dew or moisture condensation should be anticipated and if such conditions are prevalent, painting shall be delayed until midmorning to be certain that the surfaces are dry. Further, the days painting should be completed well in advance of the probable time of day when condensation will occur, in order to permit the film an appreciable drying time prior to the formation of moisture.
- E. All paint shall be applied under favorable conditions by skilled painters and shall be brushed out carefully to a smooth, even coating without run or sags. Enamel shall be applied evenly and smoothly. Each coat of paint shall be allowed to dry thoroughly, not only on the surface but throughout the thickness of the paint film before the next coat is applied. Finish surfaces shall be uniform in finish and color, and free from flash spots and brush marks. In all cases, the paint film produced shall be satisfactory in all respects to the Owner.
- F. Exposed nails and other ferrous metal or surfaces to be painted with water-thinned paints

shall be spot primed with aluminum paints.

- G. In order to provide contrast between successive coats, each coat shall be of such tint as will distinguish it from preceding coats.
- H. The Contractor shall not only protect his work at all times, but shall also protect all adjacent work and materials by the use of sufficient drop cloths during the progress of his work. Upon completion of the work, he shall clean up all paint, spots, oil, and stains from floors, glass, hardware, and similar finished items.
- I. Paint shall be applied so as to obtain coverage per gallon and the dry film thickness recommended by the manufacturer. Dry film thickness readings shall be taken to insure that required thicknesses have been achieved. The Contractor shall record in a manner satisfactory to the Owner, the quantities of paint used for successive coats on the various parts of the work.
- J. Spraying with adequate apparatus may be substituted for brush application of those paints and in those locations for which spraying is suitable.
- K. If paints are thinned for spraying, the film thickness after application shall be the same as though the unthinned paint were applied by brush. That is, the addition of a thinner shall not be used as a means of extending the coverage of the paint, but the area covered shall be no greater than the area which would have been covered with the same quantity of unthinned paint.
- L. Blast cleaned metal surfaces shall be coated immediately after cleaning, before any rusting or other deterioration or contamination of the surface occurs. Blast cleaned surfaces shall be coated not later than 8 hours after cleaning under ideal conditions or sooner if conditions are not ideal.

3.03 CLEANUP:

- A. The Contractor shall at all times keep the premises free from accumulation of waste material and rubbish caused by his employees or work. At the completion of the painting, he shall remove all of his tools, scaffolding, surplus materials, and all of his rubbish from and about the buildings and shall leave his work "broom clean" unless more exactly specified.
- B. The Contractor shall also, upon completion, remove all paint where it has been spilled, splashed, or splattered on all surfaces, including floors, fixtures, equipment, furniture, glass, hardware, etc., leaving the work ready for inspection.

END OF SECTION

SECTION 11305

SEMI-POSITIVE DISPLACEMENT RESIDENTIAL GRINDER PUMP UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers the furnishing of factory-built, semi-positive displacement residential grinder pump units. All components, except as otherwise noted, shall be provided by one supplier.

1.02 SYSTEM DESCRIPTION:

- A. The system shall consist of complete factory-built and tested grinder pump units, each consisting of grinder pumps suitably mounted in a basin constructed of high density polyethylene (HDPE) with an integral access way, electrical quick disconnect (NEMA 4X), remote electrical alarm/disconnect panel, manual transfer switch, electric motor, all necessary internal wiring and controls, pump installation and removal systems, fittings, valves and all associated equipment and accessories required to make a complete system.
- B. Equipment and accessories not specifically described herein shall be the manufacturer's standard catalog products unless otherwise approved by the Owner.

1.03 QUALITY ASSURANCE:

- A. All equipment shall conform to the following criteria:
 - 1. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station in its tank shall be listed by Underwriter's Laboratories, Inc., to be safe and appropriate for the intended use. The grinder pump shall conform to the Department of Environmental Protection Division of Air Quality Control regulations governed by the following policy:

"A source of sound will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:

 - a. Increases the broadband sound level by more than 10 dB(A) above ambient, or
 - b. Produces a "pure tone" condition - when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

The grinder pump shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low-pressure sewer system applications. As evidence of compliance with this requirement, the grinder pumps shall bear the National Sanitation Foundation seal.

2. Equipment shall be manufacturer's standard products presently in commercial production.
3. Conform to Hydraulic Institute Standards.
4. All the equipment specified under this Section shall be furnished by a single supplier and shall be products of manufacturers regularly engaged in the production of said equipment. The supplier shall have the sole responsibility for proper functioning of the complete grinder pump package.
5. The grinder pump stations shall conform to requirements for materials, installation, and equipment approvals of state, local, Underwriters Laboratories, Inc., NEC, NEMA, ASTM, NSF, and other applicable codes whether or not called for on the drawings or the specification.
6. Base the use of unspecified materials on their continuous and successful employment under similar conditions, as called for in this section.

B. MANUFACTURER'S QUALIFICATIONS:

1. The equipment furnished hereunder shall be the product of a company experienced in the design and manufacture of grinder pumps specifically intended for use in pressure sewage systems. Manufacturers proposing equipment for this project shall have at least five (5) years experience in the design and manufacture of units of similar size and mechanically similar to the specified units which have been in successful operation with no less than two hundred fifty grinder pump units. Furthermore, the manufacturer shall submit detailed installation and user instructions for its product, and provide evidence of an established service support program including parts lists and service manuals. The manufacturer shall submit an installation list with number of units, location, contact person and phone number and date of installation.
2. Upon request from the Owner, the grinder pump manufacturer shall demonstrate proof of financial responsibility with respect to performance and delivery date.
3. Upon request from the Owner, the grinder pump manufacturer shall provide proof or evidence of the facilities, equipment, and skills required to produce the equipment specified herein.
4. In addition to requirements set forth in Section 01140 under "Services of Manufacturer's Representative," the manufacturer shall provide the supervisory service of a factory trained engineer, who is specifically trained on the type of

equipment supplied, for a period of not less than two 8-hour days to assist in installation of the pumping equipment and related appurtenances, to provide initial startup of each grinder pump, and to instruct the Owner's operating personnel in the operation and maintenance of the equipment provided.

C. FACTORY TESTS:

1. Each grinder pump shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as the anti-siphon valve, check valve, discharge line, level sensors and each unit's dedicated controls. All factory tests shall incorporate each of the above-listed items. Actual appurtenances and controls which will be installed in the field, shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps will not be acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve, with the maximum pressure no less than 60 psi.
2. The OWNER reserves the right to witness such testing procedures at the Pump Manufacturer's facility. OWNER shall be notified 14 days prior to the testing.
3. All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means.

D. Field acceptance tests shall be performed as specified in Part 3 Execution.

1.04 REFERENCES:

The latest editions of the following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

- | | |
|------------|---|
| ASTM A48 | Specifications for Gray-Iron Castings. |
| ASTM A53 | Specifications for Pipe, Steel, Black and Hot-dipped, Zinc Coated, Welded and Seamless. |
| ASTM D1785 | Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120. |
| ASTM D2464 | Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80. |
| ASTM D2467 | Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80. |

ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.

National Electric Code (NEC)

NEC Code National Electrical Code.

National Electric Manufacturers Association (NEMA)

NEMA Standard as Specified.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. SHOP DRAWINGS AND PRODUCT DATA:

1. Six (6) complete sets of shop drawings including manufacturer's data sheets showing illustrated cuts of the item(s), scale details, sizes, dimensions, capacities, performance characteristics, wiring diagrams, controls, and other pertinent information, shall be submitted to the Owner for review and approval. If more than one size or type is shown, the proposed items shall be clearly indicated. Approval of the shop drawings will not relieve the Contractor of the responsibility for proper fit or detail design.
2. Provide descriptive literature, bulletins, and/or catalog cuts for each item of equipment.
3. Provide data on the characteristics and performance of all pumps and motors. Pump data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, and horsepower. Curves shall be submitted on 8½-inch by 11-inch sheets.
4. Provide the total weight of each item of equipment including the weight of the single largest component of each item.
5. Provide a complete total bill of materials for all equipment.
6. Proof of 250 operating units.
7. Proof of five (5) years experience.
8. Evidence of established service and spare parts program.
9. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

B. DESIGN DATA:

1. Provide structural design calculations and drawings for the pump chamber including a buoyancy analysis which demonstrates that the grinder pump unit is stable against buoyant forces produced by groundwater. The structural drawings and calculations shall be prepared and stamped by a Registered Professional Engineer in the state of installation.
2. Provide complete wiring diagrams and schematics of all controllers, control panels, and control devices furnished under this section.
3. Provide complete wiring diagrams and schematics of all power and control systems including connections to the work of other sections.

C. OPERATION AND MAINTENANCE INSTRUCTIONS:

The grinder pump manufacturer shall be responsible for supplying six (6) sets of written instructions, which shall be sufficiently comprehensive to enable the Owner to operate and maintain the pump and all associated equipment supplied by the station manufacturer. Said instructions shall assume that the operator is familiar with pumps, motors, piping, and valves but that he has not previously operated and/or maintained the exact equipment supplied.

The instructions shall include, but not be limited to, the following:

1. Descriptions of, and operating instructions for each major component of the grinder pump as supplied.
2. Instructions for operation of the grinder pump in all intended modes of operation.
3. Instructions for all adjustments which must be performed at initial startup of the grinder pump, adjustment which must be performed after the replacement of level control system components, and adjustments which must be performed in the course of preventive maintenance as specified by the manufacturer.
4. Instructions for the adjustment, calibration, and testing of selected electronic components or assemblies, normally considered replaceable by the manufacturer, whose performance is not ascertainable by visual inspection.
5. Service instructions for major components not manufactured by the grinder pump manufacturer but which are supplied by him in accordance with these specifications. Incorporation of literature produced by the actual component manufacturer shall be acceptable.
6. Electric schematic diagram of the grinder pump unit as supplied, prepared in accordance with NMTBA and JIC standards. Schematics shall show, to the extent of authorized repair, pump motor branch, control, and alarm system circuits and interconnections among these circuits. Wire numbers shall be shown on the

schematic. Schematic diagrams for electronic equipment, the detail parts of which are normally repairable by the owner-town-servicer, need to be included and shall not be substituted for an overall schematic diagram. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall schematic diagram.

7. At the time of delivery, each set of instructions shall be clearly visible, attached to or inside each unit provided.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Prior to ordering the grinder pump units, the Contractor shall confirm the total number of units to be ordered with the Owner. The Owner shall determine the timing of delivery during the duration of the Contract.
- B. All grinder pump units shall be delivered to the Town of Chelmsford DPW, 100% completely assembled, including testing, ready for installation by others.
- C. Grinder pump units will be individually mounted on wooden pallets.

1.07 WARRANTY:

- A. The manufacturer shall offer a limited parts and labor warranty guaranteeing its product to be free from defects in material and factory workmanship for no less than twenty four (24) months from the date of installation, but no greater than thirty six (36) months from the date of delivery to the Owner. The Warrantee shall be a 100% on-site warrantee. Repair will be made free of charge and be made on-site by an authorized service provider within 24-hours of notice given to the manufacturer by the Owner.
- B. The manufacturer shall offer an installation training program from which the Owner will develop a list of certified grinder pump installers to have available to residents at the time of installation.

PART 2 - PRODUCTS

2.01 EQUIPMENT - SEMI-POSITIVE DISPLACEMENT GRINDER PUMPS:

A. GENERAL:

The semi-positive displacement type grinder pump shall be a removable core type unit rated at one horsepower, operating on a 240 volt, single phase, 60 Hertz electrical system.

B. CORE UNIT:

1. Each grinder pump unit shall have a cartridge type easily removable core assembly containing pump, motor, grinder, controls, check valve, stainless steel discharge piping, anti-siphon valve, electrical quick disconnect, and wiring.

2. The watertight integrity of the core unit, including wiring and access cover, shall be established by 100% factory test at a minimum of 5 psig.
3. The controls included in the core unit shall provide for fully automatic operation of the grinder pump assembly, and no external control panel shall be required for normal operation of the grinder pump unit.
4. Core unit shall have two (2) lifting hooks with nylon lift-out harness in the top housing to facilitate removal of the core unit from the tank when necessary.

C. PUMPS:

1. Pumps shall be custom designed, integral, vertical rotor, motor driven, solids handling pumps of the progressing cavity type with mechanical seal.
2. Rotor: Through-hardened, highly polished, precipitation hardened stainless steel.
3. Stator: Specifically compounded ethylene propylene synthetic elastomer suitable for domestic wastewater service. Physical properties: High tear abrasion resistance, grease resistance, water and detergent resistance, temperature stability, good aging properties, and outstanding wear resistance. The stator shall be designed and mounted in such a way as to accommodate rotor run-out and permit direct connection of the rotor to the motor shaft with no intermediate flexible coupling.
4. The pumps shall be capable of delivering 15 gpm against a rated total dynamic head of 0 feet (0 psig) and 9 gpm against a rated total dynamic head of 138 feet (60 psig). The pump(s) shall also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

D. GRINDERS:

1. Rotating type with a stationary hardened and ground chrome steel shredding ring spaced in close annular alignment to the driven impeller assembly positioned immediately below the pump elements; direct-driven by a single, one-piece motor shaft.
2. Grinder Impeller Assembly: Securely fastened to pump motor shaft; carry two hardened type 400 series stainless steel cutter bars; dynamically balanced to operate without objectionable noise or vibration over the entire range of recommended operating pressures.
3. Constructed to eliminate clogging and jamming under all normal starting and operating conditions with sufficient vortex action to scour tank free of deposits or sludge banks which would impair the operation of the pump.

4. To meet the above requirements, the following shall be accomplished in conjunction with the grinder pump tank:
 - a. Grinder shall be positioned in such a way that solids are fed in an up-flow direction.
 - b. Diameter of inlet shroud opening shall be no less than 5 inches (127 mm).
 - c. Average inlet velocity, at maximum flow, shall not exceed 0.2 feet per second.
 - d. Cutter bars shall extend above the impeller disc 0.20 to 0.25 inches (5.1 to 6.4 mm).
 - e. Nominal speed of impeller disc to be 1725 RPM.
5. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable quantity of "foreign objects," such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the pump and the 1-1/4 inch diameter stainless steel discharge piping.

E. ELECTRIC MOTOR:

1. One HP (746 watts), 1725 RPM, capacitor start, ball bearing, squirrel cage induction type with a low starting current not to exceed 30 amperes and high starting torque of at least 8.4 foot pounds.
2. Inherent protection against running overloads or locked rotor condition shall be provided for the pump motor by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. The motor protector combination to be investigated and listed by Underwriters' Laboratories, Inc., for the specific application.

F. MECHANICAL SEAL:

1. Core: Provided with a mechanical shaft seal to prevent leakage between the motor and pump.
2. Seal: Stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

G. DISCHARGE HOSE AND SLIDEFACE DISCONNECT/VALVE:

All discharge fittings and piping shall be constructed of 304 Series stainless steel, polypropylene or PVC. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and removal.

H. ELECTRICAL QUICK DISCONNECT:

The grinder pump unit shall include a single NEMA 4X electrical quick disconnect for all power and control functions. An integral tube shall allow venting of the control compartment to assure proper operation of the pressure switch level system.

I. CHECK VALVE:

1. Pump to be equipped with factory installed, gravity operated, flapper type integral check valve built into the discharge pipe, providing full-ported passageway when open and introducing friction loss of less than 6 inches of water at maximum rated flow.
2. Valve Body: High gloss injection molded PVC Type I-II.
3. Working Parts: Series 300 stainless steel and fabric reinforced synthetic elastometer to ensure corrosion resistance, dimensional stability and fatigue strength.
4. A non-metallic hinge: Integral part of flapper assembly providing maximum degrees of freedom for assured seating at a low back pressure.

J. ANTI-SIPHON VALVE:

1. Pump shall be constructed with a positively-primed flooded suction configuration.
2. Pump shall be equipped with integral anti-siphoning, air relief valve in the discharge piping just below the main check valve to provide added assurance that the pump cannot lose prime even under negative pressure conditions in the discharge piping system. This valve shall automatically close when the pump is running and open to atmosphere when the pump is off.

K. CONTROLS:

1. The primary on/off and alarm functions are to run on independent circuits. The alarm circuit shall also function as a redundant on/off switch in case of on/off switch failure. Control components shall be located inside the top housing of the core unit. The top housing shall be attached with stainless steel tamper proof fasteners. Non-fouling wastewater level detection for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air-bell level sensor connected to a pressure switch. Other types of level detection devices prone to fouling and need periodic maintenance such as mercury floats or conductance probes shall not be acceptable. The level detection device shall have no moving parts in direct contact with the wastewater. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type.

2. Refer to Paragraph 2.01-H for electrical quick disconnect for controls.
3. Each level control to have its own built in fail safe design to prevent the entrance of moisture into the controls in case of switch diaphragm failure.
4. To assure reliable operation of pressure sensitive switches, each core to be equipped with a quick disconnect breather assembly, complete with check valve to prevent accidental entry of water into motor compartment in the event of accessway flooding.
5. The grinder pump shall be furnished with a length of 6 conductor, gauge to meet Massachusetts electric code, length to be site specific, type SJOW cable, pre-wired and watertight with NEMA 6 electrical disconnect to meet UL requirements. There shall be no junction box required in the station.

L. CORROSION PROTECTION:

All materials exposed to wastewater shall have inherent corrosion protection; i.e., HDPE cast iron, stainless steel, or PVC. Any exterior steel surfaces are to be suitably protected against corrosion.

M. SERVICEABILITY:

All mechanical and electrical connections shall provide easy disconnect accessibility for core unit removal and installation. All maintenance tasks for the grinder pump station shall be possible without entry of the grinder pump station (as required by OSHA Permit for required confined spaces). "Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space."

2.02 TANK AND INTEGRAL ACCESSWAY:

- A. The tank shall be made of high density polyethylene of a grade selected for environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. Corrugations of outside wall are to be of a minimum amplitude of 1½-inch to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be a minimum .250-inch thick. All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to maximum external soil and hydrostatic pressure.
- B. The access way shall be an integral extension of the tank assembly and include a lockable cover assembly providing low profile mounting and water-tight capability. Access way design and construction shall facilitate field adjustment of station height in

increments of 4-inches or less without the use of any adhesives or sealants requiring cure time before installation can be completed.

- C. The station shall have all necessary penetrations molded in and factory sealed. No field penetrations shall be acceptable.
- D. All discharged piping shall be constructed of 304 Series Stainless Steel and terminate outside the access way bulkhead with a stainless steel, 1¼-inch female NPT fitting. The discharge piping shall be including a stainless steel ball valve rated for 200 psi WOG. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.
- E. The access way shall also include a 2-inch PVC vent to prevent sewage gases from accumulating in the tank.
- F. Each unit shall be furnished with one EPDM Grommet to accept a 4.50" outside diameter DMV pipe.

2.03 CONTROL PANELS:

- A. The electrical control panels shall be furnished by the grinder pump manufacturer.
- B. Each Grinder pump station control panel shall be U.L. listed and shall include a NEMA 3R Thermoplastic enclosure. It shall include circuit breaker(s) and all necessary components to accomplish proper pump and control operation including the following alarm capabilities:
 - 1. When liquid level in sewage tank rises above the alarm level, visual and audio alarms will be activated.
 - 2. Audio alarm may be silenced by means of the externally mounted, push-to-silence button.
 - 3. Visual alarm remains illuminated until sewage in tank returns to normal operating level.
 - 4. Battery operated visual alarm to be activated when liquid level rises to within 6 inches of the invert of the gravity inlet. This alarm shall be capable of operating during a power outage.

The visual alarm shall be a red fluted lens mounted to the top of the enclosure in such a manner as to maintain rain proof integrity.

The audio alarm shall be capable of being de-activated by depressing a weather proof, push-type switch mounted on the exterior of the enclosure.

- C. Control panels shall be furnished with an inner, hinged, deadfront panel containing all

operator control devices and mechanisms, such as circuit breaker operating handles, manual transfer switch operating handle, push buttons, selector switches, indicating lights, etc. Locks shall be provided for the control panels by the Contractor.

D. Manual Transfer Switch

1. Each grinder pump shall be furnished with a generator transfer switch to allow grinder pump operation with an emergency generator during periods of extended power outages. In the event that normal power is lost the transfer switch can be manually set to disconnect the normal source of power and connect the grinder pump to an emergency power source.
2. Transfer of power from the normal supply source to generator power shall be through the use of a three position, circuit isolating load break selector switch clearly marked LINE-OFF-GEN. Functions of the switch positions are as follows:

LINE The grinder pump is connected to the normal source of power

OFF Grinder pump is disconnect from both the normal and the emergency power sources.

GEN Grinder pump is connected to the emergency power source.
3. The normal source of power and the grinder pump shall be permanently connected to terminals L1, L2, and terminals T1, T2 respectively in the generator transfer switch.
4. A 20 amp; 250 volt; 2 pole; 3 wire NEMA L6-20P flanged inlet receptacle shall be provided for temporary cord and receptacle connection to the emergency generator. This receptacle shall be wired such that the receptacle blades will in no case be powered from any supply other than the emergency generator.
5. The three position selector switch and generator receptacle shall be pre-wired and dead front panel mounted behind the hinged cover of a NEMA 4X fiberglass enclosure with approximate dimensions of 8-inches wide by 10-inches deep.

2.04 REDUNDANT CHECK VALVE:

- A. Each grinder pump unit shall include one separate check valve per unit for installation in the discharge line between the grinder pump and the sewer main to ensure maximum protection against backflow in the event of sewer service line break.
- B. The valve shall be 1-1/4-inch, gravity operated, flapper- type. The check valve shall provide full-ported passageway when open and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Working parts shall be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability and fatigue strength. A non-metallic hinge shall be an

integral part of the flapper assembly, providing maximum degrees of freedom for assured seating at a very low back pressure:

- C. The valve body shall be a high gloss, injection molded part made of PVC type I-II with hub and socket compatible with 1-1/4-inch PVC solvent weld system. Dimensions for hub and socket shall be in accordance with Commercial Standards C5-272-65.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation of the grinder pump and related appurtenances shall be performed in accordance with all written instructions furnished by the manufacturer.
- B. After installation, Contractor shall clean all surfaces damaged in shipment or installation and shall touch-up in the field with the same materials as original coatings.

3.02 INTERFERENCE WITH EXISTING WORKS:

The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works.

3.03 HYDRAULIC UPLIFTS OF STRUCTURES:

The Contractor shall be responsible for the protection of all structures against hydraulic uplift.

3.04 FIELD ACCEPTANCE TESTS:

- A. After installation of the equipment and after completion of the services of the manufacturer's representative as detailed in Section 01140 SPECIAL PROVISIONS, the Contractor shall operate each unit to demonstrate its ability to pump without excessive vibration, motor overloading, or overheating. Each pump shall be operated for a sufficient period of time to permit thorough observation of all pump components.
- B. The Owner shall be notified in writing at least seven days in advance of the tests. If testing cannot be conducted because of scheduling, unavailable service personnel, etc., the Engineer's fees for a second visit shall be paid by the Contractor.
- C. All defects or defective equipment shall be corrected or replaced promptly at the Contractor's expense.
- D. All final adjustments necessary to place the equipment in satisfactory working order shall be made at the time of the above tests.
- E. The Contractor shall provide water for testing. All labor and materials necessary for the test shall be furnished by the Contractor.

- F. All piping shall be tested for tightness. Should leaks be found, faulty joints shall be repaired, and all defective pipe and fittings shall be removed and replaced in a manner satisfactory to the Owner.
- G. Contractor shall field test the emergency connections as provided by connecting the emergency generator if provided as part of this project or by utilizing the Owner's emergency generator available for intended use with the pumps. The pumps shall also be operated under temporary power conditions for a sufficient time to permit thorough observation of all pump components. The Owner shall determine the number of pump units to be tested in this manner.

3.05 SPARE PARTS:

- A. Contractor shall prepare a list of spare parts as specified in Section 01329, SUBMITTAL OF OPERATION AND MAINTENANCE MANUALS, for Owner's approval.

END OF SECTION

SECTION 11306

CENTRIFUGAL GRINDER PUMP UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section of the specification covers factory-built centrifugal submersible grinder pumps to be furnished and installed at the sites indicated on the Contract Drawings. Each unit shall be complete with all necessary parts and equipment specified herein, installed in a fiberglass reinforced polyester tank. All components, except as otherwise noted, shall be provided by one supplier and shall be installed by the Contractor.

1.02 RELATED WORK:

- A. Excavation, backfill, and site work are included in Division 2.
- B. Electrical work excepts as specified herein is included in Division 16.
- C. Valves and piping outside of the grinder pump units are included in Division 2.

1.03 SYSTEM DESCRIPTION:

- A. The system shall consist of centrifugal pumps, each with a grinder, electric motor, electric controls, level controls, tank with integral accessway, pump installation and removal systems, fittings, valves and all associated equipment and accessories required to make a complete system.
- B. Equipment and accessories not specifically described herein shall be the manufacturer's standard catalog products unless otherwise approved by the Owner.

1.04 QUALITY ASSURANCE:

- A. All equipment shall conform to the following criteria:
 - 1. Equipment shall be manufacturer's standard products presently in commercial production.
 - 2. Conform to Hydraulic Institute Standards.
 - 3. All the equipment specified under this Section shall be furnished by a single supplier and shall be products of manufacturers regularly engaged in the production of said equipment. The supplier shall have the sole responsibility for proper functioning of the complete grinder pump package.
 - 4. Any reference to a specific manufacturer or model number is for the purpose of establishing a quality or parameter for specification writing and is not to be

considered proprietary. In all cases, any source or device that has the quality and operating capabilities specified may be accepted.

5. Conform to requirements for materials, installation, and equipment approvals of state, local, Underwriter's Laboratories, Inc., or other applicable codes, whether or not called for on the drawings or in the specifications. All electrical devices and equipment shall be UL listed.
6. Workmanship shall be first class in all respects.
7. Base the use of unspecified materials on their continuous and successful employment under similar conditions, as called for in this section.

B. MANUFACTURER'S QUALIFICATIONS:

1. Upon request from the Owner, the grinder pump manufacturer shall demonstrate proof of financial responsibility with respect to performance and delivery date.
2. Upon request from the Owner, the grinder pump manufacturer shall provide proof or evidence of the facilities, equipment, and skills required to produce the equipment specified herein.
3. In addition to requirements set forth in Section 01140 under "Services of Manufacturer's Representative," the manufacturer shall provide the supervisory service of a factory trained engineer, who is specifically trained on the type of equipment supplied, for a period of not less than two 8-hour days to assist in installation of the pumping equipment and related appurtenances, to provide initial startup of each grinder pump, and to instruct the Owner's operating personnel in the operation and maintenance of the equipment provided.

C. FACTORY TESTS:

1. The pumps, motors, and controls shall be given an operational test in accordance with the standards of the Hydraulic Institute. Recordings of the test shall substantiate the correct performance of the equipment at the design head, capacity, speed, and horsepower as herein specified.
2. The Owner or his representative shall be invited to witness the operational test at the manufacturer's facility or other location designated by the manufacturer.

D. Field acceptance tests shall be performed as specified in Part 3 Execution.

1.05 REFERENCES:

A. The latest editions of the following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

1. ASTM A48 Specifications for Gray-Iron Castings.
2. ASTM A53 Specifications for Pipe, Steel, Black and Hot-dipped, Zinc Coated, Welded and Seamless.
3. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
4. ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
5. ASTM D2467 Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.

Massachusetts Electric Code (MEC)

MEC Code Massachusetts Electrical Code.

National Electrical Manufacturers Association (NEMA)

NEMA All applicable Standard.

1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. SHOP DRAWINGS AND PRODUCT DATA:

1. Six complete sets of shop drawings including manufacturer's data sheets showing illustrated cuts of the item(s), scale details, sizes, dimensions, capacities, performance characteristics, wiring diagrams, controls, and other pertinent information, shall be submitted to the Owner for review and approval. If more than one size or type is shown, the proposed items shall be clearly indicated. Approval of the shop drawings will not relieve the Contractor of the responsibility for proper fit or detail design.
2. Provide descriptive literature, bulletins, and/or catalog cuts for each item of equipment.
3. Provide data on the characteristics and performance of all pumps and motors. Pump data shall include guaranteed performance curves, based on actual shop tests of

similar units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets.

4. Provide the total weight of each item of equipment including the weight of the single largest component of each item.
5. Provide a complete total bill of materials for all equipment.

B. DESIGN DATA:

1. Provide structural design calculations and drawings for the pump chamber including a buoyancy analysis which demonstrates that the grinder pump unit is stable against buoyant forces produced by groundwater. The structural drawings and calculations shall be prepared and stamped by a Registered Professional Engineer.
 2. Design and hydraulic data for PVC pipe size changes are the responsibility of the Contractor. These design changes, should they be necessary, are to be included in Section 02088, "PVC Pressure Pipe."
 3. Provide complete wiring diagrams and schematics of all controllers, control panels, and control devices furnished under this section.
 4. Provide complete wiring diagrams and schematics of all power and control systems including connections to the work of other sections.
- C. Submit details on all items in other specification sections which are to be supplied and installed as part of the grinder pump package specified in this Section.
- D. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

E. OPERATION AND MAINTENANCE INSTRUCTIONS:

The grinder pump manufacturer shall be responsible for supplying written instructions, which shall be sufficiently comprehensive to enable the Owner to operate and maintain the pump and all associated equipment supplied by the station manufacturer. Said instructions shall assume that the operator is familiar with pumps, motors, piping, and valves but that he has not previously operated and/or maintained the exact equipment supplied.

The instructions shall include, but not be limited to, the following:

1. Descriptions of and operating instructions for each major components of the grinder pump as supplied.
2. Instructions for operation of the grinder pump in all intended modes of operation.

3. Instructions for all adjustments which must be performed at initial startup of the grinder pump, adjustment which must be performed after the replacement of level control system components, and adjustments which must be performed in the course of preventive maintenance as specified by the manufacturer.
4. Instructions for the adjustment, calibration, and testing of selected electronic components or assemblies, normally considered replaceable by the manufacturer, whose performance is not ascertainable by visual inspection.
5. Service instructions for major components not manufactured by the grinder pump manufacturer but which are supplied by him in accordance with these specifications. Incorporation of literature produced by the actual component manufacturer shall be acceptable.
6. Electric schematic diagram of the grinder pump unit as supplied, prepared in accordance with NMTBA and JIC standards. Schematics shall show, to the extent of authorized repair, pump motor branch, control, and alarm system circuits and interconnections among these circuits. Wire numbers shall be shown on the schematic. Schematic diagrams for electronic equipment, the detail parts of which are normally repairable by the owner-town-servicer, need to be included and shall not be substituted for an overall schematic diagram. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall schematic diagram.

1.07 DELIVERY, STORAGE, AND HANDLING:

A. SHIPPING:

1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Deliver spare parts at same time as the pertaining equipment. Deliver the spare parts to the Owner after completion of work.

B. Receive, store and safeguard all equipment, materials, and spare parts at the job site:

1.08 WARRANTY:

The manufacturer shall offer a limited warranty guaranteeing its product to be free from defects in material and factory workmanship for a minimum period of eighteen (18) months from date of Substantial Completion of the project, provided the product is properly installed, serviced, and operated under normal conditions and according to the manufacturer's instructions. Parts repair or replacement required as a result of such defects shall be made free of charge during this period upon return of the defective parts or equipment to the manufacturer or its nearest authorized service center.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

1. Myers Division, a Pentair Company, Ashland, Ohio.
2. Hydromatic Pumps, a Marley Company, Mission, Kansas.
3. Peabody Barnes, Incorporated, Mansfield, Ohio.
4. Acceptable equivalent manufacturer.

2.02 EQUIPMENT - CENTRIFUGAL GRINDER PUMP:

A. GENERAL:

The centrifugal type grinder pump shall be removable on rails and shall be rated two horsepower when operated on a 240 volt, single phase, 60 Hertz electrical system.

B. PUMPS:

1. Pumps shall be submersible type, single stage, centrifugal pumps capable of pumping continuously at conditions indicated on the drawings and specified hereunder. Pump casing shall be made of high tensile close-grained cast iron.
2. The pump shall be arranged to automatically clamp the pump discharge to the discharge connection when lowered along guides.
3. Discharge connection shall be cast iron, rigidly bolted to floor with stainless steel cinch anchors; machined to receive yoke and face of the pump discharge; discharge connection also shall hold the lower ends of the guides.
4. Shaft seals shall consist of two mechanical seals mounted in tandem, with an oil chamber between the seals. The rotating faces of the seals shall be carbon and the stationary faces shall be ceramic.

C. MOTOR:

1. Submersible motor windings shall be open type with Class F insulation. Winding housing shall be filled with a clean dielectric oil for cooling windings and seals and lubricating bearings.
2. The motor shall be protected from excessive temperatures by built-in automatic overload protection. The heat sensor thermostats embedded in the motor windings shall open when the temperature in the motor rises to over 220°F and shall automatically reset when the temperature drops. The motor starter shall be equipped with overload heaters so all normal overloads are protected by external heater block.

3. Motors shall be sufficient horsepower for operation anywhere on the pump head-capacity curve without overloading, with a 1.15 service factor based on the nameplate rating.
4. Motor ball bearings shall be designed for minimum B-10 life of 30,000 hours.
5. Flexible Power and Control Cables: Each pump shall be furnished with sufficient flexible power and control cable to reach from the pump to the electrical enclosure indicated. Cable leads shall be epoxy sealed at motor connection to prevent corrosion.
6. Design of each pump shaft shall have ample provision to compensate for pump thrust and for overhung load on impeller. Shafts to be stainless steel.
7. Grinder pump impeller shall be of bronze construction and recessed multi-vane semi-open design and shall thread onto motor shaft.
8. The grinder mechanism shall consist of radial cutter and a shredding ring mounted directly below the pump volute inlet. Both shredding ring and the cutter shall be removable from the outside without disassembling the pump. The shredding ring and the cutter shall be constructed of 440C stainless steel hardened to Rockwell 55-60.
9. Provide moisture sensing probes in oil filled seal chamber.
10. Provide stainless steel cable or chain to raise or lower the pump. The chain or cable shall be sized according to the pump weight.

D. LIFT-OUT SYSTEM:

1. Lift-out system shall be self-sealing with a simple up and down motion required to remove and reinstall the pump in the basin.
2. All components of the lift-out system shall be made of corrosion-resistant materials.
3. Lift-out system shall be adjustable so that perfect vertical alignment can be obtained.
4. All stationary components of the lift-out system shall be securely attached to the fiberglass structure.

E. CONTROLS:

1. Three mercury float switches shall be suspended from a detachable bracket fastened inside the tank to the access frame. They shall be suspended at the proper depths to control the following levels:
 - a. High water level
 - b. Pump "ON" level
 - c. Pump "OFF" level
2. Dry contacts wired to terminal blocks shall be provided for the following alarm conditions:
 - a. Motor Overload
 - b. Seal Leak
 - c. High Water
3. A NEMA Type 4X molded fiberglass Junction Box shall be mounted in the basin close below the cover. The box shall be connected by a length of 1 inch schedule 40 PVC conduit and elbow to a conduit fitting providing a water tight basin penetration 30 in. below finished grade. The fitting shall be located on the inlet side of the basin and shall accept a 1 inch schedule 40, PVC conduit connection using a standard PVC, solvent welded conduit coupling. Wire splices in the junction box shall be butt splices with heat shrink covering to provide submersible splices. All cord connectors to float switches and motors shall be watertight, strain relief type. Conduit feed connector to the junction box shall include explosion proof seal "Y." Float switch wiring shall be in a separate conduit or shielded.
4. All switches in the control panel shall be labeled. A wiring diagram shall be provided with all wires color codes and numbered.
5. All control voltages to the pump chamber shall be low enough to be intrinsically safe from the possibility of arcing in the pump chamber.
6. Electrical inlet connections shall be provided on both sides of inlet pipe, each at 45 degrees angle with pipe to provide flexibility in route of electrical connections to house and panel.

F. VALVES:

1. All valves shall be provided by the pump unit manufacturer and shall be manufacturer's standard catalog product.
2. Check Valve:

Pump unit shall be supplied with factory installed check valve built into the discharge pipe.

3. Shut-off Valve:

A shut-off valve shall be furnished and installed in the discharge piping. If the discharge depth is more than 2 feet from the surface, a handle extension shall be supplied. One extension shall be supplied for the first individual grinder pump unit, and one for each additional 20 units.

2.03 FIBERGLASS BASIN:

Grinder pump unit shall be installed in a suitable manufacturer's standard custom molded fiberglass reinforced polyester (FRP) basin so that the unit is readily removable for maintenance. The basin shall be furnished with an inlet flange to accept a 4-inch nominal diameter PVC Drain- Waste-Vent (DWV) pipe and with provision for the pump discharge pipe. The basin shall sit on and be fastened to an anti-flotation weight which will prevent flotation when the unit is completely submerged. Basin height shall be as indicated on the drawings. The basin cover shall be watertight and shall withstand the weight of the pump unit plus one 250 pound man and shall be bolted to the basin or furnished with other means of security, such as a padlock. The cover shall not project more than one inch above the ground surface.

2.04 CONTROL CABINETS:

- A. The electrical control cabinets shall be furnished by the grinder pump supplier and shall be installed under Division 16, ELECTRICAL.
- B. The control cabinets shall be NEMA Type 3R surface mounting type to house circuit breakers as shown on the drawings, motor starter, control and alarm relays and devices, terminal blocks, motor capacitors, alarm light/horn, silence pushbutton, manual transfer switch and generator receptacle.
- C. The controls shall include a hand-off-automatic selector switch and indicating lights for motor overload, seal leak, high water level and motor run.
- D. Control cabinets shall be furnished with an inner, hinged, deadfront panel containing all operator control devices and mechanisms, such as circuit breaker operating handles, manual transfer switch operating handle, pushbuttons, selector switches, indicating lights, etc. The alarm silence pushbutton shall be accessible from the outside of the cabinet and shall silence the horn only. The alarm light shall remain on until the alarm condition is cleared.
- E. Generator receptacles shall be 30 ampere, 600 volt, weatherproof, 3 wire, 4 pole having an angle body, spring cover, arcing chamber, reversed contacts, and longer ground contact bonded to body. Receptacles shall be Crouse-Hinds Co., Catalog No. ARE3422-S22, to match plugs on the City's existing and proposed portable generator.

- F. Manual transfer switches shall be heavy-duty, load break, 250 volt, 30 ampere, 2 pole, rated 2 HP.
- G. Control devices shall be heavy-duty, oiltight with full size operators or standard size dome lenses. Terminal blocks shall be furnished for all external connections. The alarm light/horn unit shall be a heavy duty, weatherproof unit consisting of a case metal or molded polycarbonate body, polycarbonate red lens, incandescent lamp rated 50 candlepower, built-in flasher rated 60 to 80 flasher per minute and built-in horn rated 100 db at 5 feet. Relays shall be heavy duty type with NEMA A600 contacts. Motor starters shall be magnetic, full-voltage, non-reversing, NEMA size 0. Motor overload relays shall be 2 pole, ambient-compensated, manual reset type with auxiliary alarm contact.

2.05 REDUNDANT CHECK VALVE:

- A. Each grinder pump unit shall include one separate check valve per unit for installation in the discharge line between the grinder pump and the sewer main to ensure maximum protection against backflow in the event of sewer service line break.
- B. The valve shall be 1-1/2-inch, gravity operated, flapper- type. The check valve shall provide full-ported passageway when open and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Working parts shall be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability and fatigue strength. A non-metallic hinge shall be an integral part of the flapper assembly, providing maximum degrees of freedom for assured seating at a very low back pressure.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation of the grinder pump and related appurtenances shall be performed in accordance with all written instructions furnished by the manufacturer.
- B. After installation, Contractor shall clean all surfaces damaged in shipment or installation and shall touch-up in the field with the same materials as original coatings.

3.02 INTERFERENCE WITH EXISTING WORKS:

The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works.

3.03 HYDRAULIC UPLIFTS OF STRUCTURES:

The Contractor shall be responsible for the protection of all structures against hydraulic uplift until such structures have been accepted finally by the Owner.

3.04 FIELD ACCEPTANCE TESTS:

- A. After installation of the equipment and after completion of the services of the manufacturer's representative as detailed in Section 01140 SPECIAL PROVISIONS, the Contractor shall operate each unit to demonstrate its ability to pump without excessive vibration, motor overloading, or overheating. Each pump shall be operated for a sufficient period of time to permit thorough observation of all pump components.
- B. The Owner shall be notified in writing at least seven days in advance of the tests. If testing cannot be conducted because of scheduling, unavailable service personnel, etc., the Engineer's fees for a second visit shall be paid by the Contractor.
- C. All defects or defective equipment shall be corrected or replaced promptly at the Contractor's expense.
- D. All final adjustments necessary to place the equipment in satisfactory working order shall be made at the time of the above tests.
- E. The Contractor shall provide water for testing. All labor and materials necessary for the test shall be furnished by the Contractor.
- F. After installation, all piping shall be tested for tightness. Should leaks be found, faulty joints shall be repaired, even to the extent of disassembling and remaking the joint, and all defective pipe and fittings shall be removed and replaced in a manner satisfactory to the Owner.

3.05 SPARE PARTS:

- A. The Contractor shall provide 2 spare pump units.
- B. Furnish the following spare parts:
 - 1. For the Centrifugal Pumps:
 - a. Six mechanical seals.
 - b. Six wearing rings.
 - c. Six sets of pump discharge gaskets.
 - d. Six liquid level sensors.
 - e. Six relays of each type.
 - f. Six redundant check valves.

END OF SECTION

SECTION 11307

PACKAGED SUCTION LIFT PUMP STATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section of the specification covers the packaged suction lift pump station to be furnished and installed at the site indicated on the Drawings. The station shall be complete with all equipment specified herein, installed in fiberglass reinforced polyester resin pump chamber. All components, except as otherwise noted, shall be provided by one supplier and shall be installed by the Contractor.

1.02 RELATED WORK:

- A. Excavation, backfill, site work and manholes used for wetwell is included in Division 2.
- B. Concrete and concrete reinforcement is included in Division 3.
- C. Electrical work except as specified herein is included in Division 16.
- D. The standby Generators are included in Division 16.
- E. Painting is included in Division 9.
- F. Valves and piping outside of the pumping station are included in Division 2.
- G. Instrumentation is included in Division 13.

1.03 SYSTEM DESCRIPTION:

- A. The system shall consist of a fiberglass pump chamber which will contain two self-priming centrifugal pumps, motors, electrical and level controls with all internal piping and valves, and other items specified herein, or required to provide a complete system as specified or shown on the drawings.
- B. Control of pumps shall be automatic, using a system actuated by change in wetwell liquid level. All equipment for the station shall perform automatically with provision for manual override.
- C. Equipment and accessories not specifically described herein shall be the manufacturer's standard catalog products unless otherwise approved by the Owner.
- D. Electrical power to be furnished to the site shall be 3 phase, 60 Hertz, 3-wire, 480 volts, maintained within plus or minus 10 percent. Station power and control voltage shall be 120/240 volts, single phase. Pumps shall be rated 480 volts, 3 phase.

1.04 QUALITY ASSURANCE:

A. All equipment shall conform to the following criteria:

1. Equipment shall be manufacturer's standard products presently in commercial production.
2. Conform to Hydraulic Institute Standards.
3. All the equipment specified under this Section shall be furnished by a single supplier and shall be products of manufacturers regularly engaged in the production of said equipment. The supplier shall have the sole responsibility for the proper functioning of the complete package pump station.
4. Any reference to a specific manufacturer or model number is for the purpose of establishing a quality or parameter for specification writing and is not to be considered proprietary. In all cases any source or device that has the quality and operating capabilities specified may be acceptable.
5. Conform to requirements for materials, installation and equipment approvals of state, local, Underwriter's Laboratories, Inc., or other applicable codes, whether or not called for in detail on drawings or in the specifications.
6. Workmanship shall be first class in all respects.
7. Base the use of unspecified materials on their continuous and successful employment under similar conditions, as called for in this section.

B. MANUFACTURER'S QUALIFICATIONS/SERVICES:

1. Upon request from the Owner, the pump station manufacturer shall demonstrate proof of financial responsibility with respect to performance and delivery date.
2. Upon request from the Owner, the pump station manufacturer shall provide proof or evidence of facilities, equipment and skills required to produce the equipment specified herein.
3. In addition to requirements set forth in Section 01140 under "Services of Manufacturer's Representative," the manufacturer shall provide the supervisory service of a factory trained engineer, who is specifically trained on the type of equipment supplied, for a period of not less than two 8-hour days per station to assist in installation of pumping equipment, and related appurtenances, to provide initial startup of each pump station and to instruct the Owner's operating personnel in the operation and maintenance of the equipment provided.

C. FACTORY TESTS:

1. The pumps, motors, and controls shall be given an operational test in accordance with the standards of the Hydraulic Institute. Recordings of the test shall substantiate the correct performance of the equipment at the design head, capacity, speed and horsepower as herein specified.
2. Perform hydrostatic and leakage shop tests on all assembled pumps, piping, valves and fittings in accordance with the latest test standards of the Hydraulic Institute to at least 1.5 times the specified operating or working pressure or the static head, whichever ever is the greatest.
3. The Owner or his representative shall be invited to witness the operational test at the manufacturer's facility or other location designated by the manufacturer.
4. The pump chamber shall be tested for structural strength and watertight integrity predicated on depth of setting by subjecting the chamber to a minimum vacuum test of 15-inches or more of mercury for 30 minutes.
5. Results of all above Factory Testing required shall be submitted for review 30 days prior to the shipping of the completed station.

D. Field acceptance tests shall be performed as specified in Part 3 Execution.

1.05 REFERENCES:

A. The latest editions of the following standards form a part of this specification:

American National Standards Institute (ANSI)

- | | | |
|------|---------|---|
| ANSI | A21.10 | Standard for Gray-Iron and Ductile Iron Fittings Fitting, 3-in. through 38-in. for Water and Other Liquids. |
| ANSI | A21.115 | Standard for Rubber-Gasket Joints for Ductile Cast-Iron and Gray-Iron Pressure Pipe and Fittings. |
| ANSI | A21.15 | Standard for Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges. |
| ANSI | A21.51 | Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids. |

American Society for Testing and Materials (ASTM)

- | | | |
|------|-----|--|
| ASTM | A48 | Specifications for Gray-Iron Castings. |
|------|-----|--|

National Electrical Code (NEC)

- | | | |
|----|--|--------------------------------|
| NE | | Code National Electrical Code. |
|----|--|--------------------------------|

National Electrical Manufacturers Association (NEMA)
NEMA Standard as specified.

1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. SHOP DRAWINGS AND PRODUCT DATA:

1. Shop drawings including manufacturer's data sheets, showing illustrated cuts of the item(s), scale details, sizes, dimensions, capacities, performance characteristics, wiring diagrams, controls, and other pertinent information shall be submitted to the Owner for review. If more than one size or type is shown, the proposed item shall be clearly indicated.
2. Provide descriptive literature, bulletins, and/or catalog cuts for each item of equipment.
3. Provide data on the characteristics and performance of all pumps and motors. Pump data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets.
4. Provide the total weight of each item of equipment including the weight of the single largest component of each item.
5. Provide a complete total bill of materials, including parts list with manufacturer's ordering numbers, for all equipment.
6. List of recommended spare parts with ordering numbers.

B. DESIGN DATA: CONTRACTOR SHALL PROVIDE:

1. Shop drawings of the pump station chamber for review.
2. Structural design calculations for the pump station chamber, for record purpose only, including a buoyancy analysis which demonstrates that the pumping station structure (with internal piping and equipment) is stable against buoyant forces produced by groundwater. The structural calculations shall be prepared and stamped by a Registered Professional Engineer.
3. Concrete design mix data and concrete test cylinders reports from an approved concrete testing laboratory certifying that the concrete used in the structure conforms with the strength requirements specified in Division 3.
4. Complete wiring diagrams and schematics of all controllers, control panels, control devices, and operators stations furnished under this Section.

5. Complete wiring diagrams and schematics of all power and control systems including connections to work of other Sections.
6. All submittal items required in other specification sections which are to be supplied and installed as part of the prefabricated pumping station specified in this Section.
7. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

C. MANHOLE FALL PREVENTION SYSTEMS:

1. Where manholes exceed 20 vertical feet from the proposed rim elevation to the invert, manholes shall be provided with a fall prevention system. Fall prevention systems shall be in accordance with OSHA requirement 29 CFR 1910.27 and as described herein and as indicated on the contract drawings.
2. Carrier rail assembly shall be 1-5/16-inch O.D. by 1-inch ID Type 6061-T6 aluminum notched .875-inches by .875-inches by 5/32-inches at 6-inch centers; tapped 3/8-inches at 9-inch centers opposite notches.
3. Manhole rung clamp assembly shall be constructed from 6061-T6 aluminum 11-inches long by 1.25-inches wide with 2 slots 7/16-inches by 1.25-inches at 9-inch centers and serrated on one side.
4. Safety locking mechanism shall be cast of manganese bronze with stainless steel springs, and drop forged links and snap-locking pawl shall be minimum tensile strength of 110,000 psi. Roller bearing shall be killian type. Stainless steel springs shall comply with Military Specification QQ-W-423B.
5. Safety harness shall be adjustable to fit waists 30-inch to 48-inch. Belt shall be nylon web equipped with 3 stainless steel 'D' rings.

D. OPERATION AND MAINTENANCE INSTRUCTIONS:

The pump station manufacturer shall be responsible for supplying written instructions, which shall be sufficiently comprehensive to enable the operator to operate and maintain the pump station and all equipment supplied by the station manufacturer. Said instructions shall assume that the operator is familiar with pumps, motors, piping, and valves, but that he has not previously operated and/or maintained the exact equipment supplied.

These instructions shall be prepared as a systems manual applicable solely to the pump station and equipment supplied by the manufacturer to these specifications, and shall include those devices and equipment supplied by him. However, items of equipment for which the station manufacturer has made mounting or other provisions, but which he has not supplied, may be excluded from these instructions.

These instructions shall include, but not be limited to, the following:

1. Descriptions of, and operating instructions for, each major component of the pump station as supplied.
2. Instructions for operation of the pump station in all intended modes of operation.
3. Instructions for all adjustments which must be performed at initial startup of the pump station, adjustments which must be performed after the replacement of level control system components, and adjustments which must be performed in the course of preventive maintenance as specified by the manufacturer.
4. Instructions for the adjustment, calibration, and testing of selected electronic components or assemblies, normally replaceable by the manufacturer, whose performance is not ascertainable by visual inspection.
5. Service instructions for major components not manufactured by the pump station manufacturer but which are supplied by him in accordance with these specifications. Incorporation of literature produced by the actual component manufacturer shall be acceptable.
6. Electrical schematic diagram of the pump station as supplied, prepared in accordance with NMTBA and JIC standards. Schematics shall show, to the extent of authorized repair, pump motor branch, control, and alarm system circuits, and interconnections among these circuits. Wire numbers shall be shown on the schematic. Schematic diagrams for electronic equipment, the detail parts of which are normally not repairable by the station operator, need not be included, and shall not be substituted for an overall schematic diagram. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall schematic diagram.
7. Layout drawing of the pump station as supplied, prepared in accordance with good commercial practice, showing the locations of all pumps, motors, valves and piping.

Operation and maintenance instructions which are limited to a collection of component manufacturer literature without overall pump station instructions will not be acceptable.

Operation and maintenance instructions shall be specific to the equipment supplied in accordance with these specifications. Instruction manuals applicable to many different configurations and pump stations, and which require the operator to selectively read portions of the instructions, will not be acceptable.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Ship equipment and material complete except where partial disassembly is required by transportation regulations or for protection of components.

station. The upper end of the pump chamber shall be convex and approximately hemispherical in shape, and shall provide suitable transition to the entrance tube.

2. Chamber structure shall have adequate thickness and reinforcements for a burial depth as indicated on the drawings. Pump station manufacturer shall supply stainless steel anchor bolts and clamps for installation of the pump chamber on the concrete pad.
3. The entrance tube, pump chamber, internal equipment, and piping shall be plumb. Pump chamber shall incorporate internal drainage methods as described in the paragraph entitled CHAMBER BASE. Station designs requiring external supports to raise one side of the pump chamber to accomplish drainage will not be acceptable.

B. MATERIALS:

1. The pump chamber shall be manufactured of molded fiberglass reinforced isophthalic polyester resins with a minimum of 30 percent fiberglass, and a maximum of 70 percent resin. Glass fibers shall have a minimum average length of 1-1/4-inches. Resin fillers or extenders shall not be used. Major design characteristic considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to ensure a long life. They shall be impervious to micro-organisms, mildew, mold, and fungus, and be non-corrosive inside and outside when installed in soils deleterious to metal or concrete structures.
2. All interior surfaces of the pump chamber and entrance tube shall be gel coated with a polyester resin. It shall be of suitable thickness and formulated to provide:
 - a. Maintenance-free service
 - b. Abrasion resistance
 - c. Color fastness
 - d. Gloss retention
 - e. Protection from sewage, grease, oils, gasoline, and other common chemicals.
3. Interior surfaces shall be white for maximum light reflectivity. The base shall be of a darker color to de-emphasize the presence of dirt, grease, etc. Colors used for both portions shall result in a pleasing appearance and shall be submitted to the Owner for approval.

C. CHAMBER BASE:

1. The pump chamber shall be constructed of fiberglass filled with reinforced concrete. Concrete shall be completely encapsulated by fiberglass, which shall be bonded to the concrete with an epoxy bonding agent. The base shall incorporate a water collection sump, not less than 8-inches deep, designed to accommodate the sump pump described below. The base or pump chamber floor shall be designed to permit drainage to this sump with the chamber base flush to the concrete pad, and without creating misalignment or plumbing strain. The base shall incorporate a suitable flange in 7 feet 6 inches stations or fiberglass encapsulated mounting beams in 10 feet stations for securing the pump chamber to the concrete pad to prevent flotation.

D. ENTRANCE TUBE:

1. The entrance tube shall be constructed of the same materials as the pump chamber described herein, and may be provided in one or more sections as required. Tube shall incorporate a ladder, air ducts, and cover as described below. The tube shall have a minimum inside diameter of 36-inches for 7 feet 6 inches station and 44-inches for 10 feet diameter station, and shall permit removal of all internal equipment without dismantling or removal of the ladder or air ducts.
2. The entrance tube cover shall be constructed of fiberglass with a suitable drip lip around the edge, and shall be hinged to the entrance tube. A gasket shall be provided at the top of the tube to seal the cover-to-tube joint and to protect the edge of the tube. The cover shall be provided with a molded handle and a lock of the disc-and-tumbler type. Maintenance personnel shall be able to open the cover from the inside without a key. A latching mechanism shall be provided to lock the cover in the open position against a load that can reasonably be expected as maintenance personnel enter and exit the tube. Two additional ladder rungs or equivalent handles shall be mounted on or molded into the underside of the cover to facilitate ingress and egress by forming an extension of the ladder when the cover is latched open. The outside of the cover shall be covered or painted with a coating having reflective properties to reduce heat absorption.
3. The access ladder through the entrance tube shall have rails of fiberglass construction. Rungs shall be 1-1/4-inch diameter aluminum spaced on 12-inch centers, and shall be of ribbed or textured construction, with a non-skid surface.
4. Two air vent ducts shall provide ventilation for the pump chamber. Ducts shall be constructed of polyvinyl chloride, and shall have an inside diameter of 5-inches or equivalent cross-sectional area. Each duct shall run from the top of the entrance tube through the full length of the tube and pump chamber to terminate at the blower and dehumidifier cabinet. For enclosures in which the entrance tube is constructed of one or more separate sections, air ducts in the entrance tube shall align accurately with ducts in the pump chamber. The pump station manufacturer shall supply suitable sleeves or gaskets to seal the air duct sections. The air vents

shall have screened openings at the outside, and shall be designed to prevent the entrance of rain, snow, rocks and other foreign matter.

E. VENTILATING BLOWER:

A ventilating blower shall provide forced ventilation of the pump chamber. Blower shall be a squirrel cage, high-efficiency type with adequate capacity to change the air in the pump chamber once every two minutes and shall be 1/3 HP, 120 V. Blower motor shall be protected by a circuit breaker, and shall be controlled by a percentage timer having a range of zero to 10 minutes. The ventilating blower and lights shall turn on automatically when the entrance tube cover is raised. A manual switch shall permit use of the lights and blower when the cover is closed.

F. DEHUMIDIFIER:

A dehumidifier assembly shall maintain correct relative humidity in the pump chamber to keep the electrical equipment dry and to prevent excessive condensation. The dehumidifier shall be a hermetically sealed, freon, refrigeration type supplied complete with compressor, expansion coils, fan, condenser coil, and controls; and shall be 1/2 HP, 120 V. The dehumidifier shall be controlled by an adjustable humidistat and low air temperature cutout. Fresh air from the incoming air duct shall discharge over the condenser coil. Condensate shall drain to the sump in the chamber base.

G. SUMP PUMP:

1. A submersible sump pump with close coupled vertical motor shall be installed in the sump. Pump shall have a minimum capacity of 1,000 gph at a 20 foot head and shall be 1/2 HP, 120 V. The pump shall be equipped with a mechanical shaft seal to exclude water from the motor housing. The pump shall be controlled automatically by a built-in float switch capable of operating on a 5-inch differential. It shall discharge into the wet well through a 1-1/4-inch pipe. The sump pump discharge line shall include two check valves separated by a minimum of 5 feet, and a gate valve. All valves shall be easily disassembled to remove stoppages or to replace parts without disturbing the piping connections. Piping shall be equipped with unions which allow convenient disassembly of piping or removal of the sump pump.
2. An enclosure of 1/4-inch rustproof mesh to keep out debris shall protect the sump pump.

H. STATION LIGHTING:

1. To provide adequate illumination for the control panel and all areas in the station, provide two enclosed fluorescent type lighting fixtures, each having two 20-watt fluorescent tubes and separate ballasts.
2. The lights shall turn on automatically when the entrance tube cover is raised, and an additional switch shall permit use of the lights with the cover closed.

3. Provide an emergency commercial grade battery unit with twin sealed-beam lamps, to adequately light the pump station in case of failure of the feeder circuit to the accessory panel. The unit shall be complete with built-in charger, wiring, and shelf and shall be suitable for 1-1/2 hours of continuous operation, with automatic low battery shut-off.

I. ELECTRIC HEATER:

A 1500 watt, 120 volt electric unit heater shall be provided for connection to a convenience outlet.

J. FLOW METER:

1. An ultrasonic flow meter shall be provided under Section 13500 INSTRUMENTATION for site installation as shown on the plans.
2. A 120 volt single pole circuit breaker in the accessory panel and power wiring in the pump station, which is required for the flowmeter, shall be provided and installed under this section of the specification.

K. PERSONNEL EMERGENCY ALARM:

1. A personnel emergency alarm, push button (maintain contact type), push to alarm-pull to silence, minimum 1-1/2-inch diameter, shall be centrally located within one foot of the pump station floor.
2. Upon pushing the button an alarm signal shall be sent to the alarm annunciator panel via the telemetering panel. That panel is provided under Section 13500 INSTRUMENTATION.
3. Power and signal wiring within the pump station shall be provided under this section of the specification.

L. STATION FLOODING ALARM SYSTEM:

1. A float operated mercury contact type switch unit shall be installed 6-inches above the finish floor level at the pump chamber. The switch shall be installed in the casings to make the electrical circuit as required in case of station flooding.
2. The unit shall include a sealed float, switch, immersible cable, adjustable cable holder and all accessories and appurtenances required for a complete, operating system. Switch casings shall be designed with an eccentrically loaded lead weight of sufficient size to tilt when the liquid level rises above the finished floor and makes or breaks the contacts in the mercury switch. The electrical cable shall enter the casing through a locked compression fitting to form a watertight connection.

3. An electrical cable shall be provided for the switch unit. Cables shall be of sufficient length to reach the pump station control panel without splicing. Float switch alarm wiring and conduit shall be provided under this section of the specifications.

2.03 PUMPS:

A. DESCRIPTION:

Pumps shall be horizontal, self-priming sewage pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.

B. SIZE:

Pumps shall have a 6-inch suction connection and a 6-inch discharge connection.

C. MATERIAL:

All areas of the pump casing and volute which are exposed to sewage shall be constructed of cast iron of no lesser grade than Class 30.

D. INTERNAL PASSAGES:

All openings, internal passages, and internal recirculation ports shall be large enough to permit passage of a sphere 3-inches in diameter, and any trash or stringy material which will pass through the average house collection system. Screens or any other internal devices which create a maintenance nuisance or interfere with priming and performance of the pump will not be permitted. Certified dimensional drawings indicating size and locations of the priming recirculation port of ports shall be submitted to the Owner prior to shipment.

E. PUMP PERFORMANCE:

1. Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

Name of Pump Station

Capacity, in GPM,	each
Total Dynamic Head,	in feet
Total Dynamic Suction Lift,	in feet
Total Dynamic Discharge Head,	in feet
Maximum Static Suction Lift,	in feet
Total Discharge Static Head,	in feet

2. Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat,

resulting not only in loss of the suction leg, but also in siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrences shall be considered normal, with proper installation of air release line free to the atmosphere.

3. In consideration of such occurrences and with the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to ensure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

F. REPRIME PERFORMANCE:

1. Pumps must be capable of a reprime lift of 10 feet at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime, and within five minutes will deliver liquid remaining in the pump casing after a pump is shut down, with the suction check valve removed. Additional standards under which reprime tests shall be run are:
 - a. Piping shall incorporate a discharge check valve downstream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.
 - b. A 10-foot length of one-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump station fitted with an air release valve.
 - c. No restrictions shall be present in pump or suction piping which could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 4.5 feet and one 90-degree ell.
 - d. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.
 - e. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.
 - f. Liquid to be used for reprime test shall be water.
2. Certified reprime performance test data, prepared by the pump manufacturer and certified by a registered professional Engineer, shall be submitted to the Owner prior to shipment.

G. SERVICEABILITY:

1. The pump manufacturer shall demonstrate to the Owner's satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features.

- a. No special tools shall be required for replacement of any components within the pump.
- b. The pump must be equipped with a removable cover plate, allowing access to pump interior to permit the clearance of stoppages and to provide simple access for service and repairs without removing suction or discharge piping.
- c. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable cover plate. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.
- d. Each pump shall incorporate a suction check valve that can be removed or installed through the removable cover plate opening, without disturbing the suction piping. Sole function of check valve shall be to eliminate repriming with each cycle. Pumps requiring suction check valves to prime or reprime will not be acceptable.
- e. Means shall be provided for external adjustments of the clearance between the impeller and wear plate.

H. CONSTRUCTION:

1. Impeller:

The impeller shall be two-vaned, semi-open, nonclog, cast in ductile iron with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew.

2. Seal:

- a. The pump shaft shall be sealed against leakage by a mechanical seal. Both the stationary sealing member and mated rotating member shall be of tungsten titanium carbide alloy. Each of the mating surfaces shall be lapped to a flatness of one-half light band (5.8 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads that will cause deflection, vibration, and axial or radial movement of the pump shaft.

The seal shall be lubricated with oil from a separate, oil-filled reservoir. The same oil shall not be used to lubricate both shaft seal and shaft bearings.

The seal shall be warranted for a minimum of 4 years from date of shipment. Should the seal fail within the first year, the manufacturer shall be obligated, upon notification, to furnish a new seal, without charge to owner, F.O.B. factory. The cost of replacement seals thereafter will be on a pro-rata basis as follows:

Percentage of New Seal Price

<u>Failure Within</u>	<u>Paid by Owner</u>
2 years	25%
3 years	50%
4 years	75%

3. Shaft Bearings:

The pump impeller shaft bearings shall be anti-friction ball or tapered roller bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Bearings shall be lubricated from a separate reservoir. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal will not be acceptable.

4. Pump Suction Spool:

Each pump shall be equipped with a one-piece, cast iron suction spool, flanged on each end. Each spool shall have one 1-1/4 NPT and 1/4 NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

I. GAUGES:

Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full scale reading. Compound gauges shall be graduated -30 to 30 feet water column minimum. Pressure gauges shall be graduated 0 to 140 feet water column minimum.

Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installation shall be complete with all hoses and fittings and shall include a shutoff valve installed in each gauge line at the point of connection to suction and discharge pipes.

2.04 VALVES AND PIPING:

A. SUCTION LINES AND VALVES:

1. The pump suction lines inside the pump chamber shall be Class 22 cast iron pipe with sizes shown on the drawings, terminating in fiberglass reinforced polyester resin mechanical joint belts outside of the pump station chamber. Suction pipe connections inside the pump station chamber shall be made with flanged-to-flexible connection devices to relieve misalignment stresses.

2. The suction line outside the pump chamber shall be 8-inch ductile iron pipe. Flexible couplings shall be installed on each suction line outside the pump chamber at locations as indicated on the drawings.
3. Each suction line shall be equipped with a 2-way plug valve to permit isolation of the pumps from the wet well. Plug valves shall be of the non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to ANSI 125 pound standards. Valves shall be furnished with a drip-tight shutoff plug mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface.

B. DISCHARGE LINES AND VALVES:

1. The station discharge line shall be 8-inch Class 22 cast iron pipe, terminating in a fiberglass reinforced polyester resin mechanical joint bell outside the pump station chamber. A flexible coupling shall be installed on the discharge line within three feet of pump chamber. The force main outside the pump station chamber shall be ductile iron pipe. Discharge pipe connections inside the pump station chamber shall be made with a flanged-to-flexible connection device with locking pin, to relieve misalignment stresses.
2. Full flow type swing check valves shall have cast iron bodies with flanged ends rated in 125 pounds. Valves shall be fitted with an external level and spring. Bronze body ring shall be threaded into the valve port. Valve clapper shall be cast iron, bronze face, and shall swing completely clear of water way when valve is full open. Hinge pin shall be of 18-8 stainless steel construction and shall be utilized with bronze bushings and O-ring seals. Valves shall be equipped with removable cover plate to permit entry for complete removal of internal components without removing the valve from the line. Valve rating shall be 175 psi water working pressure, 350 psi hydrostatic test pressure.
3. The discharge header shall include an 8-inch 3-way plug valve to permit either or both pumps to be isolated from the common discharge header. The plug valve shall be of the non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to ANSI 125 pound standard. Valves shall be furnished with a drip-tight shutoff plug capable of withstanding the maximum static pressure of the operating system mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface. Valves shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall be equipped with a locking device to hold the plug in the desired position.

C. SERVICE LINES:

Pump station shall be equipped with external service line connections consisting of a 1-1/4-inch sump pump discharge line, and a 3/8-inch air bubbler line. Service lines shall be encased in a single 6-inch pipe at the point of transition through the pump chamber wall. Service lines shall be grouted in place in the 6-inch pipe to effect a permanent watertight seal. Pipe shall terminate in a fiberglass reinforced polyester resin mechanical

joint bell outside the pump chamber. The Contractor shall extend service lines from the pump station to the wet well and shall enclose service lines in a 6-inch ductile iron pipe extending from the mechanical joint bell through the wall of the well as shown on the drawings. Service lines and 6-inch ductile iron pipe shall be grouted watertight at the point of transition through the wet well wall.

D. SUPPORTS AND THRUST RESTRAINTS:

1. All restrained joint pipes connected to the pump station shall be supported by concrete or concrete block pillars in accordance with pump station manufacturer's written instructions, to prevent piping and earth burden loads from being transmitted to the station chamber.
2. Pump station discharge force main piping shall be protected against thrust by using a restrained push-on joint pipe and fittings which are capable of being deflected after assembly.

E. AIR RELEASE VALVES:

1. Each pump shall be equipped with one automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycle. The valve shall close to prevent recirculation. Valves shall provide visible indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line will not be acceptable.
2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.
3. A cleanout port, 3-inches or larger in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.
5. The valves shall be piped so that all air or moisture is released to the wetwell only.

F. PIPING:

1. Flanged header pipe shall be centrifugally cast, cast iron, complying with ANSI A21.6 (AWWA C101) and Class 22 thickness, complying with ANSI A21.1.
2. Flanges shall be Class 125 rated and complying with ANSI B16.1.
3. Pipe and flanges shall be threaded to ANSI B2.1 pipe thread, with suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be aligned within 1/2° between flanges. Flanges shall be faced or a gasket finish applied which shall have concentric grooves a minimum of 0.010-inch deep by approximately 0.030-inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4-inch apart.

2.05 DRIVE UNIT:

A. MOTORS:

1. The pump motors shall be 30 HP maximum, horizontal, open drip proof, induction type, with normal starting torque and low starting current characteristics, suitable for 3 phase, 60 Hertz, 480 volt, AC electrical current. The motors shall not be overloaded at the design condition or at any head in the operating range as specified.
2. Each motor shall have a current NEMA design cast iron frame with copper windings.
3. Motors shall be code letter F. Motors shall have a 1.15 service factor at rated voltage and a power factor of not less than 90 percent under rated loaded conditions. Power factors of less than 90 percent shall be corrected to at least 90 percent under rated load conditions by the manufacturer of the motor.

B. CAPACITORS:

1. The supplier of the pump motors shall furnish 480 volts, 3 phase capacitors to be wired at the motor terminals by the Contractor under Division 16 ELECTRICAL. The capacitors shall be switched on or off with the motors.
2. The capacitors shall be of the indoor, dustproof type containing non-flammable, non- PCB dielectric. Dielectric shall be completely bio-degradable and shall not bio-accumulate.
3. The capacitors shall be sized in accordance with the motor manufacturer's recommendation based on its motor characteristics such as type, speed, NEMA design designations and horsepower output. The 30 horsepower motors shall be assumed to be 75 percent loaded. The capacitors shall be sized to increase the power factor to 90 percent under these underloaded conditions.
4. The supplier of the motors and capacitors shall inform the Contractor of the proper percent ampere reduction (% AR) so that proper overload heaters can be installed in the starters.
5. The capacitors shall be as manufactured by General Electric Co., Westinghouse Electric Corp., Square D Co., or approved equal.

C. DRIVE TRANSMISSION:

1. Power shall be transmitted from motors to pumps by means of V-belt drive assemblies. The drive assemblies shall be selected to establish proper pump speed to meet the specified operating conditions.
2. Each drive assembly shall have a minimum of two V-belts. In no case will a single belt drive be acceptable. Each V-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump.
3. Drive systems with a safety factor of less than 1.5 to 1 will not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.

D. BELT GUARDS:

1. A fiberglass reinforced isophthalic polyester belt guard shall be furnished with each drive assembly to assure maximum protection for maintenance personnel.
2. Assemblies shall be manufactured to permit complete removal from the pump unit without interference of any unit components.
3. The guard shall be finished in accordance with Section 3, color definitions of ANSI 253.1, 1967, Safety Color code for Marking Physical Hazards.

E. DRIP SHIELDS:

Pumps shall be mounted on, or otherwise equipped with, fiberglass reinforced polyester resin drip shields which serve to direct condensate or liquid spills away from the pump and framework to the station sump.

F. FINISH:

The pumps, piping, and exposed steel framework shall be cleaned with industrial grade chemical cleaner. The prime coat shall be a zinc base synthetic primer. The finish coat shall be an automotive grade white acrylic enamel.

2.06 ELECTRICAL CONTROL COMPONENTS:

A. PANEL ENCLOSURE:

1. The electrical control equipment shall be mounted within a NEMA Type 1A, dead front enclosure, molded of fiberglass reinforced isophthalic polyester resin. A door of the same material shall be secured to the enclosure with a continuous, stainless steel piano hinge. The control compartment shall incorporate a removable back panel on which control components shall be mounted. The back panel shall be secured to the enclosure with collar studs.

2. A duplex utility receptacle providing 115 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.
3. All operating controls and instruments shall be securely mounted in such a manner that any or all standard options offered by the pump station manufacturer may be added in the field without rearrangement of existing controls and instruments. All controls and instruments shall be clearly labeled to indicate function.
4. A main terminal block and ground lug shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC). Ten percent of the control terminals shall be furnished as spares.

B. MOTOR STARTERS:

1. Pump motor starters shall be furnished in a NEMA Type 1 enclosure to be installed in the service cabinet specified under Division 16.
2. A properly sized motor circuit protector shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of 22,000 amperes.
3. A padlocking mechanism, "off" position only, shall be installed on each motor circuit protector. Operator handles for the mechanisms shall be located on the exterior of the enclosure door, with interlocks which permit the door to be opened only when motor circuit protectors are in the OFF position.
4. An auto transformer type, reduced voltage starter with 65 percent tap shall be furnished for each pump motor. Starters rated "0," "00," or half size are not acceptable. Power contacts shall be double-break and made of cadmium oxide silver. All motor starters shall be equipped to provide overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload reset push-buttons shall be located on the exterior of the enclosure in such a manner as to permit resetting the overload relays without opening the enclosure door.
5. Overload relays shall be of the block-type, utilizing melting alloy type spindles, and shall have visual trip indication with trip-free operation. Pressing of the overload reset lever shall not actuate the control contact until such a time as the overload spindle has reset. Resetting of the overload reset lever will cause a snap-action control contact to reset, thus reestablishing a control circuit. Overload relays shall be manual reset only and not convertible to automatic reset. Trip setting shall be determined by heater element only and not by adjustable overload relays. Overload relays shall be equipped with a normally open alarm contact.

C. INDICATORS:

1. Indicating lights shall be heavy duty, oil tight type and equipped with integral step-down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less with a minimum life of 15,000 hours. Lamps shall be replaceable from the front without opening the control panel door and without use of tools. Lenses for pump running lights shall be red and for alarm lights shall be amber.

Indicating lights shall be furnished for the following functions:

- a. Pump No. 1 High Temperature
- b. Pump No. 2 High Temperature
- c. Pump No. 1 Running
- d. Pump No. 2 Running
- e. Wetwell High Level
- f. Wetwell Low Level
- g. Station Flood
- h. Control Power Failure
- i. Personnel Emergency

D. LOAD CENTER (ACCESSORY PANEL) IN PUMP CHAMBER:

1. The control panel shall incorporate an integral load center utilizing multiple circuit breakers. Each circuit breaker shall be a heavy duty device with a trip rating of 15 or 20 amperes and an interrupting capacity of 10,000 amperes rms symmetrical at 120/240 volts AC. Each circuit breaker shall be clearly labeled to indicate the circuit it protects. A 2-pole, 30 ampere main circuit breaker shall be provided. A separate branch and circuit breakers shall be provided for each of the following components:

- a. Sump Pump
- b. Lights and Blower
- c. Dehumidifier
- d. Duplex Utility Receptacles
- e. Emergency Lighting
- f. Flow Meter/Transmitter
- g. Control Circuit

h. Heater

E. SWITCH CONTROLS:

1. Switches shall be furnished to accomplish the following minimum functions:
 - a. Select the mode of operation for each pump.
 - b. Select the sequence of pump operation.
 - c. Select an air bubbler pump for operation.
2. Pump mode selector switches shall be connected to permit manual start, manual stop or automatic operation of each pump individually. Manual operation shall override all standard shutdown systems supplied with the pump control system except motor overload.
3. Pump sequence selector switch shall permit selection of automatic pump alternation, or selection of either pump to run as lead pump for each cycle.
4. A selector switch shall provide manual alternation of the air pumps in the bubbler system. The switch shall be connected in such a manner that either air pump may be selected to operate continuously.
5. A momentary-contact push button shall silence the alarm audible device. A momentary-contact push button shall reset alarm indicators and contacts.
6. A test-off-automatic selector switch shall control all alarm functions.
7. Switches shall be heavy duty, oil tight type with contacts rated NEMA A-600 minimum.
8. Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter control circuit to indicate the total running time of each pump in "hours" and "tenths of hours."

F. WIRING:

1. The pump station as furnished by the manufacturer shall be completely wired, except for the service conduits, up to the conduit fittings on the entrance hatch exterior. Three separate service conduits are required; one for each pump motor circuit connected to the motor junction box and one for 120/240 volt station feeder, pump motor starter control wiring, and alarm wiring connected to the station control panel. Extension of raceways from the condulets provided to equipment in the service cabinet shall be furnished and installed under Section 16055.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications for industrial controls set forth by the

Joint Industrial Council (JIC), National Machine Tool Builders Association (NMTBA), and National Electrical Code (NEC).

3. All user servicable wiring shall be Type XHHW or THWN, 600 volts, and shall be color coded as follows:
 - a. Line and Load Circuits, AC or DC power Black
 - b. AC Control Circuit at Less Than Line Voltage Red
 - c. DC Control Circuit Blue
 - d. Interlock Control Circuits, Wired from External Source Yellow
 - e. Equipment Grounding Conductor Green
 - f. Current Carrying Neutral White
 - g. Hot with Circuit Breaker Open Orange
4. Control circuits inside the panel, with the exception of wiring or solid state electronic circuitry, shall be 16 gauge minimum, Type MTW or THW, 600 volts. Wiring in conduit shall be 14 gauge minimum.
5. Motor branch conductors and other power conductors shall not be loaded above 60°C temperature rating. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be contained in wire troughs with removable covers to facilitate field repairs and addition of optional components. All unshielded wires extending from components mounted on door shall be terminated on a terminal block mounted on the back pane. Splices and solder-type lugs shall not be used on any wires in the panel enclosure. All wiring outside the panel shall be in conduit.
6. Control conductors connecting components mounted on the panel enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation.
7. The pump station manufacturer shall ground all electrical equipment inside the pump station to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making the connections.
8. Conduit requirements are as follows:
 - a. All conduit and fittings shall be UL listed.

- b. The service conduits and other conduits subject to damage shall be hot-dipped galvanized, heavy wall, rigid steel.
- c. Liquid-tight, flexible metal conduit shall be used for connections to equipment subject to vibration and may be used where not subject to damage except as otherwise specified and shall be constructed of a smooth, flexible galvanized steel core with a smooth abrasion resistant, liquid tight polyvinyl chloride cover. A continuous copper ground shall be built in during manufacture (size 3/8-inch through 1-1/4-inches). Sizes 1-1/2-inches through 4-inches shall be installed in accordance with Article 351 of the National Electrical Code (NEC).
- d. Flexible metal conduit shall be supported in accordance with Article 351-8 of NEC.
- e. Conduit shall be sized according to NEC requirements.

G. EQUIPMENT MARKING:

1. A permanent corrosion resistant name plate(s) shall be attached to the control panel and include the following information.
 - a. Equipment serial number
 - b. Supply voltage, phase, and frequency
 - c. Current rating of the minimum main conductor
 - d. Electrical diagram number
 - e. Motor horsepower and full load current
 - f. Motor overload heater element
 - g. Motor circuit breaker trip current rating
 - h. Name and location of equipment manufacturer
2. Control components shall be permanently marked using the same identification shown on the electrical diagram. Identification shall be mounted adjacent to the device.
3. Switches, indicators, and instruments shall be plainly marked to indicate function, position, etc. Markings shall be mounted adjacent to and above the device.
4. Legend plates for component marking shall be impervious to oil and grease and comply with the following:

- a. Engraved laminated phenolic 0.062" thick minimum
- b. Engraved or embossed aluminum 0.32" thick minimum

Character shall be 0.125" high minimum and contrast with the background color.

5. Legends for pilot lights may be back lighted. When this style marking is supplied, the legend shall be enclosed and protected by the pilot light lens.
6. Tape type embossed plastic labels are not approved for any equipment identification.

2.07 LEVEL CONTROL SYSTEM:

A. FUNCTIONAL DESCRIPTION:

1. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
2. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.
3. The electronic pressure switch shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level." When the liquid is lowered to the "lead pump stop level," the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating. These levels shall be adjustable as described below.
4. Upon operator selection of automatic alternation, the level control system shall select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.
5. During emergency power operation only the lead pump shall run. The lag pump will be "locked out." Both pumps shall be stopped during automatic transfer switch operation. Contacts for these functions shall be provided in the automatic transfer switch as specified under Section 16055.

B. ELECTRONIC PRESSURE SWITCH:

1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply

and 120V outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.

2. The electronic pressure switch shall be capable of operating on a supply voltage of 108V to 132V AC 60 Hertz, in an ambient temperature range of -18°C (0°F) through $+55^{\circ}\text{C}$ (131°F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of ± 0.1 feet of water.
3. The electronic pressure switch shall consist of the following integral components: Pressure sensor, display, electronic comparators, and output relays.
4. The pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-15 PSI, temperature compensated from -40°C (-40°F) through $+85^{\circ}\text{C}$ ($+185^{\circ}\text{F}$), with a repeat accuracy of $\pm 0.25\%$ full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
5. The electronic pressure switch shall incorporate a digital panel meter which, upon operator selection, shall display liquid level in the wet well, and the 1/2 digit display calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet.
6. Level adjustments shall be electronic comparator setpoints to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be adjustable, and accessible to the operator without opening the control panel or any cover panel on the electronic pressure switch. Pushbuttons shall be provided to permit the operator to read the setpoints on the display. Pushbuttons shall be suitable for use in low power electronic circuitry. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.
7. Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The ON state of each relay shall be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing fused overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to the one NEMA size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.
8. Each electronic pressure switch shall be subject to a severe environmental test to minimize field failures. The test shall include but is not limited to a vibration test, exposure to elevated temperatures, and a burn-in under load. Further testing may be conducted at the manufacturer's discretion.

9. The electronic pressure switch shall be equipped with replaceable plug-in integrated circuits and output fuses. The main circuit board assembly shall be provided with keyed plug-in connections to "off-board" components permitting main board removal without de-soldering. All printed circuits shall have a conformal coating applied to both sides to protect against moisture or fungus.
10. Circuit design in which application power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
11. The control circuit for one of the pumps shall be equipped with a time delay to prevent simultaneous motor starts. The time delay shall be a pneumatic dash pot type with contacts rated NEMA A-600 minimum. Field adjustment range shall be 0.2 to 10 seconds minimum.

C. ALTERNATOR:

Pump alternator relay shall be of electromechanical industrial design. Relay contacts shall be rated NEMA A-300 minimum.

D. HIGH PUMP TEMPERATURE PROTECTION:

The control system shall be equipped to protect the pump from damage caused by excessive temperature. Each pump shall be furnished with a temperature switch wired to cause shutdown of the pump motor when the pump housing exceeds +63EC (+145EF). Such occurrence shall illuminate an indicator to alert the operator to the cause of shutdown. The indicator shall remain illuminated and the pump motor locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit will not be acceptable.

E. HIGH WATER ALARM WITH ALARM SILENCE:

1. The electronic pressure switch shall be equipped with an additional electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. In the event that the wet well liquid reaches a preset high water alarm level, the solid state output shall energize a high water alarm relay and an indicating light visible on the front of the control panel. The high water alarm relay shall be equipped with (1) SPDT dry contact. Two 115 VAC alarm circuits shall also be supplied which may be used to energize field connected alarm devices. The high water alarm relay shall remain energized until the wet well has been lowered and the circuit has been manually reset.
2. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to deenergize one of the 115 VAC alarm circuits while corrective actions are underway. The high water alarm indicator, dry contacts and remaining 115 VAC alarm circuit shall be maintained in the alarm condition. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit to reset when the wet well has been lowered.

F. AIR BUBBLER SYSTEM AND PIPING:

1. Two (2) vibrating reed type air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour at a pressure not to exceed 7 psi. One air pump shall operate continuously while the remaining air pump serves as standby. Liquid level control system utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure reducing valves, rate of flow control valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable.
2. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.
3. An air bell constructed of PVC 3-inches in diameter shall be provided for installation at the outlet end of the air bubbler line in the wet well. The bell shall have a 3/8 NPT tapped fitting for connection of the bubbler line.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation of the pump station and related appurtenances shall be performed in accordance with written instructions by the manufacturer.
- B. Contractor shall clean all surface coatings damaged in shipment or installation and touch up in field with the same materials as original coatings.

3.02 INTERFERENCE WITH EXISTING WORKS:

The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works.

3.03 HYDRAULIC UPLIFT OF STRUCTURES:

The Contractor shall be responsible for the protection of all structures against hydraulic uplift until the structures have been accepted finally by the Owner.

3.04 FIELD ACCEPTANCE TESTS:

- A. After installation of the equipment and after completion of the services of the manufacturer's representative as detailed in Section 01140 SPECIAL PROVISIONS, the Contractor shall operate each unit to demonstrate its ability to pump without excessive vibration, motor overloading, or overheating. Each pump shall be operated for a sufficient period of time to permit thorough observation of all pump components.
- B. The start-up and testing shall be conducted in accordance with Section 01752 STARTUP AND TESTING.

- C. Notify Owner in writing at least three days in advance. If testing cannot be conducted because of scheduling, unavailable service personnel, etc., Engineer's fees for second visit shall be paid by the Contractor.
- D. All defects or defective equipment shall be corrected or replaced promptly at the Contractor's expense.
- E. All final adjustments necessary to place the equipment in satisfactory working order shall be made at prior to the tests.
- F. If sufficient sewage is not available for the test, the Contractor shall provide water for testing. All labor and materials necessary for the test shall be furnished by the Contractor.
- G. After installation, all piping shall be tested to the pressures for tightness as specified in Paragraph 1.04 C.2 in an approved manner. Piping between the wetwell and the pump chamber shall be pressure tested after backfilling and before any structures are constructed on top. Should leaks be found, faulty joints shall be repaired, even to the extent of disassembling and remaking the joint, and all defective pipe and fittings shall be removed and replaced in a manner satisfactory to the Owner.

END OF SECTION

F:\Technical Specifications\11307.DOC

SECTION 11376

BLOWER SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish, install and test six (6) belt-driven rotary positive displacement blower packages complete with all appurtenances as indicated on the drawings and as herein specified.

1.02 RELATED WORK:

- A. Section 01752, STARTUP AND TESTING
- B. Section 01750, EQUIPMENT CHECKOUT AND TESTING
- C. Section 03302, FIELD CONCRETE
- D. Section 09900, PAINTING
- E. Section 11303, SUBMERSIBLE PUMP PACKAGES
- F. Section 13424, INSTRUMENTATION
- G. Division 16, ELECTRICAL

1.03 SYSTEM DESCRIPTION:

The blower packages shall be designed and manufactured to suit the arrangement shown on the drawings. If the equipment furnished has different connections than those indicated, the Contractor shall submit a piping layout of the necessary changes for the approval of the Owner. Revisions to the structure or to other work resulting from such different connections shall be at the expense of the Contractor.

1.04 QUALITY ASSURANCE:

A. ALL EQUIPMENT SHALL CONFORM TO THE FOLLOWING CRITERIA:

1. Equipment shall be manufacturer's standard products presently in commercial production.
2. All the equipment specified under this Section shall be furnished by a single supplier and shall be products of manufacturers regularly engaged in the production of said equipment. The supplier shall have the sole responsibility for proper functioning of the complete blower system.

3. Any reference to a specific manufacturer or model number is for the purpose of establishing a quality or parameter for specification writing and is not to be considered proprietary. In all cases any source or device that has the quality and operating capabilities specified may be acceptable.
4. Conform to requirements for materials, installation and equipment approvals of state, local, Underwriter's Laboratories, Inc., or other applicable codes, whether or not called for on the drawings or in the specifications.
5. Workmanship shall be first class in all respects.
6. Base the use of unspecified materials on their continuous and successful employment under similar conditions, as called for in this section.

B. MANUFACTURER'S QUALIFICATIONS:

1. Upon request from the Owner, the manufacturer shall demonstrate proof of financial responsibility with respect to performance and delivery date.
2. Upon request from the Owner, the manufacturer shall provide proof or evidence of facilities, equipment and skills required to produce the equipment specified herein.
3. As described in Section 01680 under "Services of Manufacturer's Representative," the manufacturer shall provide the supervisory service of a factory trained engineer, who is specifically trained on type of equipment supplied, for a period of not less than two 8-hour days to assist in installation of the equipment, and related appurtenances, to provide initial startup and to instruct the Owner's operating personnel in the operation and maintenance of the equipment provided.

C. FACTORY TESTS:

The motors and controls shall be given an operational test in accordance with the standards of the Hydraulic Institute. Recordings of the test shall substantiate the correct performance of the equipment at the discharge pressure, capacity, speed and horsepower as herein specified.

- D. Field acceptance tests shall be performed as specified in Part 3 EXECUTION.

1.05 REFERENCES:

- A. The latest editions of the following standards form a part of this specification:

American National Standard Institute (ANSI)

American Society for Testing and Materials (ASTM)

National Electric Code (NEC)

11376-2

1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. SHOP DRAWINGS AND PRODUCT DATA:

1. Shop drawings including manufacturer's data sheets, showing illustrated cuts of the item(s) with scale details, sizes, dimensions, capacities, performance characteristics, wiring diagrams, controls, and other pertinent information shall be submitted to the Owner for review. If more than one size or type is shown, the proposed items shall be clearly indicated.
2. Provide descriptive literature, bulletins, and/or catalog cuts for each item of equipment.
3. Provide data on the characteristics and performance of all blowers and motors. Blower data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets.
4. Provide the total weight of each item of equipment including the weight of the single largest component of each item.
5. Provide a complete total bill of materials for all equipment.

B. DESIGN DATA:

1. Provide complete wiring diagrams and schematics of all controllers, control panels, control devices, and operators stations furnished under this Section.
2. Provide complete wiring diagrams and schematics of all power and control systems including connections to work of other Sections.

C. Submit details on all items required in other specification Sections which are to be supplied and installed as part of the blower packages specified in this Section.

D. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

E. OPERATION AND MAINTENANCE MANUALS:

The Contractor shall provide five (5) copies of Operation & Maintenance Manuals in accordance with the General Conditions. The manufacturer shall be responsible for supplying written instructions, which shall be sufficiently comprehensive to enable the operator to operate and maintain the equipment supplied by the manufacturer. Said instructions shall assume that the operator is familiar with blowers, motors, piping, and

valves, but that he has not previously operated and/or maintained the exact equipment supplied.

These instructions shall be prepared as a systems manual applicable solely to the blowers and equipment supplied by the manufacturer to these specifications, and shall include those devices and equipment supplied by him. However, items of equipment for which the manufacturer has made mounting or other provisions, but which he has not supplied, may be excluded from these instructions.

These instructions shall include, but not be limited to, the following:

1. Descriptions of, and operating instructions for, each major component of the blowers packages as supplied.
2. Instructions for operation of the blowers in all intended modes of operation.
3. Instructions for all adjustments which must be performed at initial startup of the blowers, and adjustments which must be performed in the course of preventive maintenance as specified by the manufacturer.
4. Instructions for the adjustment, calibration, and testing of selected electronic components or assemblies, normally considered replaceable by the manufacturer, whose performance is not ascertainable by visual inspection.
5. Service instructions for major components not manufactured by the manufacturer but which are supplied by him in accordance with these specifications. Incorporation of literature produced by the actual component manufacturer will be acceptable.
6. Layout drawing of the blower packages as supplied, prepared in accordance with good commercial practice, showing the locations of all blowers, motors, valves and piping.

Operation and maintenance instructions which are limited to a collection of component manufacturer literature without overall blower system instructions will not be acceptable.

Operation and maintenance instructions shall be specific to the equipment supplied in accordance with these specifications. Instruction manuals applicable to many different configurations and blowers, and which require the operator to selectively read portions of the instructions, will not be acceptable.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Ship equipment and material complete except where partial disassembly is required by transportation regulations or for protection of components.
- B. Receive, store, and safeguard all equipment and materials at the job site.

1.08 WARRANTY:

The Contractor shall be responsible for obtaining the manufacturer's warranty, providing that the blower packages shall be of quality construction, free from defects in material and workmanship.

1. The equipment, apparatus, and parts furnished shall have manufacturer's standard warranty but not less than (1) year, excepting only those items that are normally consumed in service, such as oil, grease, packing, gaskets, O-rings, etc. The manufacturer shall be solely responsible for the warranty of all components.
2. Components failing to perform as specified by the Owner, or as represented by the manufacturer, or proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the Owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. The physical layout of the blowers shown on the drawings and specified herein are based upon the equipment manufactured by Roots Division of Dresser Industries, Inc. The manufacturer shall develop a layout consistent with the contract drawings and specifications to be reviewed by the Owner during the review of shop drawings.
- B. If other equipment is proposed, the Contractor shall demonstrate to the Owner that all requirements of materials, performance and workmanship have been met or exceeded by the equipment proposed.
- C. Revisions to the structure or to other work resulting from the other proposed equipment shall be at the expense of the Contractor.

2.02 EQUIPMENT:

A. GENERAL:

1. The Contractor shall furnish and install six (6) air blower packages, as shown on the drawings and specified herein. Each blower shall be designed as follows:

Aeration Blower No.	Blower Discharge (SCFM/ACFM)	Discharge Pressure (psi)	Maximum Blower Speed (rpm)	Maximum Gear Tip Speed (fpm)
AB-1	272/305	3.7	2260	2351
AB-2	272/305	3.7	2260	2351
SB-1	100/113	3.6	2356	2101
SB-2	100/113	3.6	2356	2101
SB-3	50/57	3.6	2572	1648
SB-4	40/46	3.6	2228	1430

2. The blower performance shall be guaranteed with an allowable tolerance of plus or minus four (4) percent at the above design conditions.
3. Provide additional sheaves for each blower that will allow each blower to operate at 90% of the design blower discharging volume (SCFM) at the design discharge pressure (psi).
4. Provide additional sheaves for blower SB-2 to allow SB-2 to serve as a backup for blowers, SB-1, SB-3 and SB-4.
5. At the operating conditions specified above, each blower shall not produce a sound pressure level in excess of 85 dBA, as measured at the point one meter from the blower.
6. Level switches to enable and disable blowers SB-1 and SB-2 are installed in the Surge Tanks and Section 11303, SUBMERSIBLE PUMP PACKAGES.
7. A blower shutdown alarm, to combine high temperature shutdown and motor breaker trip, shall be wired to the plant annunciator panel(CP-4), furnished under Section 13421, INSTRUMENTATION.

B. BLOWERS:

1. The air blowers shall be of the rotary positive displacement type, and shall be constructed with inlet and discharge connections oriented as shown on the contract drawings. Each blower shall be equipped with steel mounting feet.
2. The blower casing shall be one-piece, with separate headplates, and shall be made of close-grained cast iron.
3. Each impeller shall be made from high-strength cast iron. The impellers shall be of the straight, two-lobe involute type, and shall operate without rubbing or liquid seals or lubrication. The impellers shall be dynamically balanced by removing metal from the impeller body, and shall be center-timed to permit rotation in either direction.

4. The blower shafts shall be alloy steel, and shall be pressed into the impeller body and pinned.
5. Each impeller and shaft assembly shall be supported by oversized anti-friction bearings engineered for long-service life and fixed to control the axial location of the impeller/shaft in the unit. A cylindrical roller bearing shall be provided at the drive shaft designed to handle the stresses of V-belt drive, while single-row ball bearings shall be used at all other locations.
6. The impellers shall be timed by a pair of carburized and ground steel spur gears, mounted on the shafts with a tapered fit, and secured by a locknut.
7. Each bearing shall be provided with a positive lip-type oil seal designated to prevent lubricants from entering the air stream. Further provision shall be made to vent the impeller side of the oil seal to atmosphere to eliminate any possible carry-over of lubricant into the air stream. The drive end bearings shall be grease lubricated, and shall be provided with grease fittings. The timing gears and the gear end bearings shall be lubricated by splash from the gears dipping into the oil.

C. DRIVE SYSTEM:

A V-belt drive shall be used, with an appropriate service factor applied. A suitable weatherproof guard meeting OSHA specifications shall be supplied.

D. MOTORS:

Each blower package shall have a 3 phase, 60 Hertz, 460 volt, open drip proof motor with a service factor of 1.15. The motor shall be of the squirrel cage induction type as manufactured by U.S. Electrical Motors or approved equal. The motor shall be rated for continuous duty under full load conditions and shall have Class B insulation. Maximum temperature rise shall be 40 C. The motor shall be capable of withstanding momentary overloads of 50% without injurious heating. The motor shall operate without excessive heating, flashing or sparking under any conditions within the required capacity of load and speed. The motor horsepower shall be as follows:

<u>Aeration Blower No.</u>	<u>Motor Horsepower</u>
AB-1	7.5
AB-2	7.5
SB-1	3
SB-2	3
SB-3	2
SB-4	2

E. INTAKE FILTER SILENCER:

1. The intake filter silencer shall have a capacity of 750 CFM. The cartridge type filter silencer shall be constructed of carbon steel, shall have a female thread pipe connection, and shall have a removable weatherhood mounted upright. Universal silencer Model CCS or approved equal.
2. The dry pleated paper element shall be 99.5% efficient on particles of 2 micron size. The element shall be cleanable and removable. At 100% of the rated flow, the pressure drop shall not exceed 2.8 inches of water.

F. INLET SILENCER:

The silencer shall be of horizontal arrangement, rigidly connected to the blower suction, and shall be of multi-chamber design with internal tubing and porting for positive displacement blower suction service. Construction shall be of carbon steel plate and shall incorporate two (2) shell layers. Universal silencer or approved equal.

G. COMBINATION BASE/DISCHARGE SILENCER/RELIEF VALVE:

1. The discharge silencer shall be of horizontal arrangement connected to the blower discharge by a reinforced silicone rubber flexible connector to isolate the blower from thermal related stresses. The silencer shall be of multi-chamber design with internal tubing and porting for positive displacement blower discharge service. Construction shall be of carbon steel plate with two (2) shell layers.
2. The discharge silencer shall be welded to a heavy steel machinery base with anti-vibration welded reinforcements. Bolted construction is not acceptable. The relief valve shall be mounted on the exit chamber of the silencer for longevity of the valve and reduced relieving noise.

H. ANCHOR BOLTS, EMBEDDED ITEMS AND TEMPLATES:

All anchor bolts and embedded items for complete installation or mounting, holding down or supporting of equipment to be furnished under this section, including necessary location drawings and templates required to install the items in concrete, masonry, etc., shall be furnished and delivered to the site by the manufacturer of the equipment furnished under this section, for installation under other sections of these specifications.

I. CHECK VALVES:

Check valves shall be of the double door type as manufactured by Valve and Primer Corporation or approved equal. They shall be of the compact wafer design for fitting between ANSI flanges. The doors shall be spring loaded, normally closed by means of one or more stainless steel torsion springs. Flow from the blower shall cause the doors to open and upon blower shutdown, the torsion spring(s) shall force the door to close. Seating in the body shall be resilient and air tight. The sealing element shall be Buna-N compression molded to the body. The valve exterior will be painted Phenolic Primer Red Oxide for

resistance to corrosion. The materials shall be certified to conform to ASTM specifications.

J. BUTTERFLY VALVES:

Butterfly valves shall be of the wafer type as manufactured by DeZURIK or approved equal. The valves shall be in accordance with ANSI B16.1, B16.5 and have a working pressure of 200 psi. The body shall be furnished in cast iron. The seal shall be made of highly wear resistant elastomer with phenolic back-up ring providing the benefit of a soft elastic and hard non-collapsible seat. The valve shall be fitted with a 10 position memory stop.

K. THERMOMETERS:

The thermometers shall be of the mercurial type as manufactured by Weiss Instruments, Inc. or approved equal. The case shall be of die cast aluminum with wide angle construction. A protective glass cover shall be retained within the outer edges of the case. The stem assembly shall have standard fittings of all brass construction for assurance of proper response to temperature changes. The scale shall be black on white reading 30 - 300 F.

L. PRESSURE GAUGES:

The pressure gauges shall be liquid filled and read - 15 psi. The gauges shall be stem mounted with a 1/4" NPT LM connection. The socket shall be made of brass, bourbon tube of beryllium copper, case of stainless steel and the ring crimped stainless steel. The gauge shall have a multi-function plug which shall serve as a vent, pressure relief and liquid fill access. The gauges shall be manufactured by U.S. Gauge or approved equal.

M. SNUBBERS:

Brass snubbers as manufactured by Getloi Company or approved equal shall be furnished with the pressure gauges. Snubber shall have a maximum operating pressure of 10,000 psi and an operating temperature range of -65F - 650F. The housing shall be brass and the snubbing element shall be sintered porous type 316 stainless steel of high strength.

N. SAFETY TEMPERATURE SWITCHES:

Provide NEMA 4 safety temperature shutdown switches that are connected to the blower control circuit to provide for automatic shutdown of the blower unit on high discharge temperature. Switches shall be manufactured by Allen Bradley or approved equal.

O. VIBRATION PADS:

Units shall be furnished with waffle-embossed synthetic rubber isolation pads, suitable for bolting, and shall be installed in accordance with manufacturer's recommendations.

2.03 PAINTING:

- A. The components of the blowers and motors shall be thoroughly cleaned to remove mill scale, dirt, rust, grease, and other foreign matter.
- B. Motors, casings and receivers customarily finished at the shop shall be given coats of paint filler and enamel or other approved treatment customary with the manufacturer.
- C. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.
- D. Other ferrous surfaces shall be given one shop coat of an approved rust-inhibitive primer which shall be compatible with the field coats, and applied in accordance with the instructions of the manufacturer.
- E. Each part shall be separately packaged and clearly marked.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation of the blower packages and related appurtenances shall be performed in accordance with all written instructions furnished by the manufacturer.
- B. After installation, Contractor shall clean all surfaces damaged in shipment or installation and shall touch up in the field with the same materials as original coatings.

3.02 FIELD ACCEPTANCE TESTS:

- A. After installation of the equipment and after completion of the services of the manufacturer's representative the Contractor shall operate each unit to demonstrate its ability to operate without excessive vibration, motor overloading, or overheating. Each blower shall be operated for a sufficient period of time to permit thorough observation of all components.
- B. Start-up and testing shall be conducted in accordance with Section 01752, STARTUP AND TESTING.
- C. Notify Owner in writing at least three days in advance of the tests. If testing cannot be conducted because of scheduling, unavailable service personnel, etc., the Engineer's fees for a second visit shall be paid by the Contractor.
- D. All defects or defective equipment shall be corrected or replaced promptly at the Contractor's expense.
- E. All final adjustments necessary to place the equipment in satisfactory working order shall be made prior to the tests.

- F. All labor and materials necessary for the test shall be furnished by the Contractor.
- G. After installation, all piping shall be tested for tightness in an approved manner. Should leaks be found, faulty joints shall be repaired, even to the extent of disassembling and remaking the joint, and all defective pipe and fittings shall be removed and replaced in a manner satisfactory to the Owner.

END OF SECTION

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SECTION 13121

PRE-ENGINEERED BUILDING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers furnishing the design, fabrication and erection of one . Work includes the building frame, the shell covering, windows, doors and any other appurtenances affixed to the building as shown on the drawings and/or specified herein.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 03300, CAST-IN-PLACE CONCRETE
- C. Section 05500, MISCELLANEOUS METALS
- D. Section 15408, PLUMBING
- E. Section 15700, HEATING AND VENTILATING
- F. Division 16, ELECTRICAL

1.03 SYSTEM DESCRIPTION:

The pre-engineered building is a clear span rigid frame metal building of nominal width, length, wall height, and roof pitch indicated.

1.04 QUALITY ASSURANCE:

- A. The pre-engineered building shall be furnished by Wedgecor, Inc., Inland Building Systems, HCI Steel Building Systems, Inc. or approved equal.
- B. The structure shall be designed to withstand the loads according to Massachusetts Building Codes for the following:
 - 1. Dead load of structure
 - 2. Roof live load - __ psf
 - 3. Snow load - __ psf
 - 4. Wind load of __ psf
 - 5. Seismic - $Z = \underline{\hspace{1cm}}$, as defined in Section 7 of MBMA "Recommended Design Practices Manual"

- C. Each member shall be designed to withstand stresses resulting from combinations of loads that produce maximum percentage of actual to allowable stress in that member, as prescribed in MBMA "Recommended Design Practices Manual."

D. DESIGN CRITERIA:

1. All structural steel sections and welded plate members shall be designed in accordance with the latest edition of the AISC, "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings."
2. All light gauge cold formed structural members and exterior covering shall be designed in accordance with the latest addition of AISC, "Specification for the Design of Cold-Formed Steel Structural Members."
3. Design primary and secondary members and covering for applicable loads and combination of loads in accordance with Metal Building Manufacturer's Association (MBMA) "Recommended Design Practices Manual."
4. For welded connections, comply with AWS "Structural Welding Code."
5. Design load requirements shall be as determined by local state building codes, and as per "Recommended Design Practices Manual" of the Metal Building Manufacturers Association.

1.05 REFERENCES:

- A. The following standards form a part of this specification:

Metal Building Manufacturers Association

Recommended Design Practices Manual

American Institute of Steel Construction

Specifications for Design, Fabrication and Erection of Structural Steel for Buildings

Specifications for the Design of Cold-Formed Steel Structural Members

American Welding Society

AWS D.1 Structural Welding Code

Steel Structures Painting Council (SSPC)

SSPC	SP1	Solvent Cleaning
SSPC	SP3	Power Tool Cleaning
SSPC	SP7	Brush-Off Blast Cleaning

Steel Door Institute (SDI)

SDI-100	Recommended Specification for Standard Steel Doors and Frames
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American National Standards Institute (ANSI)

ANSI	A115	Specifications for Door and Frame Preparation for Hardware
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1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Submit manufacturers product information, specifications and installation instructions for building components and accessories.
- B. Submit complete erection drawings showing anchor bolt settings, sidewall, endwall, and roof framing, transverse cross-sections, covering and trim details, and accessory installation details to clearly indicate proper assembly of building components.
- C. Submit a summary of all design loads transmitted to the foundations at all building columns and posts, both vertical and horizontal, for all loading combinations required.
- D. Submit the maximum column reactions resulting from the specified loadings, specify the number required and the diameter of the anchor bolts to resist the maximum shear reaction at the plane of the base plate.
- E. Submit written Certifications and design drawings prepared and signed by a Professional Engineer, registered to practice in the state of Massachusetts, verifying that the building design meets indicated loading requirements and codes of authorities having jurisdiction and that the foundation design will support the building reactions and other loads imposed by the building use..

1.07 DELIVERY, STORAGE AND HANDLING:

- A. Deliver and store prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight ventilated coverings. Store metal sheets or panels so that water accumulations will drain freely. Do not store sheets or panels in contact with other materials, which might cause staining.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Hot rolled structural shapes shall be ASTM A36 or A529.
- B. Tubing or pipe shall be ASTM A500, Grade B; ASTM A501; or ASTM A53.
- C. Members Fabricated from Plate or Bar Stock shall be 42,000 psi minimum yield strength; ASTM A529, A570, or A572.
- D. Members Fabricated by Cold Forming shall be ASTM A607, Grade 50.
- E. Galvanized Steel Sheet shall be ASTM A446 with G90 coating; "Class" to suit building manufacturer's standard.

2.02 STRUCTURAL FRAMING COMPONENTS:

- A. Truss Beams shall be hot-rolled structural steel, factory welded and shop painted. Furnish complete with attachment plates, bearing plates, and splice members and factory drilled for bolted field assembly.
- B. Length of span and spacing of frames shall be as indicated on the Drawings except that slight variations may be acceptable to meet the manufacturer's standard.
- C. Columns shall be hot-rolled structural shapes. Maximum column depths to be 16-inches at sidewalls and less than 10 inches at end walls.
- D. Wind Bracing shall be adjustable, threaded steel rods, 1/2" diameter minimum; ASTM A36 or A572, Grade D.
- E. End Walls shall be post and beam type.
- F. Secondary Framing: Purlins, eave struts, end wall beams, flange and sag bracing; shall be minimum 16 gauge rolled formed sections.
- G. Base channel, sill angle, end wall structural members (except columns and beams), purlin spacers, shall be minimum 14 gauge cold formed steel, galvanized.
- H. Bolts shall be ASTM A307 or A325 as necessary for design loads and connection details, shop painted, except zinc- or cadmium-plated units to be provided when in direct contact with panels. Foundation anchor bolts shall be cast-in- place with the concrete foundation.
- I. Shop fabricate to the indicated size and section, complete with base plates, bearing plates, and other plates as required for erection and with all required holes for anchoring, or

connections to be shop drilled or punched to template dimensions. Shop connections shall be power riveted, bolted, or welded. Field connections shall be bolted.

- J. Prime structural steel primary and secondary framing members with manufacturer's standard rust-inhibitive primer having over 50% rust-inhibitive pigment, such as zinc chromate iron-oxide alkyd (TT-P-636).
- K. Prime galvanized members, after phosphoric acid pretreatment, with zinc dust-zinc oxide primer (FS TT-P-641).
- L. Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter preventing paint bond. Follow procedures of SSPC-SP2 for power tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSPC-SP1 for solvent cleaning.

2.03 ROOFING AND SIDING:

- A. Provide roofing and siding sheets formed to general profile or configuration as indicated. Provide flashings, closers, fillers, metal expansion joints, ridge covers, fascias, and other sheet metal accessories, factory formed of same material and finish as roofing and siding.
- B. Zinc-Coated Steel Sheet shall be ASTM A446, Grade C, with G90 coating complying with ASTM A525. Metal thickness shall not be less than 26 gauge (0.0179").
- C. SHEET PANEL FASTENERS:
 - 1. Manufacturer's standard system of self-tapping screws, bolts, and nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 - 2. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.
 - 3. Use aluminum or stainless steel fasteners for exterior applications and galvanized or cadmium plated fasteners for interior applications.
 - 4. Locate and space fastening for true vertical and horizontal alignment. Use proper type fastening tools to obtain controlled uniform compression for positive seal without rupture of neoprene washers.
 - 5. Provide fasteners with heads matching color of roofing or siding sheets by means of plastic caps or factory-applied coating.
- D. Flexible Closure Strips shall be closed-cell, expanded cellular rubber, self-extinguishing, cut or premolded to match corrugation configuration of roofing and siding sheets. Strips shall be provided where indicated and/or necessary to ensure weathertight construction.

- E. Metal Closure Strips shall be provided at base of siding sheets where building is set atop the concrete walls.
- F. Sealing Tape shall be 100% solids, pressure sensitive grey polyisobutylene compound tape with release paper backing. The tape shall be not less than 1/2" wide and 1/8" thick, non-sag, non-toxic, non-staining, and permanently elastic.
- G. Joint Sealant shall be one-part elastomeric, polyurethane, polysulfide, or silicon rubber as recommended by the building manufacturer.
- H. PANEL FINISHING:
 - 1. Provide a shop-applied baked enamel finish to siding and related trim and accessories.
 - 2. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coating, and seal with a chromic acid rinse.
 - 3. Apply to pretreated steel, a baked-on thermo-setting synthetic enamel system, such as acrylic enamel or silicone polyester, in one or more coats as standard with manufacturer to achieve a minimum dry film thickness of one mil.
 - 4. Apply finish coat on exterior facings and apply manufacturer's standard wash coat on reverse face.
 - 5. Colors shall be selected by the Owner from the manufacturer's standards.
 - 6. Coordinate metal siding and flashing requirements with the hood provided with the rollup door.

2.04 SHEET METAL ACCESSORIES:

- A. Unless otherwise indicated, provide coated steel accessories with coated steel roofing and siding; aluminum accessories with aluminum roofing and siding.
- B. Gutters shall be formed in sections not less than 8 feet in length, complete with end pieces, outlet tubes, and special pieces that may be required. Join sections with riveted and soldered or sealed joints. Unless otherwise indicated, provide expansion-type slip joint at center of runs. Furnish gutter supports spaced at 36" o.c., constructed of same metal as gutters. Provide standard bronze, copper, or aluminum wire ball strainers at each outlet. Gutter finish shall match roof fascia and rake.
- C. Downspouts shall be formed in sections approximately 10 feet long, complete with elbows and offsets. Join sections with minimum 1/2" telescoping joints. Provide fasteners for top, bottom, and at 5' o.c. between, designed to securely hold downspouts not less than 1" away from walls. Downspout finish shall match wall panels.

- D. Continuous Ridge Ventilators shall be factory engineered and fabricated units of continuous heat valve type, furnished by building manufacturer. Furnish unit in standard length sections in locations, throat size, and total lengths as indicated, complete with side baffles, ventilator assembly, operating damper, hardware, bird screen, end caps, splice plates, flashing, reinforcing diaphragms, closures, and fasteners. Bird screen shall be 1/2" x 1/2" galvanized steel or expanded diamond mesh. Ventilator finish shall match roof panels.

2.05 HOLLOW METAL DOORS AND DOOR FRAMES:

- A. Doors and frames shall comply with requirements of SDI-100, and as herein specified.
- B. Steel doors and frames shall be hot-rolled, pickled, and oiled per ASTM A569 and A568; cold-rolled per ASTM A366 and A568.
- C. Anchors and Accessories shall be manufacturer's standard units. Use galvanized items for units built into exterior walls, complying with ASTM A153.
- D. Unit shall be fabricated such that they are rigid, neat in appearance, and free from defects, warp or buckle. Exposed joints shall be welded continuously, ground, dressed, and made smooth, flush and visible.
- E. Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling and tapping, complying with ANSI A115. Units to have surface-applied finish hardware field installed shall be reinforced. Finish hardware to be located as indicated or, if not indicated, per NBHA "Recommended Locations for Builder's Hardware."
- F. Exposed surfaces of hollow metal units shall be shop painted, standard baked-on-rust-inhibitive primer.
- G. Provide hardware for each door, as follows:
 - 1. Hinges: 1-1/2 pair, steel template hinges, 4-1/2" x 4-1/2".
 - 2. Lockset: cylindrical, key in knob.
 - 3. Threshold: extruded aluminum (exterior doors only).

2.06 OVERHEAD ROLLUP DOORS:

- A. Provide complete operating door assemblies including door curtain, guides, counterbalances, hardware, operators, and installation accessories. The doors shall be certified to withstand a 20 psf wind load pressure with maximum deflections of 1/120 of opening width.

- B. The door curtain shall consist of interlocking slats, one-piece for door width, as follows: Steel Slats, ASTM A446, Grade A, with G90 galvanizing, not less than 20 gauge. Provide heavier metal gages as required to satisfy the load deflection limitation.
- C. Endlocks shall be malleable iron castings, galvanized, secured to curtain slats.
- D. Windlocks shall be malleable iron castings, galvanized, secured to curtain slats at 24" o.c. on both edges.
- E. The bottom bar shall consist of 2 angles not less than 1/8" thick of the same metal as the curtain slats. Provide flexible rubber, vinyl, or neoprene weather seal and cushion bumper.
- F. Curtain Jamb Guides shall be built-up of ASTM A36 steel angles, channels, and flat bars as required and shall be galvanized after fabrication.
- G. Weather Seals shall be manufacturer's standard rubber or neoprene on metal pressure bars. Provide 1/8" thick continuous sheet secured to inside of curtain coil hood.
- H. Counterbalance shall be manufacturer's standard adjustable helical torsion spring mounted around steel shaft in barrel, with grease-sealed ball bearings or self-lubricating graphite bearings for rotating members.
- I. A hood shall enclose the coiled curtain and operating mechanism and act as a weatherseal. Provide closed ends for surface-mounted hoods. Steel shall be not less than 24 gauge, hot-dip galvanized.
- J. Ferrous metal and galvanized surfaces shall be cleaned and shop painted with manufacturer's standard rust inhibitive primer.
- K. Electric Door Operators shall be the size and capacity recommended by the door manufacturer, with NEMA rated electric motor and factory pre-wired motor controls, remote control station, and accessories. Provide hand-operated disconnect or mechanism to automatically engage emergency manual chain and sprocket operation (which is to be provided), with interlock device to prevent motor operation. Provide NEMA approved momentary-contact, 3-button remote control station, marked "open", "close", and "stop". Also, provide safety edge device extending full width of the door bottom, located in neoprene or rubber astragal mounted at bottom door rail. Contact with switch before fully closing shall immediately stop door downward travel and reverse door direction to fully-opened position.

2.07 GLASS AND GLAZING MATERIALS:

- A. Glass for doors shall conform to FS-DD-G-451 and shall be of quality and type indicated, with manufacturer's label identification on each glass light. Glass shall be polished wire, Type III, Kind A (flat), Form I, Mesh ml (welded diamond) UL labeled; 1/4" thick (nominal).

B. Installation shall comply with recommendations of "Glazing Manual" by Flat Glass Marketing Association, except as otherwise indicated or recommended by product manufacturer.

C. GLAZING MATERIALS (FOR INSTALLING GLASS):

1. Silicone Sealant: FS TT-S-001543; Class A; non-acid type, except acid type if channel surfaces are porous.
2. Polysulfide Sealant: FS TT-S-227, Class A, Type 2, 2-part compounded specifically for glazing.
3. Butyl Rubber Sealant Tape: Partly-vulcanized, self-adhesive, non-staining, elastomeric performance, 98% solids, for 35% compression in joint.
4. Acrylic Sealant: FS TT-S-002400, Class by, Type II, solvent based solids 95% acrylic, compounded specifically for glazing.
5. Acrylic-Latex Sealant: Emulsion-type polymer, permanently flexible, non-staining, non-bleeding.
6. Preformed Butyl Rubber Sealant: Polymerized butyl rubber plus inert pigment, 95% solids, non-sag, 24-hour tackfree, paintable, non-staining, coiled with release paper.
7. Neoprene Glazing Gasket: ASTM D2000, designation 2BC 415 to 3BC 620, black.
8. PVC Glazing Gasket: ASTM D2287, flexible.
9. Closed-Cell Neoprene Glazing Gasket: ASTM C509, Type II, self-skinned, black.
10. Setting Blocks: Neoprene, 70-90 Shore A hardness.
11. Filler Rod: Non-adsorptive, closed-cell plastic or rubber which is compatible with glazing materials in channel, 5 to 10 psi compression for 25% deflection.

PART 3 - EXECUTION

3.01 ERECTION:

A. FRAMING AND BRACING:

1. Framing: Erect structural framing true to line, level and plumb, rigid and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrinking grout to obtain uniform

bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.

2. Purlins and Girts: Provide a rake or gable purlins with tight fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girt to structural framing and hold rigidly to a straight line by sag rods.
3. Bracing: Provide diagonal rod or angle bracing in both roof and sidewalls as required. Moment resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer's standards. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or other forms of bracing will not be required.
4. Framed Openings: Provide shapes of proper design and size to reinforce opening and to carry loads and vibrations imposed, including equipment furnishing under mechanical or electrical work. Securely attach to building structural frame.

B. ROOFING AND SIDING:

1. General:

- a. Arrange and nest sidelap joints so that prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associates items for a neat and weathertight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.
- b. Apply sealant tape continuously to clean, dry surface of weather side of fastenings on endlaps and on sidelaps of corrugated or nesting type, ribbed or fluted panels and elsewhere to make waterproof to driving rains.
- c. Install screw fasteners with power tool having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screws threads, or panels. Install screws in pre-drilled holes.

2. Roof Sheets:

- a. Provide sealant tape at lapped joints of ribbed or fluted roof sheets, and between roof sheeting and protruding equipment, vents and accessories. Provide weather seal under ridge cap; flash and seal roof panels at eave, and rake with rubber, neoprene, or other closures to exclude weather.

3. Wall Sheets:

- a. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as necessary for waterproofing. Handle and apply sealant back-up in accordance with sealant manufacturer's recommendations.
 - b. Align bottoms of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings, trim around openings, etc., with self-tapping screws; fasten window and door frames with machine screws or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
4. Sheet Metal Accessories:
- a. Install gutters, downspouts, ventilators, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting. Adjust operating mechanism for precise operation.
5. Swing Doors and Frames:
- a. Install door and frame straight, plumb, and level. Securely anchor frame to building structure. Set units with 1/8" maximum clearance between door and frame at jambs and head, and 3/4" maximum between door and floor. Adjust hardware for proper operation.
6. Windows:
- Install window frames and windows in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting.
7. Overhead Doors:
- Set doors and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with manufacturer's installation instructions. Adjust moving hardware for proper operation.
8. Translucent Panels:
- a. Attach plastic panels to structural framing in accordance with manufacturer's instructions.
 - b. Provide end laps of not less than 6 inches and side laps of not less than 1-1/2 corrugations for translucent roofing panels.

- c. Provide end laps of not less than 4 inches and side laps of not less than 1-1/2 corrugations of translucent siding panels.
- d. Align horizontal laps with adjacent roofing and siding panels.
- e. Seal intermediate end laps and side laps of translucent panels with translucent mastic.
- f. Clean panels in accordance with manufacturer's instructions.

3.02 FIELD PAINTING:

- A. Apply finish coating to factory-primed items, with finish colors selected by Owner from the manufacturer's standards. Touch-up abrasions, marks, skips or other defects to shop-primed surfaces with the same type material as shop primer.
- B. Provide finish coats which are compatible with prime paints used. Provide barriers coats over incompatible primers where required. Notify Owner in writing of anticipated problems using specified coatings with substrates primed by others.
- C. For shop-primed metal surfaces apply 2 coats of high gloss, alkyd enamel (FS TT-489).
- D. Where aluminum surfaces come in contact with ferrous metal or other incompatible materials, keep aluminum surfaces from direct contact by applications to the other material as follows:
 - 1. One coat of zinc chromate primer, FS TT-P-645, followed by two coats of aluminum paint, SSPC-Paint 101.
 - 2. In lieu of 2 coats of aluminum paint, apply one coat of high-build bituminous paint, SSPC-Paint 12, applied to a thickness of 1/16" over zinc chromate primer.
 - 3. Backpaint aluminum surfaces where it is impracticable to paint other surface.
- E. Perform surface preparation and cleaning procedures in strict accordance with coating manufacturer's instructions for each substrate condition. Remove hardware and accessories, and similar items in which are not to be finish-painted or provide surface-applied protection. Reinstall removed items.
- F. Paint and other finishing materials shall be stored, mixed and applied in accordance with manufacturer's directions. Use applicators and techniques best suited for material and surfaces to which applied.
 - 1. Apply additional coats when undercoats, stains or other conditions show through final paint coat, until paint film is of uniform finish, color and appearance.

2. Finish exterior swing doors on tops, bottoms and edges same as exterior faces, unless otherwise indicated.
3. Sand lightly between succeeding enamel or varnish coats. Thickness of the entire coating system of prime and finish coats shall be not less than 2.5 mils.

END OF SECTION

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SECTION 13122

PREFABRICATED FIBERGLASS SHELTER

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers furnishing and installing a prefabricated fiberglass shelter to house valve operators and pump controls as shown on the Drawings.

1.02 RELATED WORK:

- A. SECTION 03300, CAST-IN-PLACE CONCRETE
- B. SECTION 05500, MISCELLANEOUS METALS
- C. Division 16, ELECTRICAL

1.03 SYSTEM DESCRIPTION:

- A. Contractor shall furnish a complete, weathertight prefabricated utility building, with door, walls, roof and accessory items, as described herein and install it on a concrete slab furnished under Section 03300. The building shall be factory finished.
- B. The building described herein is based on a Plasti-Fab, Inc., fiberglass shelter. A comparable building furnished by another manufacturer may be acceptable.
- C. All accessory items shall be factory installed and wired.

1.04 QUALITY ASSURANCE

- A. All work and materials shall be in full accordance with local and/or state ordinances, and with any other prevailing rules and regulations regarding potentially hazardous equipment or locations.
- B. All electrical materials, equipment and installation shall be furnished in accordance with all applicable requirements of the National Electrical Code and the requirements of Division 16.

1.05 SUBMITTAL: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Submit manufacturer's product information and specifications for the proposed structure, including specific exterior and interior finish to be used.

- B. Submit detail and assembly drawings, including connections to the base slab, and operating and maintenance information.

1.06 WARRANTY:

The manufacturer shall warrant that any part of the installed structure supplied is free from defects in material or workmanship under normal use and service for a period of 10 years after installation and acceptance.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Plasti-Fab, Inc., Tualatin, Oregon 97062.
- B. Approved equal manufacturer.

2.02 MATERIALS:

- A. A fully insulated, corrosion-resistant fiberglass shelter shall be furnished. Shelter shall be 8 feet wide by 10 feet long and shall have a sidewall height of 7'-0". The shelter wall shall be ribbed construction for superior structural stability and shall be moulded in one piece with a minimum thickness of 1" polyurethane foam encapsulated between c@ fiberglass reinforced polyester skins. Minimum thickness of the rib sections shall be 2". Shelters shall have a gabled roof with overhang all around, and be constructed of c@ fiberglass skins laminated to a polyurethane foam core of 1" minimum thickness. Moulded as an integral part of the walls along the bottom edge shall be a 4" bolting flange of 3/16" minimum thickness. There shall be no embedded wood, treated or otherwise, anywhere in the structure.
- B. An insulated FRP door of similar construction to the shelter walls shall be included, and mounted in a recess for increased tamper resistance. There shall be a clear opening of not less than 2'-7" width by 6'-1" height with a raised all weather sill. The door shall have a resilient, closed-cell foam neoprene seal having skin on all surfaces per ASTM D-1056/SCE41-42 to provide a superior weathertight closure. Door hardware shall include: Stainless steel 3-point door catch and padlocking handle, heavy duty corrosion-resistant stainless steel hinges, rain visor over the door, and spring loaded door holder to prevent door closing during windy conditions.
- C. Shelter exterior shall be finished with a smooth gelcoat surface (color to be selected by OWNER) of minimum 10-mil thickness.
- D. The shelter shall comply with NEMA 3R requirements.

- E. A vent shall be provided. Vent opening shall be screened and shall be covered with an FRP shroud, or shall be a louvered aluminum vent cover with adjustable damper which can be closed.
- F. A NEMA 4X service panel shall be included in the shelter for 120 VAC, single phase power, and shall contain a single 15 amp breaker.
- G. Interior lighting shall be provided by a 60 watt light with vapor tight bulb and non-metallic base. The shelter shall also include a weatherproof interior switch. Two duplex convenience outlets shall be provided. All electrical components shall be prewired using 14-3 SO cord and corrosion resistant connectors.
- H. Lifting eyes shall be securely mounted at the corners of the roof in such a manner to allow the enclosure to be raised by overhead crane without structural damage.
- I. A shelf shall be furnished for mounting an electrical panel furnished by the Contractor under Division 16, ELECTRICAL. Contractor shall coordinate the shelf with the panel.
- J. Anchor bolts will be provided under Section 05500, MISCELLANEOUS METALS and installed under Section 03300, CAST-IN-PLACE CONCRETE.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation of the building shall be strictly in accordance with manufacturer's instructions to assure that the completed structure is stable and watertight. Care shall be exercised to avoid damaging or marring finished surfaces. Any such damage or marred areas shall be repaired to the Owner's satisfaction or replaced at no additional cost to the Owner.

END OF SECTION

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SECTION 13127

PRECAST CONCRETE UTILITY BUILDING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers all materials, labor, tools and equipment, and operations necessary to furnish and install a precast concrete utility building including door and louvers as shown on the contract drawings. The building shall be delivered to the jobsite and installed by the CONTRACTOR. The building Manufacturer shall provide all lifting cables and hardware needed to off-load and set the building.
- B. Building foundation shall be as shown on the drawings and specified in Section 02300, EARTHWORK.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 05500, MISCELLANEOUS METALS
- C. Division 16, ELECTRICAL WORK

1.03 QUALITY ASSURANCE:

- A. The precast concrete building manufacturer shall be a firm experienced in this type of work. And having a minimum of five [5] years experience. The structure shall be manufactured in plants having been certified under either the NPCA or PCI Plant Certification Program. The manufacturer shall submit evidence showing that he has successfully completed work of this nature prior to being approved to supply concrete to the project. The building shall be the monolithic or panel type precast concrete utility building as manufactured by Concrete Systems, Inc., Hudson, NH, Rotondo & Sons, Inc., Rehoboth, MA, or an approved equal.

1.04 REFERENCES:

The following standards form a part of these specifications:

American Concrete Institute (ACI)

ACI 318 Building Code Requirements for Reinforced Concrete

ACI 512 Recommend Practice for Manufactured Reinforced Concrete Floor and Roof Units.

American National Standard Institute (ANSI)

ANSI A58.1 Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures

American Society for Testing and Materials (ASTM)

ASTM A123 Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates and Strip.

ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement.

ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

ASTM C33 Concrete Aggregates

ASTM C150 Portland Cement

1.05 DESIGN CRITERIA:

- A. The building shall be designed to meet the following minimum loadings as required in ANSI A58.1:
1. Roof live load - 60 psf
 2. Snow load-as required in ANSI A58.1
 3. Wall wind load - 140 mph
 4. Earthquake load - as required in ANSI A58.1 for Zone 2.
- B. The building floor and roof shall be designed for an 11-foot clear span without the use of interior supports of any type. The building interior finished height shall be 8 feet minimum. The roof, floor and wall thickness shall be a minimum of four [4"] thick.
- C. The building design shall be such that the floor, walls and roof are monolithic at manufacture with end walls attached. Design shall also allow for expansion needs.
- D. The exterior walls shall be finished with an exposed aggregate architectural design configuration.
- E. The exterior surface of the building body shall receive one (1) coat of Thoroseal concrete sealer and one (1) coat of Thorocoat acrylic coating, Antique Lace color (#416). The exterior building trim shall be treated in the same manner, except Thorocoat acrylic coating shall be Good Earth color (#430).
- F. The interior walls and ceiling of the building shall receive one (1) coat of Thoroseal concrete sealer and one (1) coat of Thorocoat acrylic coating, Alpine White color (#400).

1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six (6) copies of shop and erection drawings shall be submitted for the Owner's review. The drawings shall show all dimensions of precast sections; location openings; the locations, type, size and strength of inserts, embedded angles, steel reinforcement; and all other information necessary to insure proper handling, fabrication, and erection of the building.
- B. Six (6) copies of the building design calculations and drawings stamped by a registered professional engineer in the State the building is to be installed shall be submitted to the Owner for record only.

PART 2 - MATERIALS

2.01 CONCRETE:

- A. Cement shall be Portland cement Type III. Concrete shall conform to ASTM C150. Admixtures, other than air-entraining and water-reducing admixtures, shall not be permitted unless approved by the Owner.
- B. Concrete shall have a minimum strength of 5000 psi at 28 days.
- C. Aggregate shall conform to ASTM C33.

2.02 STEEL REINFORCING:

- A. Reinforcing steel shall be new billet steel meeting the requirements of ASTM A615. Welded wire fabric shall conform to ASTM A185.
- B. Reinforcing steel shall be accurately formed and shall be free from loose rust, scale and contaminants which reduce bond.
- C. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, and or other reinforcement and shall be secured in place with wire ties or suitable clips.

2.03 INSERTS:

- A. All cast-in-place inserts shall be galvanized and of a type approved by the Owner. Galvanization shall conform to ASTM A123.

2.04 DOOR AND HARDWARE:

- A. The door shall be double flush 18 gauge galvanized steel construction insulated core 6'-0" x 6'-9" x 1-3/4" thick. Frame shall be constructed of galvanized steel with welded joints.

- B. A key operated security lock that matches the OWNERs buildings shall be installed with corrosion resistant handles. Coordinate with plant operator.
- C. The door shall be provided with non-removable pin hinges, weatherstrip, weatherstop, retaining hooks to hold door open, and a retaining chain and spring to keep the door restrained.

2.05 LOUVERS:

- A. Louvers shall be as shown on the drawings and specified in Section 05500, MISCELLANEOUS METALS.

2.06 WARRANTY

- A. The Manufacturer shall warrant the building and its components for one year from the date of installation.
- B. The precast concrete structure shall endure and not deteriorate for a period of twenty-five (25) years.

PART 3 - EXECUTION

3.01 FABRICATION AND ASSEMBLY:

- A. The manufacturer shall check and verify all dimensions, elevations, and locations of openings, anchor bolts, inserts and other cast-in items. Any discrepancy or lack of information shall be reported to the Owner before fabrication.
- B. The Contractor shall be responsible for any failure to precast sections to the correct dimensions and for any omissions or inaccuracies in the manufacture. If, in the opinion of the Owner, proper corrections cannot be made, the section shall be rejected and shall be replaced with a new section at the Contractor's expense.
- C. The roof shall have a minimum slope of 1-inch, sloped in a direction as directed by the Owner. The roof shall overhang all walls a minimum of 1-1/2-inches.
- D. The building shall be entirely assembled by the manufacturer at the plant, sealed, waterproofed, and tested for water tightness.

3.02 INSTALLATION:

- A. Erection of the building shall be done by experienced workmen, in accordance with the previously mentioned standards.
- B. All joints shall be caulked with Tremco Dynamic compound or an approved equal, to maintain a permanent seal under severe weather conditions.

- C. The roof surface shall be sealed with 0.45 EPDM membrane roofing cemented to the concrete with a compound designed for this purpose.
- D. No field holes or cuts shall be made in any section without the prior approval of the Owner. All holes shall be cut in accordance with manufacture recommendations.
- E. The building exterior shall be painted by the manufacturer. Interior walls and ceiling shall be prepared by the manufacturer for painting by removal of all foreign matter, dirt, grease and other surface contaminants.
- F. Interior finish painting shall be by the Contractor in the field. Paint color to be selected by the Owner.

3.03. MANUFACTURER'S SERVICES:

The services of a factory-trained, qualified manufacturer's service representative shall be provided for not less than one 8-hour day to assist in installation of the precast concrete utility building, to assure that the installation is in accordance with the manufacturer's recommendations.

END OF SECTION

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SECTION 13424

INSTRUMENTATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section covers furnishing and installation of the instrumentation complete. The autodialer alarm system shall be provided as described herein.

1.02 RELATED WORK:

- A. Certain alarm controls and wiring are specified under the following sections:
1. DIVISION 11, EQUIPMENT
 2. DIVISION 16, ELECTRICAL WORK
- B. The above sections shall be referenced, and work shall be coordinated to provide a complete, fully operating system, meeting the functional description of this specification.

1.03 SYSTEM DESCRIPTION:

- A. The pump station to be monitored is not continuously manned and shall use a passive alarm system. This type of system stands alone until an alarm occurs. Each alarm shall be annunciated on the pump control panel and transmitted to a voice synthesized autodialer, having the capabilities for a vocabulary as specified elsewhere in this section and programmed to accept different telephone numbers, shall transmit the alarm. The communications link shall be by telephone on standard wires.
- B. The following alarms shall be transmitted by the voice synthesized autodialers on separate channels:
- Pump Station:
- General Pump Station Alarm
- C. The required alarm inputs for each autodialer are as specified in specification section 11303.
- D. The Contractor shall pay all normal service and installation fees for work performed by the Telephone Company related to the installation of the alarm system.
- E. The Contractor shall be responsible for coordinating all work related to the instrumentation and alarm system with the electrical work and the work of all other

trades. The Contractor shall be responsible for insuring that the completed systems satisfy the functional descriptions and detailed specifications for the work.

1.04 QUALITY ASSURANCE:

- A. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The drawings and specifications are not intended to include all details of a complete equipment installation for the purposes specified. The Contractor shall be responsible for all details, which may be necessary to properly install, adjust, and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs, which may result from unauthorized deviations from the specifications.
- B. The services of a factory trained, qualified service representative of the equipment manufacturer shall be provided to inspect the complete equipment installation to insure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble free operation, and instruct the operating personnel in the proper care and operation of the equipment furnished.
- C. The selected equipment manufacturer shall guarantee that the materials and/or workmanship of the equipment will be free from defects for a period of one year upon acceptance of the facilities, providing the equipment has been operated and maintained in accordance with the manufacturer's recommendations.

1.05 SUBMITTALS: IN ACCORDANCE WITH THE REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. SHOP DRAWINGS:

- 1. Six sets of shop drawings including manufacturer's data sheets, showing illustrated cuts of the item(s) to be furnished, scale details, sizes, dimensions, capacities, performance characteristics, wiring diagrams, controls, and other pertinent information shall be submitted to the Owner for review and approval. If more than one size or type is shown, indicate clearly the intended item(s).

B. OPERATION AND MAINTENANCE MANUALS:

- 1. The Contractor shall be responsible for supplying six (6) sets of written instructions, which shall be sufficiently comprehensive to enable the operator to operate and maintain the instrumentation and all equipment supplied by the manufacturer. Said instructions shall assume that the operator is familiar with but that he has not previously operated and/or maintained the exact equipment supplied.
- 2. The operations manual shall include only information specific to this job and shall outline in non-technical terms the complete operation of the system.
- 3. The maintenance manual shall include all wiring diagrams so that trained instrumentation telemetry repair personnel can easily understand all maintenance

and repair operations.

1.06 WARRANTY:

- A. The manufacturer of the instrumentation shall warrant it to be of quality construction, free from defects in material and workmanship. It is the Contractor's responsibility to ensure that all warranted work is provided as specified.
- B. The equipment, apparatus, and parts furnished shall be warranted for a period of five (5) years from the date of Substantial Completion of the project for the autodialer. The Contractor shall be solely responsible for the warranty of all components.
- C. Components failing to perform as specified by the Owner, or as represented by the manufacturer, or proven defective in service during the warranty period, shall be replaced, or satisfactorily modified by the manufacturer without cost of parts or labor to the Owner.

PART 2 - PRODUCTS

2.01 AUTODIALER:

- A. The pump station shall be equipped with a synthesized voice autodialer. The autodialers shall act independently of any other autodialers. The autodialers shall be programmed to dial preset telephone numbers. In the event of an alarm the autodialers shall call the first programmed telephone number. Until acknowledged, the autodialers shall repeat the telephone call for a pre-set number of cycles. If the alarm is still not acknowledged within the allotted time frame the next telephone call initiated shall be to the second telephone number. The telephone calling sequence is repeated indefinitely until an acknowledgement. The pump station personnel on call can then call the alarmed pump station, acknowledge the alarm condition and query the alarm status. The Contractor shall arrange for the installation of the telephone lines to the pump stations and for procuring telephone service.
- B. The acceptable manufacturer shall be Verbatim model VSS4C by Raco Manufacturing & Engineering Co., Emeryville, CA.
- C. The autodialers shall have been programmed to initiate the dialing sequence upon sensing a power failure. All keyboard and front panel switches shall be sealed to prevent contamination by dust and moisture.
- D. The voice-synthesized autodialer shall have the following features:
 - Field programmable telephone numbers
 - Ability to be queried
 - Sealed switches
 - Surge protection on every power, telephone, input line
 - Emergency power battery constantly recharged by a regulated charger - 24 hour

- backup operating capacity
- Operating on 105-135 VAC, 60 HZ
- Adjustable number of message repetitions and repeats per cycle
- Adjustable delay between alarm callouts
- Local Enabling/Disabling switch
- Tone signal or rotary phone service compatible
- Four (4) channel monitoring capacity
- Synthesized voice messages are as follows:

Pump Station:

- General Pump Station Alarm
- E. The autodialers shall be furnished in a NEMA Type 1 enclosure, separately mounted or mounted in the alarm cabinet specified herein.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation shall be performed in accordance with written instructions by the manufacturer.

3.02 FIELD ACCEPTANCE:

- A. The Contractor shall provide the services of a factory trained representative for a period of not less than one 8-hour day to perform the following functions:
1. Complete job site demonstration of all equipment plus a written certification that the equipment has been installed properly and is fully operational.
 2. Instruct the Owner's maintenance personnel on the complete operation of all equipment.
 3. Instruct the Owner's maintenance personnel on basic maintenance and repairs, including actual "hands on" training of each person.
 4. If the minimum time specified above for the manufacturer's representative is not adequate to fully perform the specified tasks, the additional time required to complete the tasks shall be provided at no additional cost to the Owner.

END OF SECTION

SECTION 15408

PLUMBING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers the complete interior and exterior plumbing work, including but not limited to the following:

Pipe and fittings
Valves
Hangers and supports
Floor drains
Insulation, pipe and equipment
Miscellaneous fittings
Plumbing fixtures
Backflow preventers
Hoses and hose racks
Hose bibs
Wall hydrants
Water lines
Tests, Disinfection
Water Meter

- B. The following are not included under this section of the specification:

Process piping
Excavation, pumping of excavations, and backfilling
Cutting and patching, except as noted
Concrete and masonry work
Field painting
Electric wiring, except as noted

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
B. Section 02240, DEWATERING
C. Section 03300, CAST-IN-PLACE CONCRETE
D. Section 09900, PAINTING
E. Division 16, ELECTRICAL

1.03 SYSTEM DESCRIPTION:

- A. The Contractor shall furnish and install all plumbing fixtures and water and drainage piping as herein specified and as indicated on the drawings. The Contractor shall make the connection to the water mains and shall extend the drain piping as indicated on the drawings.
- B. All materials and workmanship shall be suitable for the respective positions in the work and the type of service encountered. All equipment shall be constructed to operate safely without water hammer or undue wear.
- C. The drawings show the general arrangement, direction, and sizes of pipes; it is not intended to show every offset, valve, and fitting, or every structural difficulty that may be encountered, but the piping and appurtenances shall be installed to suit, and to avoid interference with the installation, operation and maintenance of fixtures, equipment, or other piping. All measurements shall be verified at the job site.

1.04 QUALITY ASSURANCE:

- A. The Contractor, at his own expense, shall do all work required by and in accordance with applicable State and local plumbing codes; shall arrange for all permits, inspections, and tests required by those codes; and shall do everything necessary to provide complete systems which will be ready for use without further expense to the Owner.
- B. Work and materials shall conform to applicable codes, utility company standards, and the rules and regulations of authorities having jurisdiction.
- C. Should work or material called for in the specification or on the drawings not conform to the requirements of the previous paragraphs, above, the Contractor shall so notify the Owner when submitting his proposal. Failing to do this, the Contractor shall comply with these requirements at his own expense.

1.05 REFERENCES:

- A. The following standards form a part of this specification:

American Society for Testing and Materials (ASTM)

ASTM	A53	Specification for Welded and Seamless Steel Pipe
ASTM	A120	Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinance Uses
ASTM	A72	Specification for Welded Wrought Iron Pipe
ASTM	A74	Specification for Cast Iron Soil Pipe and Fittings

- ASTM A167 Specification for Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet and Strip
- ASTM B62 Specification for Composition Bronze Ounce Metal Castings
- ASTM B88 Specification for Seamless Copper Water Tube
- ASTM D3034 Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
- ASTM D3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

American National Standards Institute (ANSI)

- ANSI B16.3 Malleable-Iron Screwed Fittings 150 and 300 lb.
- ANSI B16.12 Cast Iron Screwed Drainage Fittings
- ANSI B16.26 Cast Bronze Fittings for Flared Copper Tubes
- ANSI B16.18 Cast Bronze Solder-Joint Pressure Fittings
- ANSI B16.22 Wrought Copper and Bronze Solder-Joint Pressure Fittings

American Water Works Associations (AWWA)

- AWWA C651 Standard for Disinfecting Water Mains

1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Shop drawings shall consist of manufacturer's scale drawings, cuts, or catalogs, including descriptive literature and complete characteristics, code requirements, and motor drive. Shop drawings shall be identified by name and number of equipment, as indicated on contract drawings or in the specification. Catalog data submitted without proper identification of model number or type will not be accepted or acted upon by the Owner. Information on shop drawings which applies to models or systems which are not to be provided hereunder and which does not specifically apply to the item submitted shall be deleted.
- B. Shop drawings of the following equipment and materials shall be submitted for review:

Plumbing fixtures

Floor drains
Valves (all types)
Insulation
Hangers and supports
Water mixing valves
Wall hydrants
Shock absorbers
Non-lead solder
Wall and floor cleanouts
Backflow Preventers

1.07 SEQUENCING/SCHEDULING:

- A. Contractor shall cooperate with Contractors for other work to avoid interference of plumbing work with that of other trades.
- B. Pertinent contract and shop drawings of other trades shall be consulted as required for proper coordination of work.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. PIPE AND FITTINGS:

1. All pipe and fittings shall conform to the listed ASTM and ANSI Specifications as applicable, unless otherwise indicated.
2. All water piping in buildings shall be Type L, drawn, copper water tubing. Underground water piping shall be Type K, annealed, copper water tubing with flared joints.
3. Soil, drain and waste piping 2-1/2 inches and smaller shall be composed of standard-weight, galvanized-steel pipe with screwed, galvanized, cast iron drainage fittings.
4. Except as hereinafter specified, drainage piping, which includes soil, waste, and vent piping, 3 inches and larger, shall be composed of Class XH (extra-heavy), cast iron, soil pipe with Class XH, cast iron, soil-pipe fittings.
5. Vent piping 2-1/2 inches and smaller shall be composed of standard-weight, galvanized-steel pipe with screwed galvanized malleable iron fittings.
6. PVC vent piping shall be furnished in accordance with ASTM D3034 and ASTM D3212.

B. VALVES:

1. Except where flanged valves are specified or required to suit flanged connections, the valves described below shall have screwed ends where used with pipe. Where used with copper tubing, they shall have solder-joint ends or, at the Contractor's option, may have screwed ends for which solder joint adapters for copper tubing shall be provided. In addition to the requirements hereinafter specified, all valves shall be equal in quality and performance to those made by Crane Co., New York, N.Y., Jenkins Bros., New York, N.Y., Kennedy Valve Mfg. Co., Elmira, N.Y.; Lukenheimer Co., Cincinnati, Ohio; William Powell Co., Cincinnati, Ohio; or Walworth Co., New York, N.Y. Insofar as possible, all valves shall be the product of one manufacturer.
2. Gate valves 2-1/2 inches and smaller shall be 150 lb. bronze valves with screwed or solder-joint ends, as hereinbefore specified, and body material shall conform to Standard Specification for Composition Bronze or Ounce Metal Castings, ASTM B62. Valves shall have union bonnet, rising stem, inside screw, and solid wedge gate. Stems shall be made of wrought silicon bronze. If the manufacturer does not furnish this stem material in the class specified, the valves shall be furnished in the next higher class in which the stem material is available.
3. Globe, angle and check valves 2-1/2 inches and smaller shall be 150 lb. bronze valves with screwed or solder-joints ends as hereinbefore specified, and body material shall conform to Standard Specification for Composition Bronze or Ounce Metal Castings, ASTM B62. Valves shall have union bonnet, plug disk globe, renewable or regrindable seat, swing check. Stems shall be made of wrought silicon bronze. If the manufacturer does not furnish this stem material in the class specified, the valves shall be furnished in the next higher class in which the stem material is available.
4. Globe or angle valves may be used for stop valves one inch and smaller, subject to the approval of the Owner.
5. Strainers shall be placed ahead of each control valve and elsewhere as specified or indicated on the drawings. Strainers shall be screwed or flanged as specified for valves. Bodies shall be of the T, S, or Y type designed for not less than 125 lb. working pressure. Screens shall be bronze, Monel or stainless steel. The size of the perforation shall be 1/32 inch for strainers 3/4 inch to 2 inches, inclusive, and 1/16 inch for strainers over 2-1/2 inches in size.
6. The free area of each screen shall be not less than three times the area of the strainer inlet pipe. Unless the strainer design is devoid of air pockets, a 1/4 inch air vent cock shall be provided.

7. Manufacturers of other products comparable in quality and type to those specified will be acceptable, if, said products are offered by the Contractor with satisfactory data on past performance and other information required, and if approved by the Owner.
8. Pressure-reducing valves 4 inches and smaller shall be self-contained, bronze body, single-port valves with spring-loaded diaphragm. The valve shall be equal to the pressure-reducing valves manufactured by Fisher Governor Co., Marshalltown, Iowa; Worthington Controls Co., Div., Norwood, Mass.; or Watts Regulator Co., Lawrence, Mass.

C. DRAINS:

1. Drains shall have cast iron bodies and shall be of the types listed below.
2. For convenience of listing, the various drains are identified by Josam Mfg. Co., Michigan City, Ind.; Wade Mfg. Div., Franklin Park, Ill., and Jay R. Smith Mfg. Co., Piscataway, Pa., catalog numbers, unless otherwise noted. Approved equal products of other manufacturers will be acceptable.
3. Floor drains installed over waterproofing membranes shall have flashing clamp devices.

D. CLEANOUTS AND TRAPS:

1. Cleanouts and traps (except those furnished with fixtures) shall be class XH cast iron soil pipe fittings. Cleanout ferrules shall have an iron body suitable for standard hub ends of soil pipe or soil-pipe fittings. The ferrule shall be fitted with a threaded solid cast-brass plug. Cleanout plugs in floors shall be kept just below the finished floor level and covered with an adjustable cast iron head with a heavy duty scoriated tractor cover. All plumbing fixtures shall be trapped.
2. Where traps are required for floor drains, they may be separate as above or integral with the floor drain.

E. BACKFLOW PREVENTERS:

Backflow preventers shall be Watts No. 909S reduced pressure principle backflow preventer or approval equal and shall be listed by the Department of Environmental Protection as an approved backflow prevention devices. Each unit shall be a complete assembly including shut-off valves before and after the device and shall include a strainer, test cocks and pressure differential relief valve. Furnish test kit No. TK-9A and spare parts for each backflow preventer. This Contractor shall obtain and pay for the required permits.

F. INSULATION:

1. Insulation shall be manufactured by Johns Manville, Owens-Corning, Armstrong, or an approved equal.
2. Insulation shall have white jacket.
3. Except as otherwise noted, insulation shall be glass fiber, with a "k" factor of 0.24 or less at 100°F. mean temperature.
4. Jacket material shall be fire-retardant type, applied with self-extinguishing adhesive.

G. MISCELLANEOUS FITTINGS:

1. Items listed in this subsection shall be equal to Josam, Zurn or Beacon. Manufacturers of other products comparable in quality and type to those specified will be acceptable if, said products are offered by the Contractor with satisfactory data on past performance and other information required, and if approved by the Owner.
2. Shock absorbers shall have stainless steel castings and air charged bellows; 1 inch NPT male end connections; Zurn Shoktrols Model 300.
3. Wall cleanouts for drainage lines shall be cast iron countersunk plugs with cast iron ferrule; polished nickel-bronze round access cover with securing screw; Josam Y-130-BB. Threaded plug size shall suit arrangement drawings, access cover shall be 7-3/4 inch diameter for all sizes of plugs.
4. Floor cleanouts for drainage lines shall be cast iron with seriated cut-off sections, bronze internal plug same size as ferrule, and heavy-duty cover with the letters "C.O." cast in, vandal proof screws: Josam 8000.
5. Relief valves shall be combination temperature and pressure relief valves; capacity to suit heating element size; Watts 40L.
6. Gages shall be furnished and installed with the specified equipment as indicated on the drawings or specified, and shall be complete with all shutoff cocks and extensions necessary to clear insulation and maintain visibility.
7. Gages shall have a black case and shall be 4-1/2 inches nominal diameter with phosphor bronze Bourdon tubes (beryllium copper bellows), 1/4-inches NPT male connection, stainless steel rack and pinion movement, microadjustment for calibration, white dials and black figures, threaded ring case. Gages shall have a guaranteed accuracy of at least one percent of scale range.

8. T-branch cleanouts shall be cast iron, sized to fit the line in which they are installed, with line size rough brass raised head plug with polished brass round access cover. Countersunk screw between cover and raised plugs shall be of length to suit final installation; Josam Y-1510.
9. Wall hydrant shall be cast brass non freezing with 3/4 inch NPT outlet, T handle polished face bronze wall casing, renewable nylon seat, brass operating parts and 3/4 inch male NPT inlet connection with integral vacuum breaker, Smith Series 5509.
10. Ground cleanouts shall be cast iron with seriated cut-off sections, with all brass adjustable head, heavy-duty cover with letters "C.O" cast in, and screwed cleanout plug; Josam Y-620.

H. PLUMBING FIXTURES:

1. Fixtures shall be manufactured by American Standard, Kohler, Crane, or an approved equal. Manufacturers of other products comparable in quality and type to those specified will be acceptable if said products are offered by the Contractor with satisfactory data on past performance and other information required, and if approved by the Owner. Except as otherwise noted, fixture numbers refer to Kohler.
2. Fixture traps shall have cleanouts.
3. Water Closet to be Wellworth Lite tank type K-3420 EB with all trim and solid plastic seat K-4652. Unit to be floor mounted.
4. Lavatory to be Hampton K-2705 with all trim. Size 22" x 19" with polished chrome faucet and pop up drain.
5. Servasink by Fiat - Model L-1, wall hung 23" x 4-1/2" 13-7/16" deep with No. A-1 quality built brass faucet with swing spout, mounts on rear deck. Complete with wall brackets.
6. Shower Fittings-Kohler K-9132 drain with perforated strainer. Symmons Model 596-1-X temptrol pressure balanced shower valve with integral volume control, integral stops, shower head with 2 GPM flow control, air and flange. Adjustable curtain rod and curtain hooks.
7. Floor Drains:

All floor drains shall be the product of one manufacturer such as J. R. Smith Manufacturing Company, Josam or Zurn.

(Toilet Rooms) - Cast iron body and flashing collar with 8 inch square nickel bronze adjustable strainer, similar to J. R. Smith Figure No. 2010-B.

(Unfinished Areas, Mechanical Rooms) - Cast iron body and flashing collar with cast iron bar grate, medium duty, adjustable top and sediment bucket, similar to J.R. Smith Figure No. 2360.

8. Pressure and Temperature Relief Valve::

Watts pressure and temperature relief valve with test lever and thermostat for installation directly into tank tapings shall be furnished with water heater. Watts No. 36A vacuum valve shall also be furnished with water heater.

Drain pipe from relief valve tapping shall be full size, non-ferrous and run to within 6-inches of floor.

9. Water Heater:

Storage type heater shall be as manufactured by Lochinvar, Ruud or State and shall be similar to Lochinvar's Model ETX082KK, glass lined electric storage water heater, 80 gallon capacity storage with 6-kw element - 460 volt - 3 phase, 60 Hz with recovery of 23 gallons through a 100°F rise.

10. Drinking fountain shall be Halsey Taylor Model 5904-Stainless Steel, with back panel, complete with wall mounting brackets, screws, and all necessary trim.

I. WATER METER:

Water meter shall be of type approved by the Water Department and furnished and installed in accordance with Water Department requirements.

J. HOSES AND HOSE RACKS:

Hoses shall be 3/4-inch diameter heavy duty rubber hoses reinforced with 2 braids, rated for a working pressure of 125 psi minimum, and with standard 3/4-inch solid brass garden hose thread couplings. The hoses shall not weigh less than 39 lbs. per 100 feet. Each hose shall be a minimum of 50 feet long and shall be installed where shown on the drawings, mounted on a metal hose rack with cranking provisions for winding the hose.

K. HOSE BIB:

Chicago Faucet Company No. 952 inside sill faucet with vacuum breaker, 3/4 inch hose thread outlet with lock shield cap and 293-G removable tee handle, 1/2 inch IPS female inlet, chromium plated.

L. HYDRANTS:

1. Hydrants shall be the product of one manufacturer such as Jay R. Smith Manufacturing Co., Josam or Zurn.
2. J.R. Smith Model No. 5810 bronze wall hydrant with polished bronze face, bronze casing, T-handle key, vacuum breaker, of length required by installation.

2.02 SHOP PAINTING:

- A. Before exposure to the weather, and after thorough cleaning to remove all mill scale (by sandblasting or pickling), rust, dirt, grease, and other foreign matter, the plumbing equipment, exterior casings, jackets, motors, and similar parts customarily finished at the shop shall be given coats of paint filler and enamel, or other approved treatment customary with the manufacturer.
- B. Ferrous surfaces, including flange faces, obviously not to be painted, shall be given a shop coat of grease or other suitable rust-resistant coating.
- C. Field painting is specified under Section 09900 PAINTING.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. PIPE AND FITTINGS:

1. All piping shall be installed in a neat, workmanlike manner, and the various lines shall be parallel to building walls wherever possible. Piping shall be installed to accurate lines and grades, and shall be supported by hangers of the type and spacing hereinafter specified. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Suitable provision shall be made for expansion where necessary.
2. All piping shall pitch toward low points, and provision shall be made for draining these low points. Sanitary and roof drainage piping shall be pitched 1/4-inch per foot wherever possible, but under no circumstances less than 1/8-inch per foot.
3. Cleanouts shall be installed in soil and waste piping at ends of branches, in traps and stacks, at points where direction of flow changes, and at convenient points in long runs of pipe. End cleanouts for pipe buried under floor slabs shall be brought up to just below the floor level and a flush access cover provided.
4. Before installation, uncoated steel pipe shall be placed on an anvil and hammered to remove scale.

5. Before assembly, all dirt and chips shall be removed from inside the pipe and fittings and from the threads.
6. After being cut to final lengths, the ends of steel pipe and copper tubing shall be reamed to remove burrs.
7. Threads of all screwed joints shall be clean-cut and of long taper. Screwed joints shall be made up with an approved pipe joint compound applied to the male threads only.
8. All pipe connected to recessed drainage fitting shall be screwed against the shoulder of the fittings.
9. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear the approval of the Underwriter's Laboratories or Factory Mutual Engineering Division.
10. Isolation valves shall be provided in all branches, subbranches, and equipment connections, whether or not indicated on the drawings.
11. Joints which are required to be backed off shall be entirely disjointed, the threads of both the pipe and fittings wiped clean, new joint compound applied and the connection reassembled.
12. No close nipples will be allowed.
13. Solder joints for copper tubing shall be prepared by cleaning the ends of the tubing and the inner surfaces of the fittings with steel wool until they are bright. The cleaned surface shall be given a thin coating of approved non-lead soldering flux, and the tubing end inserted into the fittings as far as possible. Heating and finishing of the joint shall be done in accordance with the recommendations of the manufacturer of the fittings, using solid string or wire solder with no more than 0.2 percent lead. Solder shall be 95 percent tin and 5 percent antimony, or other approved composition. The use of cored solder will not be permitted.
14. Flared joints for copper tubing shall be cut and burred (as above) after which the sleeve nut shall be slipped on the tubing and the end flared with a flaring tool. Care shall be taken in flaring not to crack or split the flared portion, but if inspection reveals such damage, the flare shall be cut off and a new flare made. The flared end shall be squarely seated on the fitting and the nut tightened.
15. Where ferrous pipes join nonferrous pipes carrying liquid either underground or elsewhere, such as at electric water heaters, dielectric bushings or unions shall be used to make the joint.

16. A sufficient number of unions shall be used to allow for the dismantling of all water pipe, valves, and equipment. Unions shall be 250 WSP and shall be made of brass or bronze for joining nonferrous pipe and malleable iron or steel with brass or bronze seats for joining ferrous pipe. In vent piping, Tucker connections shall be used instead of unions.
17. Joints in soil pipe shall be made with picked oakum, packed tightly into the space between the hub and the pipe, and molten lead at least one inch in depth. Each joint shall be made in one pouring and caulked to ensure tightness.
18. Joints between soil pipe and steel pipe shall be made with malleable-iron Manhoff fittings.
19. Where exposed or encased in concrete, the pipe and fittings shall be uncoated, but buried pipe or pipe in concealed or inaccessible locations, shall be coated with bituminous varnish.
20. The type of service of piping, whether exposed or concealed in pipe chases or above ceilings, shall be properly identified by means of labels. Labels shall be adhered to piping at not more than 25 feet o.c. Labeling on branch lines shall begin at take-off from main line. Piping systems to be identified include the following:

Hot water,
Sanitary vent, Cold water
Sanitary drains
Domestic water, Protected water*

*All high pressure and low pressure lines downstream of the backflow preventer are classified as "protected water" lines.

B. VALVES:

1. At the completion of the installation, the Contractor shall tag all valves with 1-1/2 inches square brass or aluminum numbered tags. Tags shall be attached to valve bonnets with metal hooks as manufactured by National Tags and Label Company, or approved equal.
2. The Contractor shall provide and hang in the operations office a typewritten, framed and glass covered valve chart indicating the number and location of the valves and the area served.

C. HANGERS AND SUPPORTS:

1. All piping and equipment shall be supported rigidly from the building structure by approved hangers and supports. Piping shall be supported to maintain the

necessary pitch, to prevent vibration, and to provide for expansion and contraction.

2. Hangers shall be secured to beams or approved malleable-iron inserts wherever practicable. The Contractor shall furnish and set all inserts before the concrete is placed.
3. Hangers shall be adjustable wrought-band, or wrought-clevis hangers with iron rods.
4. Hangers in contact with copper tubing shall be copper plated.
5. Hangers in contact with galvanized pipe shall be galvanized.
6. Vertical pipes shall be supported at each floor level by means of steel friction clamps. Long vertical drops shall be suitably braced at the top to prevent vibration.
7. Hangers shall be installed at locations not more than 8 feet from ends of each runout, nor more than one foot from each change in direction. The maximum spacing of hangers for the various sizes and types of pipe shall be as follows:

Up to 1 in.	7 ft.
1-1/2 in. to 2 in.	9 ft.
2-1/2 in. to 3 in.	11 ft.
4 in. and larger	14 ft.
Cast iron soil pipe, all sizes	5 ft.

D. INSULATION:

1. Insulation shall be Johns Manville Micro-Lok glass fiber 3-1/2 pcf density, one inch thick, with a factory-applied white vapor barrier jacket. Butted end joints shall be wrapped with a 4 inch wide strap of vapor barrier jacketing, sealed with a vapor barrier lap cement. Longitudinal joints of the jacket shall also be sealed with vapor barrier cement. If staples are used to aid fastening, they shall be brushed over with the vapor barrier lap cement. Each 3 foot section of pipe insulation shall be secured by means of 2 aluminum bands. Fittings shall be insulated with glass fiber blanket insulation, wrapping firmly and compressed to a thickness equal to the adjoining pipe insulation, held in place by spiral winding of twine. The fitting insulation shall be sealed with a wrapping of open-mesh cloth or glass fabric tape, coated with white vapor barrier lap cement. Valves and flanges 3 inches and larger shall be insulated as described for fittings. Valve insulation shall extend up to bonnets.
2. Insulation shall be applied carefully, by mechanics skilled in the trade.
3. Cold water valve shall be covered to the underside of the stuffing box gland.

4. Insulation shall be dry when applied, and shall be maintained dry until acceptance of the work by the Owner. Insulation shall be applied over clean, dry pipe, after the piping system has been tested and accepted by the Owner.
5. Insulation shall not be applied over chrome piping.
6. Insulation shall be installed on all water piping above ground, on above-ground roof drainage piping run at any angle from 0° to 45° from horizontal, inclusive, and on the vertical riser to roof drain box from the horizontal run of piping.

E. SLEEVES AND FLASHING:

1. Pipes shall be enclosed in schedule 40 steel pipe sleeves where they pass through floors or masonry or concrete walls or partitions. Sleeves shall be one size larger than the pipe or insulated line passing through. Sleeves shall finish flush with finished faces of walls and partitions, and shall extend at least one inch above finished floor. In lieu of installing sleeves in cast floors, neat cored holes may be made. Cored openings shall have tight-fitting heavy gage sheet metal sleeves, adequately anchored, and caulked to provide as watertight an installation as the cast-in-place sleeves. Sheet metal sleeves shall also extend one inch above the finished floor.
2. Uninsulated exposed lines which pass through floors, ceilings, walls, or partitions shall have chrome escutcheon cover plates; insulated lines shall not have escutcheon cover plates. Escutcheon plates at floors shall cover the one inch pipe sleeve extension above the finished floor.
3. Insulated piping shall be carried through the sleeve with no reduction in insulation thickness.
4. Where pipes pass through exterior walls, space between pipe and sleeve (surface of insulation and sleeve for insulated lines) shall be filled with a suitable non-combustible insulation and the exterior face fully sealed against the weather.
5. Counterflashing at ductwork and piping which pass through the roof shall be made with Type 304 stainless steel, conforming to Standard Specification for Corrosion-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, ASTM A167.
6. Counterflashing shall be formed to fit over base flashing with a slight clearance, to permit differential movement without damage. Counterflashing shall be fabricated to make a tight fit with the vent or other item being flashed, and shall be banded, bolted, and caulked as required to make a completely watertight flashing installation. Counterflashing shall lap over base flashing not less than 4 inches.
7. Straps for counterflashing shall be 1 x 0.037 inch temper-rolled stainless steel. All

other stainless steel shall be temper-rolled, not less than 0.018 inch thick. All metal accessories shall be stainless steel.

8. Counterflashing shall conform to details on the architectural drawings. Base flashing is excluded from this section of the specification.

F. MISCELLANEOUS:

1. Wood plugs shall be inserted in weepholes of drains installed over floor membranes. Plugs shall be removed by the Contractor who installs concrete or mortar over the floor membrane.
2. In addition to those indicated on the drawings, fittings shall be installed in accordance with the following:
 - a. Shock absorbers on water supply lines to each battery of plumbing fixtures, up-stream of each solenoid or quick-closing valve on water lines.
 - b. Vacuum breaker valve for hot water heater.
 - c. Relief valve not provided as an accessory item for a packaged hot water heater shall be provided at each hot water tank, and shall have capacity equal to the heating BTU output of the coil.

3.02 QUALITY ASSURANCE:

- A. Upon completion of installation, all pipelines shall be tested by the Contractor in the presence of the Owner or the plumbing or building inspector, and in accordance with the requirements of local or applicable plumbing or building code.
- B. Piping located underground shall be tested before being backfilled. Piping to be insulated or painted shall be tested before the insulation or paint is applied. Portions of piping which will be concealed before completion shall be tested separately in the same manner as described below for the entire pipeline.
- C. All materials, equipment, tools and labor for testing shall be furnished by the Contractor.
- D. Piping which carries water or liquid under pressure shall be filled with water and subjected to a pressure of 125 psig. or 1-1/2 times the normal working pressure, whichever is greater, for a period of two hours or longer as may be necessary to examine the piping for leaks.
- E. Soil, vent, waste, and roof or other drain piping shall be tested by filling with water to the top of the highest vent stack above the roof, with all outlets plugged. The piping shall hold this water for a period of 30 minutes without showing a drop greater than 4 inches in the water level.

- F. Should leaks be found, faulty joints shall be repaired, even to the extent of disassembling and remaking the joint. Caulking of threads or the use of chemical compounds to correct leaks will not be permitted. Defective pipe or fittings shall be replaced by the Contractor, and the tests shall be repeated until test requirements are met to the satisfaction of the Owner.

3.03 ADJUSTING AND CLEANING:

- A. Apparatus shall be thoroughly lubricated and cleaned before being placed in final operation. Finished surfaces shall be restored if damaged, and the entire installation shall be delivered in an approved condition.
- B. Items with porcelain-enameled surfaces, and others for which no satisfactory field repair is possible, shall be replaced if damaged before final acceptance of the installation.
- C. Labels shall be removed. Plumbing fixtures shall be washed clean. Floor drains and receptors shall be clean, free of debris, and shall be sealed with water. Liquid piping systems shall be thoroughly flushed.

3.04 DISINFECTION:

- A. The Contractor shall disinfect water piping before it is placed in service.
- B. The Contractor shall furnish all equipment and materials necessary to do the work of disinfecting, and shall perform the work in accordance with the procedure outlined in the Standard for Disinfecting Water Mains, AWWA C651.
- C. The dosage shall be such as to produce a chlorine residual of not less than 10 ppm after a contact period of not less than 24 hours. After treatment, the piping shall be flushed with clean water until the residual chlorine content does not exceed 0.2 ppm.
- D. During the disinfection period, care shall be exercised to prevent contamination of water in the street main.

3.05 TAPPED CONNECTIONS:

- A. Tapped connections in pipe and fittings shall be made in such a manner as to provide a watertight joint with adequate strength against pullout. The maximum size or taps in pipe or fittings without bosses shall not exceed that listed in the appropriate table of Appendix to ANSI A21.51, based on 3 full threads for ductile iron.
- B. Where the size of the connection for the pipe in question, exceeds that given above, a boss shall be provided on the pipe barrel, the tap shall be made in the flat part of the intersection of the run and branch of a tee or cross, or the connection shall be made by

means of a tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, all as indicated or approved.

- C. All drilling and tapping of ductile iron pipe shall be done normal to the longitudinal axis of the pipe; fittings shall be drilled and tapped similarly, as appropriate. Drilling and tapping shall be done only by skilled mechanics. Tools shall be adapted to the work and in good condition so as to produce good, clean-cut threads of the correct size, pitch, and taper.

3.06 RECORD DRAWINGS:

- A. As the work progresses, legibly record (red line) all field changes on a set of project contract drawings. Prior to Substantial Completion of the project, submit the red lined prints to the Owner for use in preparation of the record drawings.

3.07 OPERATION & MAINTENANCE MANUAL:

- A. Upon completion of all work, and before final inspection and acceptance of the installation by the Owner, six copies of a complete instruction manual, bound in booklet form and suitably indexed, shall be submitted to the Owner for approval. The manual shall be fully typewritten or printed; material written in longhand shall not appear in the manual. The manual shall contain the following:

1. Brief description of each system covering basic operating characteristics.
2. List of all equipment, with manufacturer's name and model number of each item.
3. Manufacturer's literature describing each item of equipment.
4. Parts list for each major item of equipment.
5. Detailed step-by-step instructions for starting and shutdown of system.
6. Detailed maintenance instructions for systems.

END OF SECTION

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SECTION 15860

VENTILATION ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. This section covers the work necessary to furnish and install a complete vapor phase chemical dilution and application system for odor control purposes. The vapor phase ODOR CONTROL EQUIPMENT will be used to provide odor control through pressure atomization of odor control reactants for the pumping station wet well. The system shall be designed with the ability to draw and treat 600, 1,200, or 3,000 SCFM at three predetermined set points depending on the switch selection on the control panel - Atomization shall be provided through properly sized stainless steel pressure atomizing nozzles. The system shall be capable of providing chemical concentrations in the range of 0.16 to 2.63 percent (by volume), and applying these reactant chemicals to the odorous airstream for a designed contact time of less than one second.
- B. The work of this section includes but is not limited to the following:
1. Stainless steel contact chamber with media access doors
 2. Force pack fixed media contact packing
 3. In-line mounted FRP blower
 4. Nozzle manifolds
 5. Pressure atomizing nozzles
 6. Line Strainer
 7. Electrical control panel
 8. Chemical feed pump
 9. Mix and dilution tank
 10. Corrosion resistant stand for tank and pump
 11. Liquid level control proportioner (mechanical)
 12. Chemical feed lines
 13. Air flow straightening valve (optional)
 14. Chemical flow switch (optional)
 15. Air flow sail switch (optional)
 16. Delta-zero rain cap
 17. Roof curb adaptor
- C. Under this section, the Contractor shall furnish all labor, materials, and equipment, and install one odor control system. The equipment shall be of a type that has been in satisfactory operation in the United States for a period of at least five years.

1.02 RELATED WORK:

- A. Contractor shall include all costs for revisions to the piping, structural, and other portions of the work which may be required to adapt the system as furnished.
- B. Ductwork from the intake to the blower of the odor control system is included in Section 15700, HEATING AND VENTILATION.
- C. The drain and the threaded connection are included in Section 15408, PLUMBING.
- D. The electrical connections between the odor control fan and the motor control center, and for the chemical feed system are included in Section 16000, ELECTRICAL.

1.03 DESCRIPTION OF SYSTEM:

- A. The vapor phase ODOR CONTROL EQUIPMENT shall be a QCID- 12 Odor Control System, as manufactured by NuTech Environmental Corp., or approved equal. The system is designed to use vapor phase reactants requiring a contact time of less than 1 second. The QCID-12 system shall be used in conjunction with the odor eliminator chemicals manufactured by NuTech Environmental Corp., described in Para. 2.20, or approved equal.
- B. The system shall be capable of drawing an odorous air stream, automatically metering, diluting and atomizing chemicals specifically formulated for the purpose of odor control, and applying these chemicals to the odorous air stream before exhausting the treated air stream to the atmosphere. The liquid proportioning level control shall include a backflow preventer to prohibit chemical flow into the fresh water supply. The chemical feed rate shall be controlled through the use of 14 changeable color coded metering tips on the chemical injector which provides dilution rates between 38:1 and 606:1. The only manual operation shall be to maintain a supply of the concentrated chemical.
- C. All components required for the proper operation of the system shall be provided by the manufacturer, whether or not specifically noted in these documents, so as to form a complete workable system when external connections for supply wiring, piping, and ducting are completed.
- D. The system shall be constructed with pre-assembled integrated components. It shall be factory tested prior to shipment.
- E. The chemical feed system shall be used to apply vapor phase odor control solutions in concentrations range from 0.16 to 2.63 percent (by volume), percent by volume. Atomization shall be provided by properly sized stainless steel pressure atomizing nozzles, assuring proper distribution of the chemicals for vapor phase odor elimination in the contact chamber and onto the force packs of the system.
- F. Additional design requirements:

<u>ITEM (No. Required)</u>	<u>SIZE/CAPACITY</u>
1. Stainless steel contact chamber(1)	16" diameter x 78" tall w/force packs and media sash type access doors, with 18" plain discharge
2. Force pack fixed media (2)	16" diameter x 4" thick PVC corrugated plate type extended surface media
3. FRP blower (1)	18" 1200 CFM at 3" S.P. in-line design
4. Nozzle manifolds (2)	1" 304 stainless steel with nozzle mounts
5. Pressure atomizing SS nozzles (4)	0.6 gph/nozzle at 40 PSI
6. Line Strainer (1)	1/2" polypropylene, 150 PSI, 100 mesh
7. Electrical control panel (1)	NEMA 4X combination starter with on/off and indicator light for blower, solid state variable speed motor drive with overload protection
8. Chemical feed pump (1)	28 gph at 60 PSI
9. Mix and dilution tank (1)	10 gallon HDPE
10. Equipment stand (1)	Non metallic equipment stand
11. Liquid level control proportioner(1)	Dilution rates of 32:1 to 606:1
12. Recirculation system	Stainless steel needle valve
13. Chemical feed lines (as required)	1/2" polyethylene rated for 150 PSI at 70EF
14. Utilities	Water supply - 4 gpm at 60 PSI Drain - through air collection duct to air source Electrical - Pump, 2.8 Amp, 120V, Blower, 14/7.0 Amp, 230/460V, 3I
15. Air flow sail switch (1)	Stainless steel air velocity switch
16. Delta-zero rain cap (1)	18" Dia. x 72" high upblast discharge with zero IP fabricated from stainless steel or FRP

17. Roof Curb Adapter (1) 18" flanged to raincap and 18" long plain end inlet tube.
18. Secondary Containment Skid (1) 90 gallon capacity PE pallet type skid.

1.04 QUALITY ASSURANCE:

- A. All the equipment under this section shall be furnished by a single manufacturer and shall be products of a manufacturer engaged in the production of such equipment with at least five (5) years experience manufacturing equipment of similar design and scope.
- B. If required by the Owner, the manufacturer shall provide satisfactory evidence of a minimum of ten (10) installations using similar chemicals which have been operational for at least one (1) year, including the address and telephone number of the operator at each installation.
- C. The odor control equipment specified is intended to be used as a standard of quality. Submittals and references for alternates shall be in accordance with the requirements stated herein. This data shall be submitted to the Owner 21 days prior to the bid date. Alternate system submittals shall be reviewed by the Owner for technical content and industry experience. By upon this evaluation, the manufacturers of the proposed alternate systems may be asked to perform an on-site demonstration. This on-site demonstration be performed at no cost to the Owner. Chemical usage during the demonstration as well as ease of operation shall be evaluated and reviewed by the owner. No alternatives shall be approved without an on-site demonstration. Acceptable alternate designs shall be identified by addendum.
- D. The Contractor shall have sole responsibility for the proper functioning of the system furnished.
- E. All equipment shall be corrosion-resistant or protected with corrosion-resistant coatings of the manufacturer's latest development and as approved by the Owner.
- F. The Contractor's attention is directed to the fact that the odor control system is an integrated system and as such shall be furnished by one supplier, who shall provide the carbon adsorber exhaust cover, fan, motor and base, carbon, fan and motor enclosure, and interconnecting duct between fan and adsorber, manufacturer's services and all necessary appurtenances to install and assemble the complete system.
- G. The Contractor shall coordinate the work of the system supplier for the installation, interconnection, and testing of the equipment, and the scheduling of the supplier's personnel. The system supplier shall be responsible for assuring himself that this equipment properly meets the functional intent of the specifications.

1.05 SUBMITTALS:

- A. Copies of all materials required to establish compliance with the specifications shall be submitted in accordance with Division 1. Submittals shall include at least the following:
1. A complete parts list denoting the materials of construction.
 2. Drawings showing the general dimensions of all equipment.
 3. Descriptive literature, bulletins, and/or catalogs of the equipment.
 4. The chemical feed pump manufacturer's catalog data sheet including rated capacity and electrical requirements.
 5. The blower manufacturer's catalog data sheets showing rated capacities and electrical requirements.
 6. Data sheets for the spray nozzles showing parts breakdown.
 7. Data on electrical devices and motors in accordance with provisions of Division 16.
 8. A list of the manufacturer's recommended spare parts.
- B. In the event that it is impossible to conform with certain details of the specifications due to manufacturing techniques, describe completely all non conforming aspects.

1.06 MANUFACTURER'S SERVICE AND O&M MANUALS:

- A. Operation and maintenance manuals shall be furnished for the equipment specified herein as provided in Division 1, GENERAL REQUIREMENTS.
- B. The manufacturer shall provide a factory representative for at least one eight hour day, on site, to instruct the Owner's personnel in the proper operation and maintenance of the equipment. This may be done in connection with the required work under Part 3, as acceptable by the Owner.

1.07 SPARE PARTS:

The Contractor shall supply the Owner with spare parts. These spare parts shall be as indicated in the manufacturers submittal.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

- A. The following equipment specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment or application as offered. They are, however, intended to cover the furnishing, delivery, installation, field testing, and field calibration of all materials and equipment as required. Any additional equipment necessary for the proper operation of the proposed installation not specifically mentioned in these specifications and/or shown on the drawings shall be furnished and installed by the contractor.
- B. See Part 1.03 of this specification for sizing and design considerations.

2.02 STAINLESS STEEL CONTACT CHAMBER:

The diluted chemical will be atomized into a forced contact chamber to provide mixing with the odorous air. The spray chamber will be constructed of stainless steel and incorporate a series of fixed media contact packing (force packs). These force packs will be designed to allow the complete utilization of the chemical, reduce the required contact time, and allow the vapor phase reactions to effectively neutralize the odorous air. The chamber shall also incorporate a mist eliminator to prevent the emission of liquid droplets larger than 40 microns to the atmosphere. The spent chemical shall be removed from the chamber by draining through the lower FORCE PACK and dripping back through the chamber's inlet duct to the air source.

2.03 FORCE PACK FIXED MEDIA:

Supply a monolithic media pack consisting of corrugated plates assembled in a rigid unit. The plates shall be oriented such that gas passages intersect and promote centrifugal separation of the airstream with minimum radii of rotation. This action promotes rapid separation of the gas stream by mass and enhances the gas/liquid interface.

2.04 FRP BLOWER:

The blower shall be a vane axial, fume exhauster, Hartzel Model 35-18 GVA EL3, or approved equal, with all FRP housing and wheel specifically designed to handle fumes of a corrosive nature. It shall be a packaged motor and drive configuration to eliminate field-assembly. The blower 18" diameter inlet and outlet shall be flanged and holes shall be drilled to manufacturer's standard specifications. It shall include a straightening vane section to improve the blower efficiency and reduce the horsepower requirement below 7.5 HP. The blower shall be v-belt driven with a 3 phase, 5 HP 60 Hz, 460 V TEFC, motor. The motor and belts shall be covered with an epoxy coated weather cover. The FRP blower shall be rated for operation at 50EC.

2.05 NOZZLE MANIFOLD:

Supply one (1) nozzle manifold mounted in the stainless steel chamber, designed to give complete spray coverage of the top Force pack. The manifold shall be mounted with quick connect fittings for rapid removal and service.

2.06 PRESSURE ATOMIZING NOZZLE:

The atomizing nozzles shall be NuTech supplied model 1/4" N-SS 1.0. The system nozzle manifold shall be supplied with one (1) nozzle. The nozzle shall have a capacity of 1.0 GPH @ 40 PSI and a 45 degree spray pattern.

2.07 LINE STRAINER:

Supply a line strainer, attached to the nozzle manifold at the stainless steel contact chamber to filter the diluted chemical solution prior to the nozzle manifold, and prevent nozzle plugging. The strainer shall be of polypropylene construction with a 100 mesh strainer inside an opaque bowl. The bowl shall be designed to be unscrewed to allow the strainer to be cleaned in place without removing it from the line.

2.08 ELECTRICAL CONTROL PANEL:

- A. The system shall include a control panel for the operation of the blower, controls, and the chemical feed system. The control panel shall be a NEMA 4X enclosure which includes a 460V, 3 phase disconnect, solid state variable speed motor drive with overload protection for the blower motor, an on/off control switch for the blower, a 3-speed selector switch, (3,000 CFM, 1,200 CFM, and 600 CFM), pilot lights, an electrical receptacle for the pump plug in connection, and all of the associated electronics for the control of the system, including a 110 V transformer for the pump motor. The chemical feed pump shall be interlocked with the blower to allow operation only when the blower is operating. The blower shall be designed to operate independently to allow ventilation without chemical addition during low odor periods.
- B. Dry type contacts shall be provided to indicate SYSTEM RUNNING and SYSTEM TROUBLE to the pump station IC panel.
- C. The panel shall be mounted as indicated on the drawings or as directed by the Owner.

2.09 CHEMICAL FEED PUMP:

The diluted chemical solution shall be applied with a magnetically coupled, sealless gear pump. The pump shall have a stainless steel liquid end capable of handling fluids from -50E F to 200EF at flows up to 37 gph @ 0 PSI and differential pressures up to 120 PSI @ 0 GPM. The pump shall be rated for continuous operation at 60 PSI. It shall include an adjustable internal bypass to increase or decrease the flow rate and/or pressure. The pump motor shall be a 1/13 hp chemical feed pump requiring a 2.8 amp/110V/1 phase/60 Hz power supply to the fused control panel. The pump shall plug into a receptacle on the control panel and shall be interlocked with the fan.

2.10 MIX AND DILUTION TANK:

A chemical dilution system shall be supplied, consisting of a 10 gallon HDPE tank equipped with a liquid proportioning level control for automated chemical make-up.

2.11 EQUIPMENT STAND:

A custom corrosion resistant non metallic equipment stand for the tank and chemical feed pump shall be supplied.

2.12 LIQUID PROPORTIONER:

The liquid proportioning level control include a backflow preventer to prohibit chemical flow into the fresh water supply. Water inflow shall be controlled by a float activated magnetic solenoid valve. As water passes through, it shall siphon a measured quantity of chemical concentrate solution. When the tank level is high enough, the solenoid valve shall close and stops the flow of water and chemical. The chemical feed rate shall be controlled through the use of 14 changeable color coded metering tips on the chemical injector which provide dilution rates between 38:1 and 606:1. The injector shall operate from an induced siphon such that the chemical concentrate can be no more than 5 feet below the injector. The only manual operation shall be to maintain a supply of the concentrated chemical.

2.13 CHEMICAL FEED-LINE(S):

The diluted chemical shall be piped to the atomizing nozzles via 1/2" O.D., chemically resistant polyethylene tubing, rated for 150 PSI @ 70E F. In outdoor applications or where the tubing is exposed to sunlight, the black UV-resistant tubing shall be provided.

2.14 AIR FLOW STRAIGHTENING VANE:

Supply a monolithic media pack consisting of corrugated plates assembled in a rigid unit. The plates shall be oriented such that as the gas flow past, all centrifugal or swirl effects from bends or elbows are eliminated.

2.15 AIR FLOW SAIL SWITCH:

The air flow from the fan shall be monitored by a sail type switch. This switch is actuated by a stainless steel "paddle" located in the air stream that operates a micro switch when the air velocity falls below a predetermined amount. This micro switch closure is used for system shutdown.

2.16 DELTA ZERO RAIN CAP:

There will be supplied an 18" diameter exhaust stack, the design of which provides superior rain protection to traditional rain caps and injects the treated airstream into the atmosphere above the building ground effect with minimal increase to the pressure drop in the system. The stack can be fabricated from either stainless steel or FRP. If it is fabricated in FRP, the color of the gel coat can be selected to blend in with the building or roof.

2.17 ROOF CURB ADAPTER, STAINLESS STEEL OR FRP:

There shall be supplied a stainless steel or FRP roof curb adapter. This adapter is flanged to connect to the Delta Zero rain cap above it and constructed to fit over the customer supplied curb. It shall incorporate a 16" long inlet tube extending down through the roof of the building to connect to the discharge of the fan unit via a flexible coupling, and flanged fan discharge 18" stub shaft.

2.18 SECONDARY CONTAINMENT SKID:

The secondary containment skid shall be a pallet type, 90 gallon capacity skid, constructed of cross linked PE. The skid shall have HDPE removable decking.

2.19 REQUIRED UTILITIES:

Water - A potable water supply with a minimum of 30 and a maximum of 60 PSI supply pressure (45 PSI is preferred) is required. The instantaneous flow demand is 4 gpm, but the total maximum water use is 3.0 gph. The standard water connection is a garden type hose, but a 3/8" rigid piping arrangement can be specified.

Electrical - The system requires a 460 v, 10 Amp power supply to run the blower and chemical feed pump.

2.20 CHEMICALS:

- A. The Contractor shall provide 55 gallons of the chemicals specified below, which represents an estimated 6 month plus supply:
- B. NuTralite™ Odor Eliminator - a 100% water soluble, glacial acetic acid based, fast reacting liquid formulation containing aldehydes and -alcohols. The product chemically reacts to neutralize the organic sulfur and nitrogen based odors from domestic sewage. These reactions must be capable of reducing both the dilution-to-threshold ratio and the Butanol intensity level of the odor. The product must be capable of reacting in the vapor phase with a contact time of less than three seconds through construction, combining and interference reactions. The chemical shall prevent the deposition of hard water scale on the nozzle.

2.21 CHEMICAL CONCENTRATE STORAGE TANK/TUBE STRAIGHTENERS:

The chemical shipping container is used as the concentrate storage tank. Two polypropylene drum siphon tube straighteners (1-5 gal & 1-55 gal) are provided to form a vapor seal on the drum and keep the siphon tube properly positioned at the bottom of the container.

PART 3 - EXECUTION

3.01 INSTALLATION:

An Installation, Operation and Maintenance Manual shall be provided which covers assembly of the components. The Contractor shall have the equipment inspected by the manufacturer's representative and the construction manager to ensure proper installation.

3.02 FIELD INSPECTION AND TESTING:

After the interconnecting piping and the interconnecting wiring are completed by the contractor, check out of the final installation, start-up, calibration, and instruction of the operating personnel shall be performed by an authorized representative of the manufacturer familiar with the operation of the ventilation odor control system within the wastewater collection and treatment process.

END OF SECTION

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SECTION 16230

GAS ENGINE DRIVEN GENERATOR

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers the standby gas engine driven generator to be furnished and installed at the site. The unit shall be complete with all equipment specified herein. All components, except as otherwise noted, shall be provided by one supplier and shall be installed by the Contractor.
- B. The principal components of the generator set shall include a gas driven engine, equipped with fuel, exhaust and cooling systems, and a power generator. The unit shall be provided with all controls and appurtenances specified herein or otherwise required to make a complete system.
- C. It shall be the Contractor's responsibility to coordinate with the Gas Utility Company and the generator set manufacturer to verify and ensure that there is sufficient gas volume and pressure available for proper operation of the generator. The Contractor shall furnish and install any equipment and materials necessary to supply the required gas volume and pressure to the generator for startup and operation at full load.

1.02 RELATED WORK:

- A. Excavation, backfill and site work are included in Division 2.
- B. Concrete and concrete reinforcement is included in Division 3.
- C. Electrical work except as specified herein is included in other sections of Division 16.

1.03 SYSTEM DESCRIPTION:

- A. The system shall be arranged to provide automatic standby power upon failure of the normal utility power source.
- B. The generator set shall be capable of continuous standby site rating of not less than 16 kw at 0.8 pf with a 3 phase, 60 Hz, 120/208 volt, alternating current generator.
 - 1. The unit shall be guaranteed to be adequate for starting a loaded, 7.5 hp, 200 volt, 3 phase, Code Letter G, submersible induction motor when already carrying a load of 3 kva at 0.9 pf with a transient voltage dip not to exceed 20 percent of rated voltage.

1.04 UNIT PERFORMANCE:

- A. The unit shall be capable of maintaining 5 percent frequency variation from no load to full load.
- B. Voltage regulation shall be as defined in Section 1.03, and recovery to steady state operation shall be within two seconds.
- C. Stable or steady state operation is defined as operation with the frequency variation not exceeding plus or minus 1.0 percent or 3 Hertz and voltage variation plus or minus one percent of their mean value for constant load from no load to full rated load. A rheostat shall provide a minimum of plus or minus 5 percent voltage adjustment from rated voltage.

1.05 QUALITY ASSURANCE:

- A. All equipment shall conform to the following criteria:
 - 1. Equipment shall be manufacturer's standard products presently in commercial production.
 - 2. All equipment specified under this Section shall be furnished by a single supplier and shall be products of manufacturers regularly engaged in the production of internal combustion engines. The supplier shall have the sole responsibility for proper functioning of the complete standby power generator.
 - 3. Any reference to a specific manufacturer or model number is for the purpose of establishing a quality or parameter for specification writing and is not to be considered proprietary. In all cases any source or device that has the quality and operating capabilities specified may be acceptable.
 - 4. The generators shall conform to requirements for materials, installation and equipment approvals of state, local, Underwriter's Laboratories, Inc., or other applicable codes, whether or not called for in detail on the drawings or in the specifications.
 - 5. Workmanship shall be first class in all respects.
 - 6. The use of unspecified materials shall be based on their continuous and successful employment under similar conditions, as called for in this section.
- B. MANUFACTURER'S QUALIFICATIONS:
 - 1. Upon request from the Owner, the generator set manufacturer shall demonstrate proof of financial responsibility with respect to performance and delivery date.

2. Upon request from the Owner, the generator set manufacturer shall provide proof or evidence of facilities, equipment and skills required to produce the equipment specified herein.
3. In addition to requirements set forth in Section 01030 under "Service of Manufacturer's Representative," the manufacturer shall provide the supervisory service of a factory trained engineer, who is specifically trained on the type of equipment supplied, to assist in installation of supplied equipment and related appurtenances, to provide initial startup of each unit and to instruct the Owner's operating personnel in the operation and maintenance of the equipment.

C. Field acceptance tests shall be performed as specified in Part 3 Execution.

1.06 REFERENCES:

A. The latest editions of the following standards form a part of this specification:

1. 527 CMR 12.00: Massachusetts Electrical Code.
2. NEMA: MG1

1.07 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. SHOP DRAWINGS AND PRODUCT DATA:

1. Shop drawings including manufacturer's data sheets, showing illustrated catalog cuts of the item(s), scale details, sizes, dimensions, capacities, performance characteristics, wiring diagrams, controls, and other pertinent information shall be submitted to the Owner for review. If more than one size or type is shown, the proposed item shall be clearly indicated.
2. Drawings showing complete skid mounted unit with all connections to off-skid items clearly shown. Foundation plan for skid-mounted unit and showing foundation bolt locations and details for the spring type vibro isolators. Drawings, descriptive data and brochures of each item of equipment.
3. Provide data on the characteristics and performance of the unit on the form provided at the end of this section.
4. Furnish four (4) copies of the manufacturers certified shop test record for the complete engine driven generator unit. The final test record shall show the generator set performance compared to what is required.
5. Provide the total weight of each item of equipment including the weight of the single largest component of each item.

6. Provide a complete total bill of materials for all equipment.

B. DESIGN DATA:

1. Provide complete wiring diagrams and schematics of all controllers, control panels, control devices, and operators stations furnished under this Section.
2. Provide complete wiring diagrams and schematics of all power and control systems including connection to work of other Sections.

C. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

D. OPERATION AND MAINTENANCE INSTRUCTIONS:

The generator set manufacturer shall be responsible for supplying written instructions which shall be sufficiently comprehensive to enable the operator to operate and maintain all equipment supplied.

The instructions shall be included by the manufacturer, in the appropriate project systems manual which is applicable solely to the project and the equipment supplied under these specifications and shall include only the devices and equipment supplied by him.

The instructions shall include, but not be limited to, the following:

1. Description of, and operating instructions for, each major component of equipment supplied.
2. Instructions for operation of the generators in all intended modes of operation.
3. Instructions for all adjustments which must be performed at initial startup and in the course of preventive maintenance as specified by the manufacturer.
4. Instructions for the adjustment, calibration, and testing of selected electronic components or assemblies, normally considered replaceable by the manufacturer, whose performance is not ascertainable by visual inspection.
5. Electrical schematic diagram prepared in accordance with NMTBA and JIC standards. Wire numbers shall be shown on the schematic. Schematic diagrams for electronic equipment, the detail parts of which are not normally repairable by the operator, need not be included, and shall not be substituted for an overall schematic diagram. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall schematic diagram.
6. Operation and maintenance instructions shall be specific to the equipment supplied

in accordance with these specifications. Instruction manuals applicable to many different configurations and which require the operator to selectively read portions of the instructions, will not be acceptable.

1.08 DELIVERY, STORAGE, AND HANDLING:

A. SHIPPING:

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
2. Pack spare parts on containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Deliver spare parts at same time as pertaining equipment. Deliver to the Owner after completion of work.

B. Receive, store, and safeguard equipment, materials, and spare parts at the job site.

1.09 WARRANTY:

A. The Contractor shall be responsible for obtaining the manufacturer's warranty providing that the supplied equipment shall be of quality construction, free from defects in material and workmanship. The warranty shall include specific details as follows:

1. The equipment, apparatus, and parts furnished shall be warranted for a period of 5 years, excepting only those items that are normally consumed in service, such as oil, grease, packing, gaskets, O-rings, etc. The generator set manufacturer shall be solely responsible for the warranty of all components.
2. Components failing to perform as specified by the Owner, or as represented by the manufacturer, or proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost to the Owner for parts or labor.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Onan Corp.
- B. Kohler Company
- C. Caterpillar, Inc.
- D. An acceptable equivalent manufacturer.

2.02 SYSTEMS:

A. FUEL SYSTEM:

1. Natural gas fuel system shall be provided and shall include the following items:
 - a. Natural gas carburetor with secondary fuel regulator designed to provide operation at full load with fuel pressure available at each site.
 - b. Fuel strainer to protect the fuel solenoid valve and carburetor at the engine.
 - c. Automatic fuel shutoff solenoid valve.
 - d. Seamless metal braid protected flexible fuel connectors, approved for use in Massachusetts.

B. ENGINE COOLING SYSTEM:

1. Radiator Cooled System:
 - a. The engine shall be equipped with an engine driven blower or pusher type fan, a unit mounted radiator cooling system complete with a unit mounted radiator, circulating water pump, bypass thermostat, and radiator belt guard. The radiator shall be supplied to operate in an ambient temperature of 110°F.
 - b. The cooling system shall be filled with a 50 percent solution of glycol and water.

C. EXHAUST SYSTEM:

1. A high degree, critical exhaust silencer shall be suitably mounted on the generator set enclosure and connected with the engine by suitable seamless (not interlocking) stainless steel flexible connector which can withstand exhaust gas temperature that may be encountered. The exhaust silencer and its supporting brackets shall be constructed of heavy gauge aluminized steel. All exhaust pipe, elbows, reducers and fittings shall be Schedule 40 steel as shown on the drawings. The flexible connection, exhaust silencer and exhaust pipe shall be sized by the generator manufacturer. A data sheet showing octave band center frequency in Hertz shall accompany all silencer shop drawings.

2.03 EQUIPMENT:

A. GOVERNOR:

1. The engine shall be equipped with a governor capable of maintaining the engine

speed from no load to full load within 5 percent of the synchronous speed.

B. STARTING SYSTEM:

1. The engine shall have a 12V DC starting system with one starting motor and starter solenoid switch.
2. Battery - one starting battery with cables and steel battery rack, shall be included. Battery shall be heavy duty lead acid type, sized to provide a minimum of 60 seconds of continuous cold cranking.
3. Float type battery charger shall be supplied to maintain the starting batteries at full charge. The charger shall be unit mounted and shall have a cranking disconnect relay or current limiting feature. Battery charger shall include high and low battery voltage alarm relays. Charger shall be equal to LaMarche A46-10-12.
4. There shall be a belt driven battery charging alternator with regulator and charge rate ammeter for charging the batteries while the engine is running.

C. ENGINE INSTRUMENTATION:

1. The following engine instruments shall be included in the generator control panel:
 - a. Lube oil pressure
 - b. Water Temperature
 - c. D.C. ammeter

Any other instruments considered necessary by the manufacturer shall also be included.

D. SAFETY SHUTDOWNS:

1. The engine shall shutdown on any of the following conditions:
 - a. Low lube oil pressure.
 - b. High jacket water temperature.
 - c. Overspeed.
 - d. Overcrank.
2. Provide common contact to close on any derangement.

E. HEATERS:

1. For radiator cooled engines, one engine jacket water heater shall be provided, if required, to maintain the engine jacket water at a temperature high enough to assure starting the engine and attaining rated voltage and frequency within 10 seconds. The jacket heater shall be of the capacity recommended by the generator set manufacturer to meet the above conditions. Input voltage to the heater shall be 120 volt, single phase, 60 Hertz.

F. MOUNTING:

1. The engine and generator shall be close coupled and mounted on a structural steel base designed to maintain proper alignment of the unit.
2. The unit shall be certified by the manufacturer to be free from any critical torsional vibrations within a range of plus or minus 10 percent of synchronous speed.
3. Vibration isolators of the spring pad type shall be supplied with the unit. The number of isolators shall be as recommended by the generator set manufacturer.
4. Vibration isolators shall be Korfund MM series or approved equal.

G. GENERATOR:

1. Minimum rating shall be as designated in Section 1.03.
2. The brushless alternator shall be a 4 pole, revolving field design with temperature compensated solid state voltage regulator and brushless rotating rectifier exciter system. No brushes will be allowed. The stator shall be directly connected to the engine fly wheel housing, and the rotor shall be driven through the semiflexible driving flange to ensure permanent alignment. The insulation system shall be Class F as defined by NEMA MG1 1.65.
3. Exciter shall be full phase, full wave rectified, with heavy duty silicon diodes mounted on the common rotor shaft and sized for maximum motor starting loads.
4. Voltage Regulation - Plus or minus one percent of any preset value over the load range. Instantaneous voltage dip or rise when measured with an oscilloscope, will not exceed 10 percent upon full load application or rejection, and will return to preset value within 2 seconds.
5. Waveform - Deviation factor of output voltage shall not exceed five percent and the value of any individual harmonic shall not exceed two percent of the fundamental when operating with unbalanced load.

6. Temperature Rise - Temperature rise of any component shall not exceed 100°C at 40°C ambient.
7. Rotor - One (1) piece laminations welded and secured to the shaft by a key and press fit. Amortisseur windings shall be installed and connected between poles as an aid to parallel operation and improved wave form during unbalanced loads. Field coils shall be machine wound on insulated pole bodies and be securely braced. Rotor shall be statically and dynamically balanced.
8. Stator - One (1) piece laminations welded together. Stator coils form-wound and placed in insulated slots. Stator pressed and welded in a rigid steel frame.
9. Bearing - Double sealed ball bearing, lubricated for life.
10. Insulation - NEMA Class F insulation.
11. Varnish - Three (3) coats modified polyester type, shall not support fungus growth.
12. Cooling - Cast aluminum fan mounted on generator shaft.
13. Radio Suppression - Radiated or conducted radio interference shall not affect normal commercial apparatus.

H. CONTROLS:

1. The engine generator set shall include a combination engine and generator control panel, shock mounted at the generator end of the unit. This control panel shall include (but not be limited to) the following:
 - Water temperature gauge
 - Oil pressure gauge
 - D.C. battery charge rate ammeter
 - A.C. voltage regulator
 - Voltage adjusting rheostat
 - A.C. voltmeter, 3-1/2 inch diameter, 2 percent accuracy
 - A.C. ammeter, 3-1/2 inch diameter, 2 percent accuracy
 - Combination VM/AM phase selector switch
 - Frequency meter, 3-1/2 inch diameter
 - Elapsed time meter, 3-1/2 inch diameter
 - Automatic cycle cranking start/stop control with fault indicating lights and corresponding safety switches for:
 - Low oil pressure (alarm and shutdown)
 - Overcrank protection (alarm and shutdown)
 - High water temperature (alarm and shutdown)
 - Overspeed (alarm and shutdown)

Selector switch, "off-auto-manual", with flashing light indicating switch off or not in auto

Relay with 120 volt, 10 ampere, SPDT contact to operate when engine running for damper interlocks

Common contact to close any fault condition for remote alarm

Panel lamps with switch

2. The control shall be designed to start the engine upon closure of a remote contact, arm alarm safeties, and shutdown the engine when the remote contact is reopened.
3. The control shall be manually reset following any fault condition.
4. Control power shall be from the engine start battery.
5. In addition to the equipment included in the control panel described above, the generator shall include a power and control junction box mounted on the side of the generator. This junction box shall include:
 - a. Power conductors terminated with pressure type ring connectors.
 - b. Grounding Lug
 - c. Terminal block with marked connection points for all external connections and for jacket heaters, etc.
 - d. Molded case line circuit breaker.

2.04 SPARE PARTS AND SPECIAL TOOLS:

- A. One set of all special tools per unit that are required for the normal operation and maintenance of the engine driven generator unit shall be furnished.
- B. The spare parts to be furnished shall include, but not be limited to, the following items per unit.
 1. One set of air filter elements
 2. One set of lube oil filter elements
 3. One thermostat with thermostat housing gasket
 4. One set of hoses and belts including one of each different size and type.
 5. One set of fuses including one of each different size and type.

- C. The spare parts shall be packed in containers, permanently labeled with work and part number and for use only for the "standby generator units." Parts shall be properly packed for an extended period of storage before use.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The generator manufacturer shall supply the services of a factory representative to check over the completed generator installation to the satisfaction of the Owner. If the Contractor does not have a qualified engine and generator representative on the job during the installation, the Owner may direct him to provide the services of a factory representative to give the necessary instructions to insure a proper installation.
- B. The complete generator unit shall be mounted on a welded steel subbase of sufficient rigidity and strength to maintain alignment of the unit. The base shall be suitable for mounting the unit on a level concrete pad. The neoprene pad type vibro-isolators shall be supplied by the generator unit manufacturer.
- C. To facilitate sound attenuation, the unit shall be oriented with the fan and exhaust facing away from the nearest residence.

3.02 PAINTING:

- A. The engine generator set and associated equipment shall be shop primed and finish coated in accordance with the manufacturer's standard practice prior to shipment. Color shall be selected by the Owner and an adequate supply of touchup paint shall be supplied by the manufacturer.

3.03 SHOP TEST:

- A. The complete generator unit with its associated equipment shall be shop tested and the test record reviewed by the Owner prior to shipment of the unit.
- B. The shop test shall consist of a minimum of three hours of full load operation at rated power factor. In addition, voltage and frequency regulation shall be tested and recorded to show full compliance with this Specification. The respective values at which each of the automatic shutdown devices stopped the engine shall also be tested and recorded.

C. During the shop test, readings shall be taken and recorded every thirty minutes for each of the following:

1. Time
2. Volts for each phase
3. Load
 - a. Amps for each phase
 - b. KW
4. Frequency
5. Engine jacket water temperature
6. Lubricating oil pressure

3.04 FIELD TEST:

- A. After installation of all equipment has been completed and as soon as conditions permit, the unit shall be subject to an acceptance test under actual operating conditions to determine that the unit operates satisfactorily without overheating of any part and that it is free of excessive vibration throughout the entire range of speed and load. The test shall also include octave band sound pressure level readings.
- B. Before performing the field tests, Contractor shall submit for the Owner's review a copy of the proposed log sheet which shall be used to record the load and all corresponding temperatures and pressures. The test shall consist of four hours of operation at full load. A portable load bank shall be used to simulate full load.
 1. The following readings shall be taken and recorded at 15 minutes intervals over the four hour test period.
 - a. Engine Jacket Water Temperature
 - b. Sound Level at 25 feet
 - c. Oil Pressure
 - d. Battery Charge Rate
 - e. A.C. Volts
 - f. A.C. Amps (all legs)
 - g. Engine Air Exhaust Temperature
 2. A second test shall be performed utilizing available connected load.
- D. The generator unit manufacturer's service representative shall be present during the field test.
- E. All field tests shall be performed to the satisfaction of the Owner without additional cost to the Owner.

ENGINE GENERATOR CHARACTERISTICS AND PERFORMANCE DATA
(To Be Submitted Under Paragraph 1.07A.3)

A. ENGINE DATA:

1. Manufacturer
2. Model number
3. Number of cylinders
4. R.P.M.
5. Bore x stroke
6. Rated capacity B.H.P.
7. B.M.E.P. at rated K.W.
8. Piston speed, feet per minute
9. Make and model of governor
10. B.H.P. required for radiator fan

B. GENERATOR DATA:

1. Manufacturer
2. Model number
3. Rated KVA
4. Rated KW
5. Voltage
6. Temperature rise above 40 degrees C ambient
 - a. Stator thermostat
 - b. Field by resistance
 - c. Class of insulation

C. Generator efficiency including excitation losses at rated power factor.

1. Full load
2. 3/4 load
3. 1/2 load

D. GUARANTEED FUEL CONSUMPTION RATE:

1. Full load CF/H
2. 3/4 load CF/H
3. 1/2 load CF/H

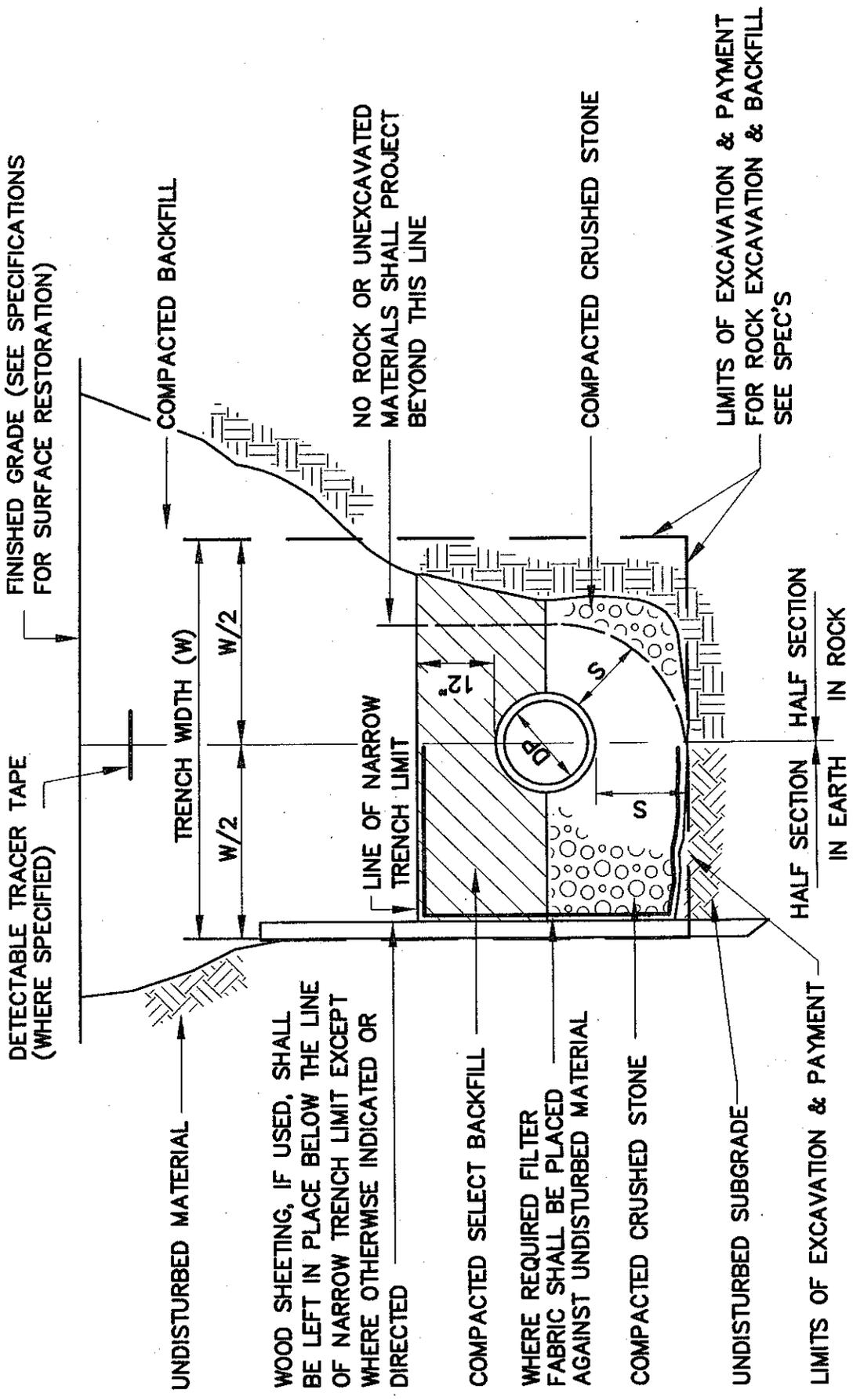
E. GENERATOR UNIT AND ACCESSORIES:

1. Weight of skid mounted unit
2. Overall length
3. Overall width
4. Overall height
5. Exhaust pipe size
6. C.F.M. air required for combustion and ventilation ----- C.F.M.
7. Heat rejected to room by engine and generator (B.T.U./HR)
8. Height from bottom of skid required for removing piston with connecting rod, also for removing cylinder liner.
9. Is the unit guaranteed to be adequate for motor starting as required by Section 1.03 of this Specification. Yes --. No --.
10. C.F.M. capacity and BHP required by radiator fan.

END OF SECTION

APPENDIX A

STANDARD DETAILS



DETECTABLE TRACER TAPE
(WHERE SPECIFIED)

FINISHED GRADE (SEE SPECIFICATIONS
FOR SURFACE RESTORATION)

UNDISTURBED MATERIAL

TRENCH WIDTH (W)

COMPACTED BACKFILL

WOOD SHEETING, IF USED, SHALL
BE LEFT IN PLACE BELOW THE LINE
OF NARROW TRENCH LIMIT EXCEPT
WHERE OTHERWISE INDICATED OR
DIRECTED

NO ROCK OR UNEXCAVATED
MATERIALS SHALL PROJECT
BEYOND THIS LINE

COMPACTED SELECT BACKFILL

WHERE REQUIRED FILTER
FABRIC SHALL BE PLACED
AGAINST UNDISTURBED MATERIAL

COMPACTED CRUSHED STONE

COMPACTED CRUSHED STONE

LIMITS OF EXCAVATION & PAYMENT
FOR ROCK EXCAVATION & BACKFILL
SEE SPEC'S

UNDISTURBED SUBGRADE

HALF SECTION IN EARTH HALF SECTION IN ROCK

LIMITS OF EXCAVATION & PAYMENT

NOTE:

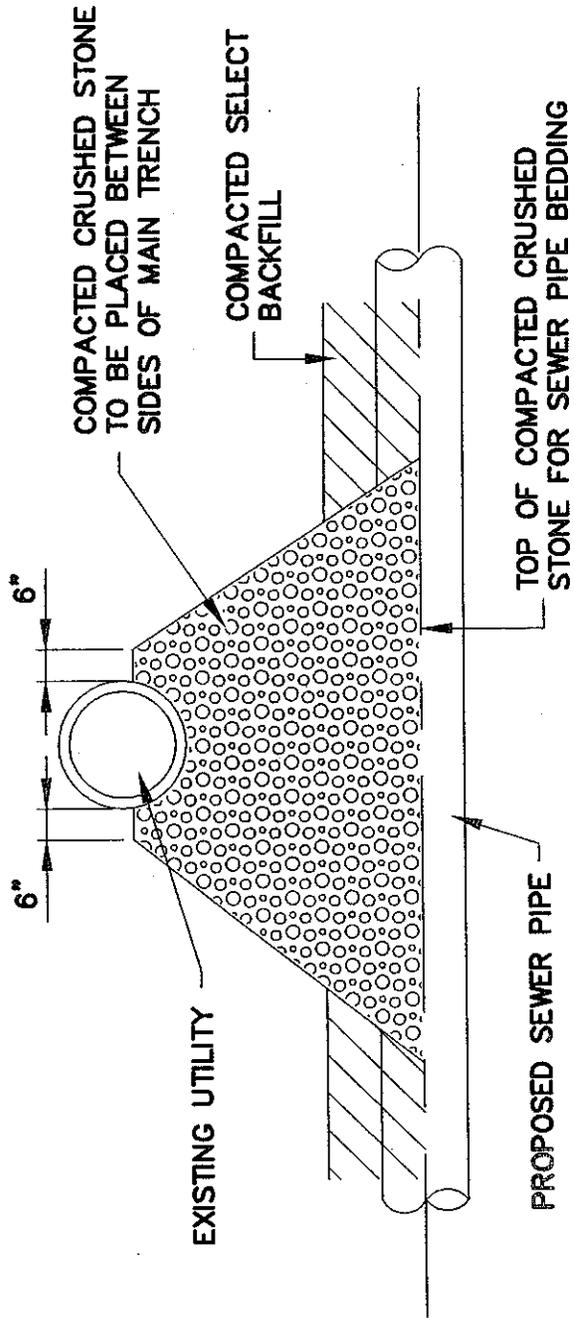
FOR W, DP, & S, SEE TABLE A

TRENCH DETAIL

(SEWER, FORCE MAIN, STORM DRAIN)
N.T.S.

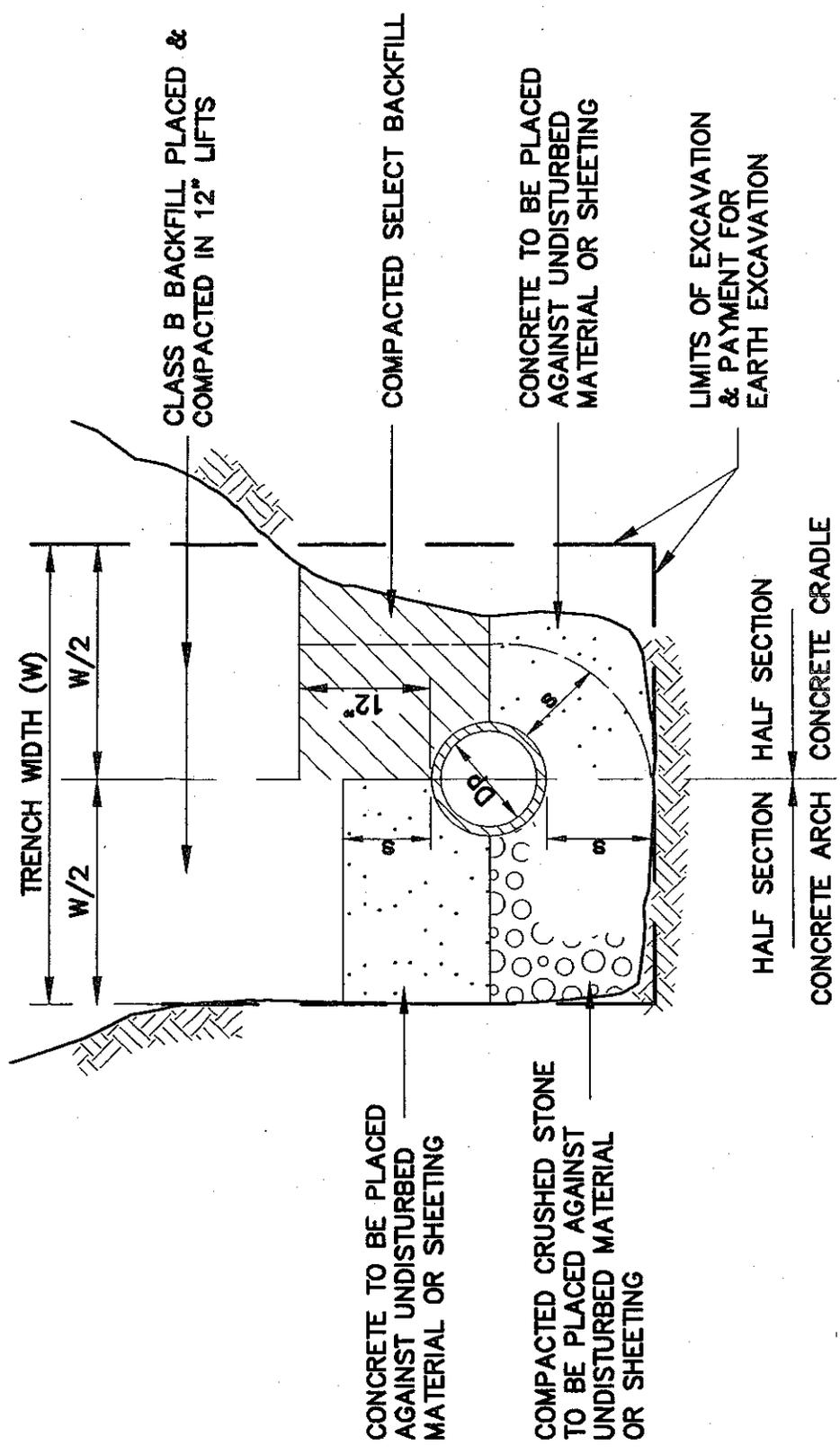
DEPTH TO INVERT	DIAMETER OF PIPE (DP)	MAXIMUM TRENCH WIDTH BELOW LINE OF NARROW TRENCH LIMIT (SHEETED OR UNSHEETED) (W)	MINIMUM CLEARANCE (S)
0-12'	TO 18"	5'	6"
0-12'	21"-24"	5'	7-1/2"
OVER 12'	TO 18"	7'	6"
OVER 12'	21"-24"	7'	7-1/2"

TABLE A



UTILITY CROSSING DETAIL

N.T.S.

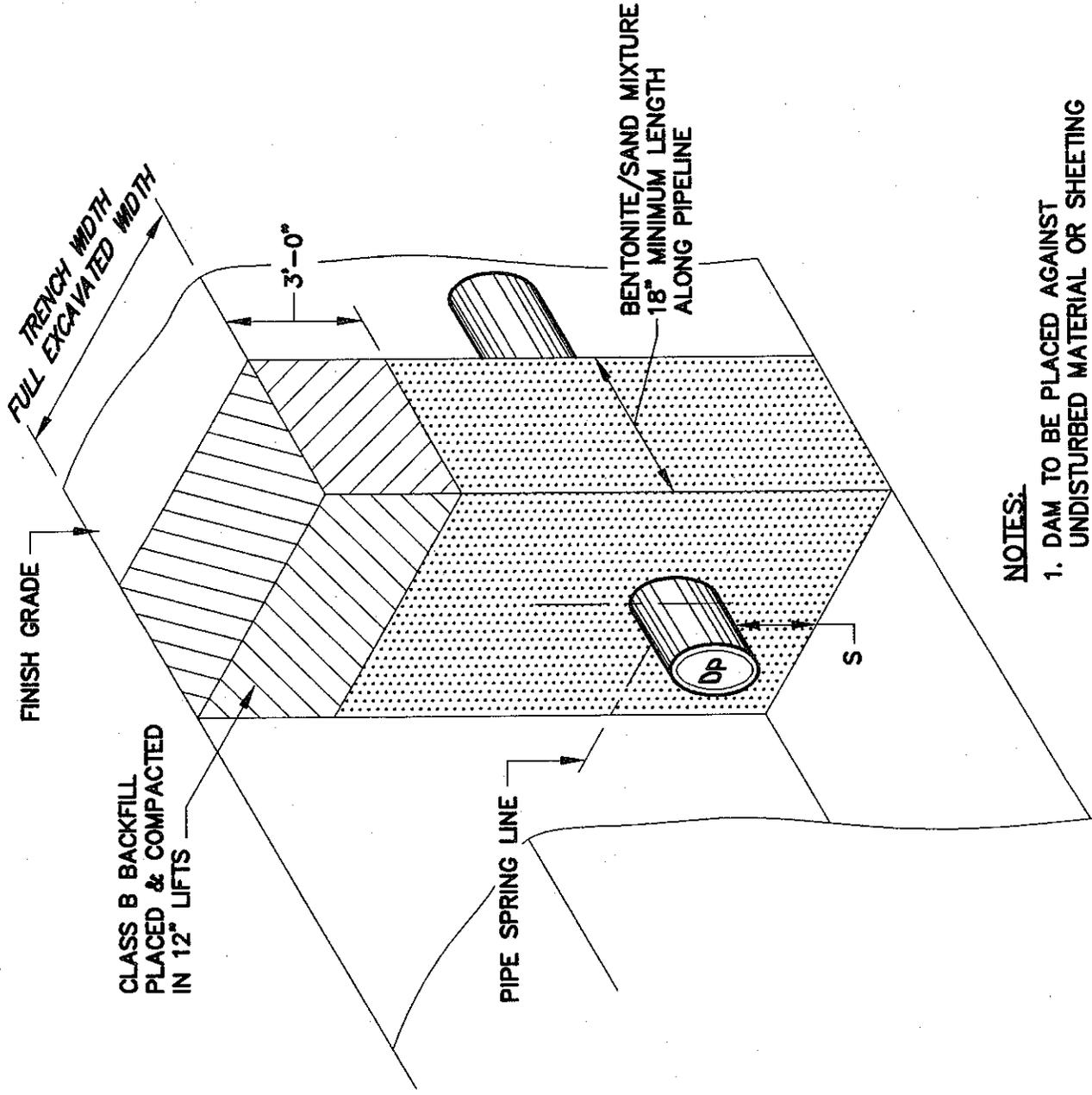


NOTE:

1. IF CONCRETE ENCASEMENT IS REQUIRED, CONCRETE OF MINIMUM THICKNESS 'S' SHALL BE PLACED ALL AROUND PIPE.
2. SEE TABLE A FOR W, S, & DP DIMENSIONS.

CONCRETE ARCH & CRADLE

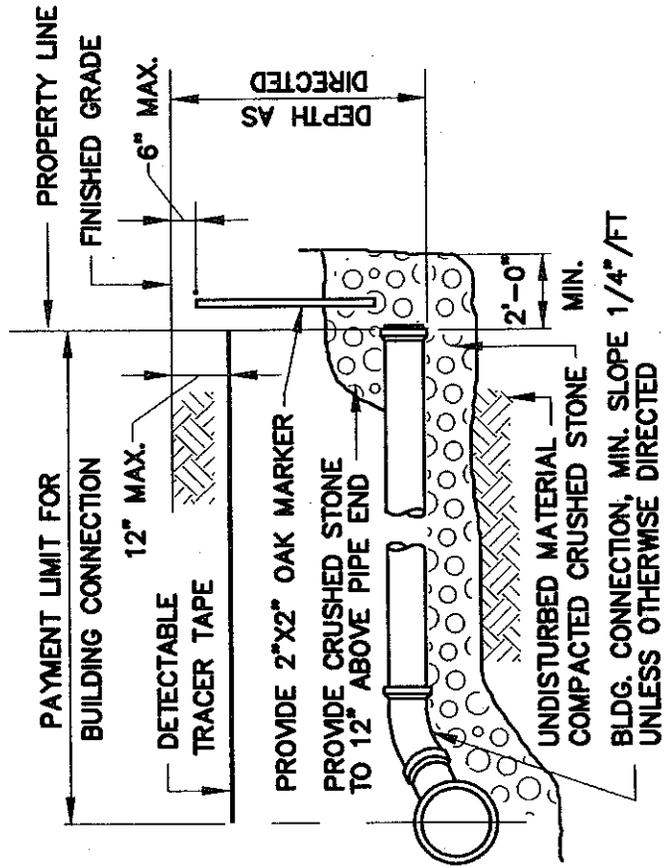
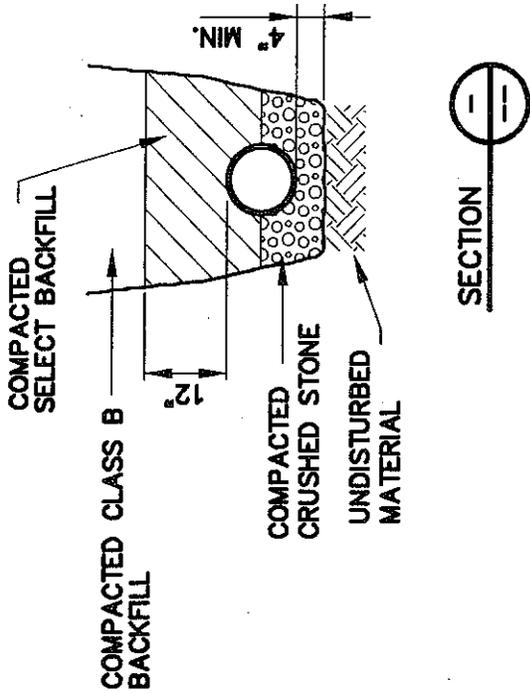
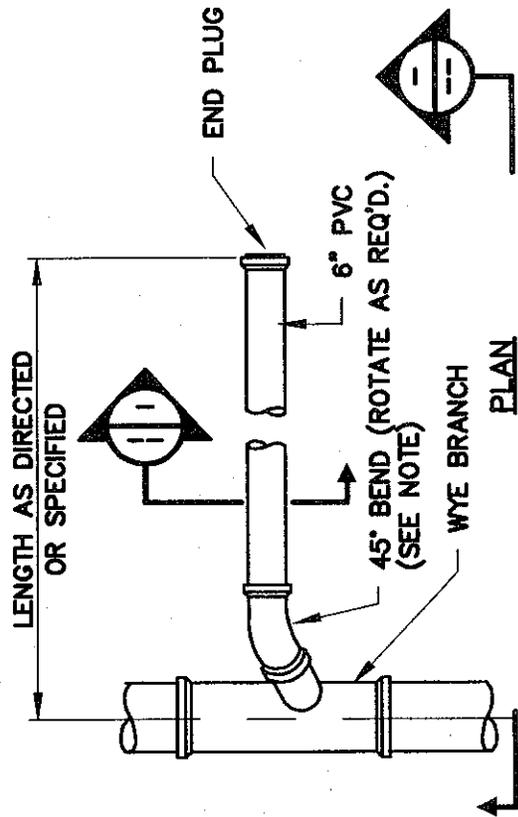
N.T.S.



NOTES:

1. DAM TO BE PLACED AGAINST UNDISTURBED MATERIAL OR SHEETING
2. SEE TABLE A FOR S & D.P. DIMENSIONS
3. SEE BENTONITE DAM SPECIFICATION SECTION 02347

BENTONITE DAM DETAIL
N.T.S.

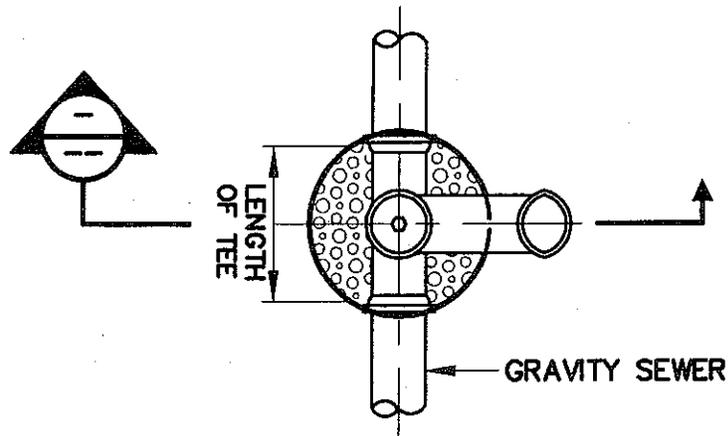


NOTE:

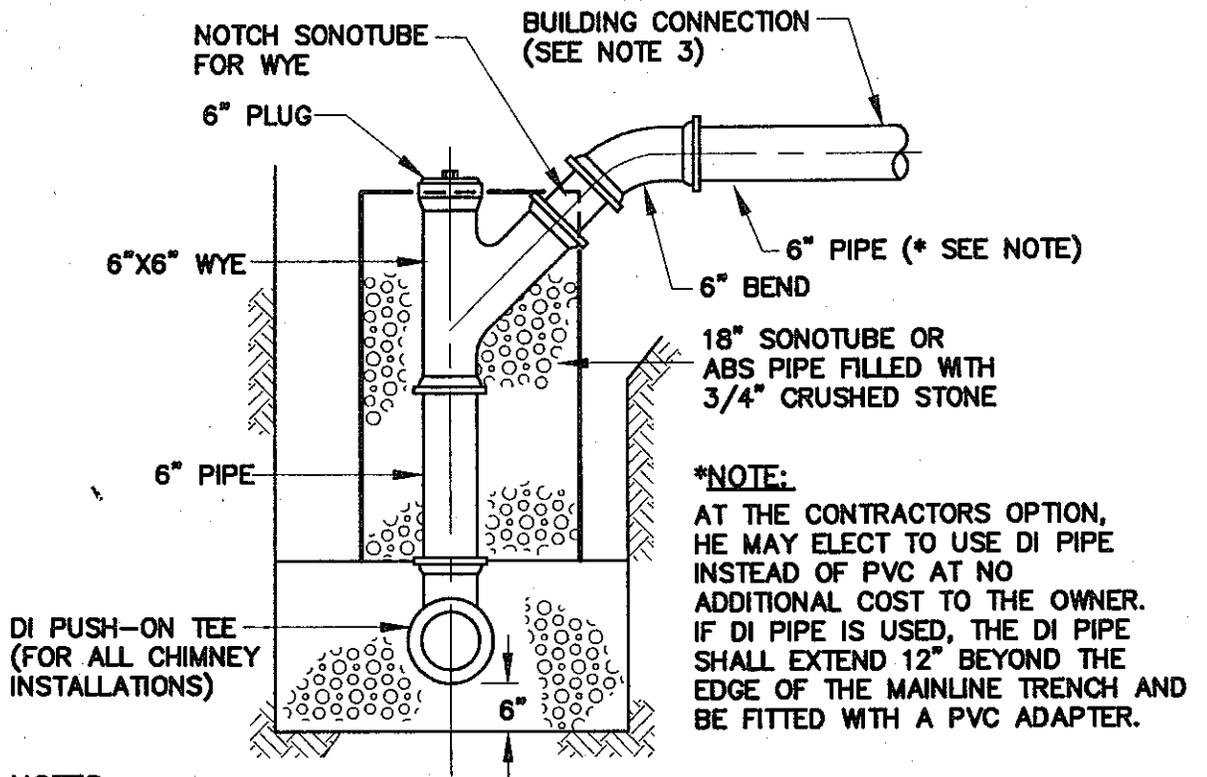
BE SURE THAT END OF BELL ON WYE BRANCH DOES NOT RUB ON UNDERSIDE OF 45° BEND.

SECTION

TYPICAL BUILDING CONNECTION DETAIL
N.T.S



PLAN VIEW



***NOTE:**

AT THE CONTRACTORS OPTION, HE MAY ELECT TO USE DI PIPE INSTEAD OF PVC AT NO ADDITIONAL COST TO THE OWNER. IF DI PIPE IS USED, THE DI PIPE SHALL EXTEND 12" BEYOND THE EDGE OF THE MAINLINE TRENCH AND BE FITTED WITH A PVC ADAPTER.

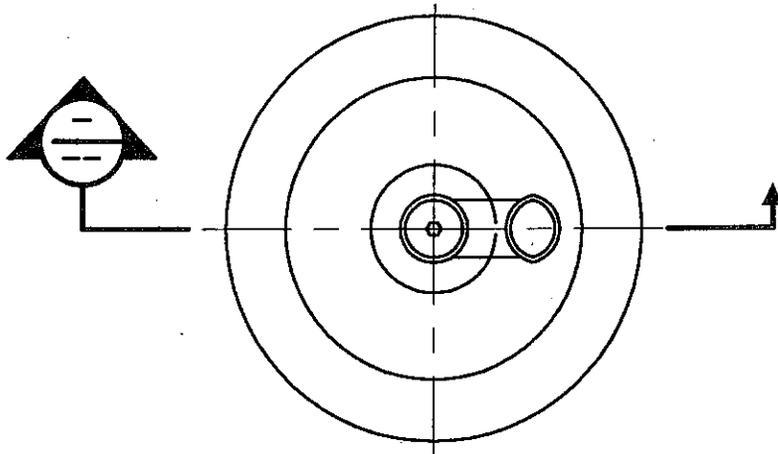
NOTES:

1. MINIMUM HEIGHT OF CHIMNEY FOR PAYMENT, REFER TO SPECIFICATION SECTION 01270
2. MINIMUM COVER OVER THE BUILDING SERVICE SHALL BE 5'-0"

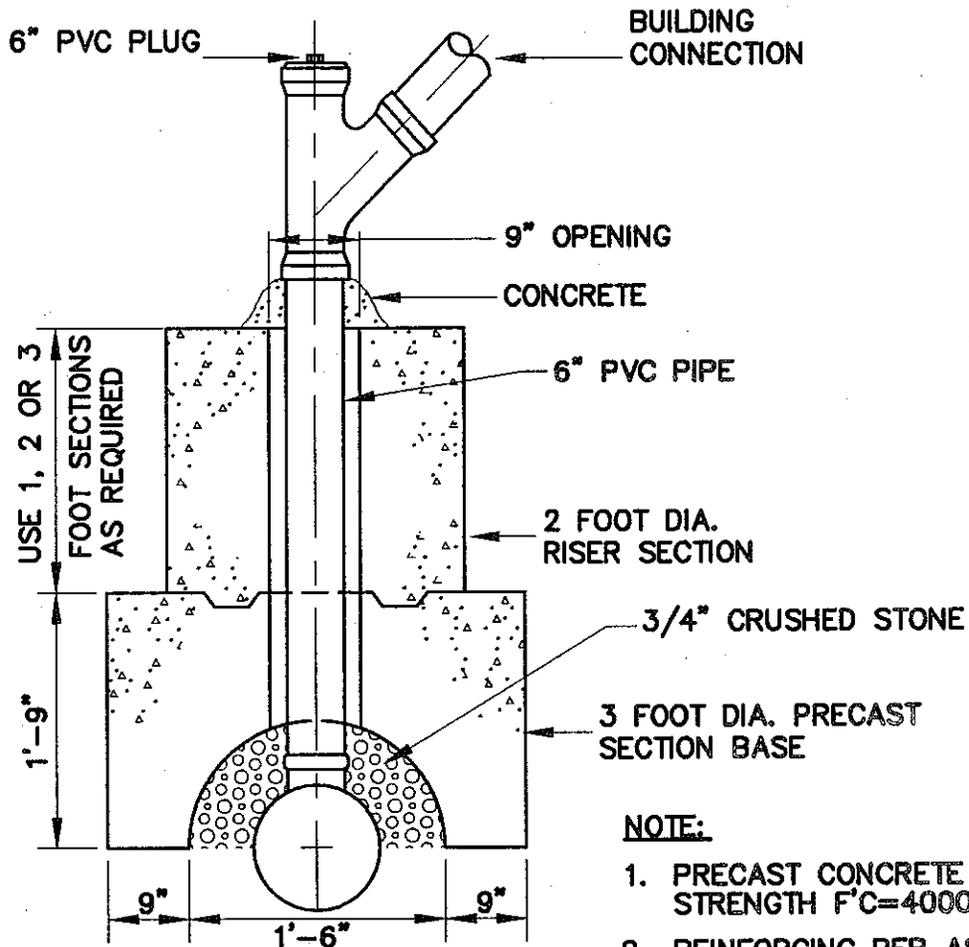
SECTION -

CHIMNEY DETAIL FOR SEWER

N.T.S.



PLAN VIEW (CONCRETE OMITTED)



NOTE:

1. PRECAST CONCRETE STRENGTH F'C=4000 PSI
2. REINFORCING PER ASTM A185
3. LIVE LOAD AASHTO HS20-44

SECTION -
PRECAST CHIMNEY FOR
8-12" SEWER MAIN

N.T.S.

ADJUST TO REQUIRED GRADE
WITH A MIN. OF ONE COURSE
AND A MAX. OF FIVE COURSES
OF BRICK MASONRY OR
REINFORCED CONC. GRADING
RINGS, ALL BRICKS TO BE
LAID AS HEADERS

2'-0" UNLESS OTHERWISE INDICATED

PRECAST CONCRETE
MANHOLE CONE

BUTYL RUBBER JOINT
SEALANT (TYP)

REINFORCING STEEL (TYP)

PRECAST CONCRETE
MANHOLE RISER

MANHOLE STEPS
SEE SPEC'S

PRECAST CONCRETE
MANHOLE BASE

BRICK MASONRY INVERT

CONCRETE FILL

COMPACTED
CRUSHED STONE

MANHOLE FRAME & COVER, SEE SPEC'S

FINISHED GRADE, SEE PLAN

MORTAR ALL AROUND

8" MIN.

12" (TYP)
2' TO 5' IN
6" INCREMENTS
COMBINATION OF
1, 2, 3 OR 4'
LENGTHS

PAYMENT LIMIT FOR MANHOLE WALLS AND CONES

5" MIN.

4'-0" DIA.

MANHOLE SEAL
SEE DETAIL

PRECAST CONCRETE
MANHOLE BASE

BRICK MASONRY INVERT

CONCRETE FILL

COMPACTED
CRUSHED STONE

1" WASH
(TYP)

0.8XD

TYP. STUB
WITH PLUG

6" MIN.

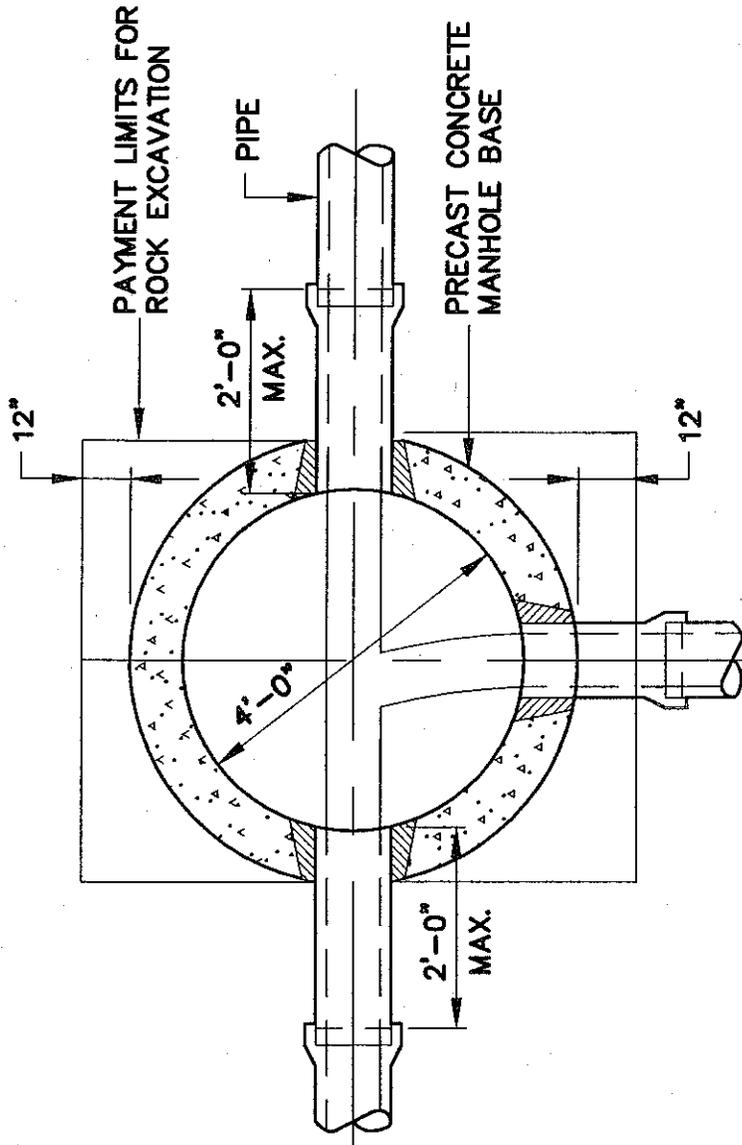
5" MIN.

6" MIN.

UNDISTURBED MATERIAL

**4'-0" DIA. PRECAST
CONCRETE MANHOLE DETAIL**

N.T.S.



4'-0" DIA. MANHOLE PLAN

N.T.S.

ADJUST TO REQUIRED GRADE WITH A MIN. OF ONE COURSE AND A MAX. OF FIVE COURSES OF BRICK MASONRY OR REINFORCED CONC. GRADING RINGS, ALL BRICKS TO BE LAID AS HEADERS

2'-0" UNLESS OTHERWISE INDICATED

PRECAST CONCRETE MANHOLE CONE

BUTYL RUBBER JOINT SEALANT (TYP)

REINFORCING STEEL (TYP)

PRECAST CONCRETE MANHOLE RISER

MANHOLE STEPS SEE SPEC'S

PRECAST CONCRETE MANHOLE BASE

TYP. PIPE STUB W/ PLUG OR BULKHEAD

MANHOLE SEAL SEE DETAIL

CONCRETE FILL

COMPACTED CRUSHED STONE

UNDISTURBED MATERIAL

MANHOLE FRAME & COVER, SEE SPEC'S

FINISHED GRADE, SEE PLAN

MORTAR ALL AROUND

8" MIN.

12" (TYP)

COMBINATION OF 1,2,3, OR 4' LENGTHS

4'-0" ϕ

5" MIN.

PAYMENT LIMIT FOR MANHOLE WALLS AND CONES

SEE TABLE FOR WALL THICKNESS

5'-0" ϕ OR LARGER

BRICK MASONRY INVERT

1" WASH

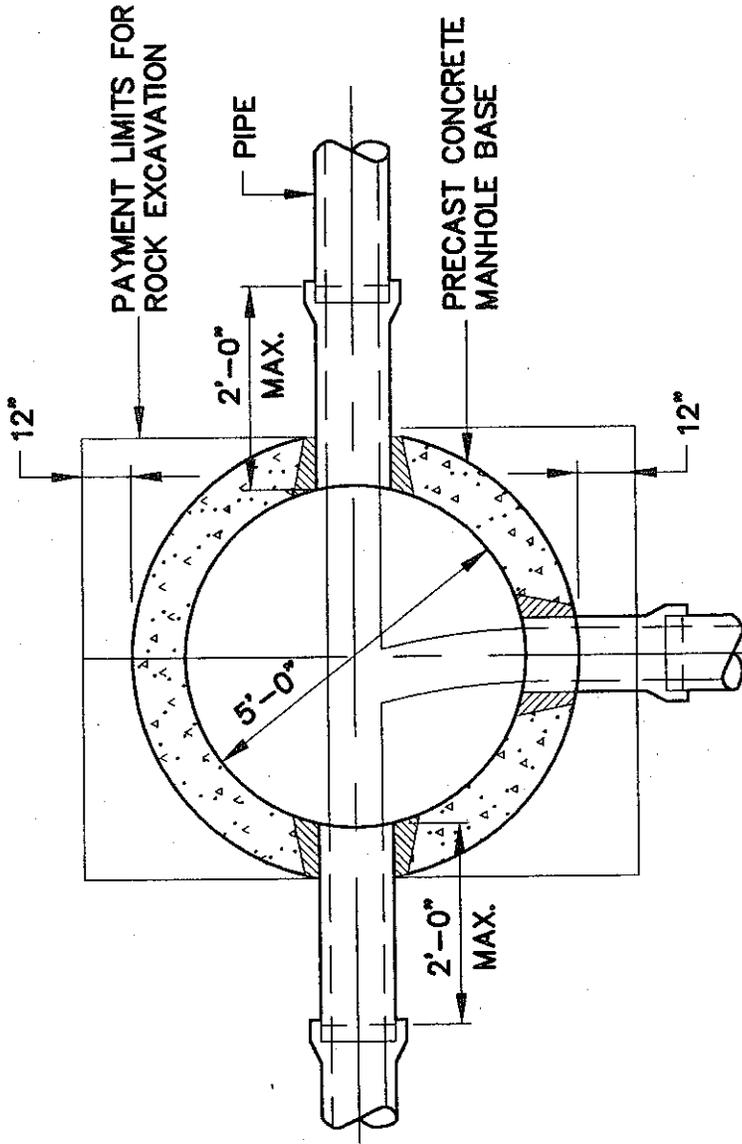
8" MIN.

6" MIN.

MH DIA.	MINIMUM WALL THICKNESS
5 FOOT	6 INCH
6 FOOT	7 INCH
7 FOOT	8 INCH
8 FOOT	9 INCH

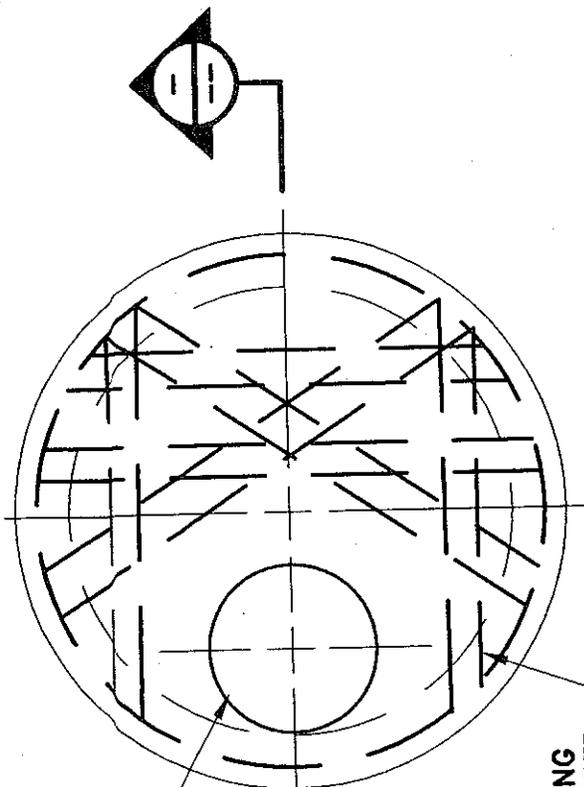
**5'-0" DIA. OR LARGER
PRECAST CONCRETE MANHOLE DETAIL**

N.T.S.



5'-0" DIA. MANHOLE PLAN

N.T.S.



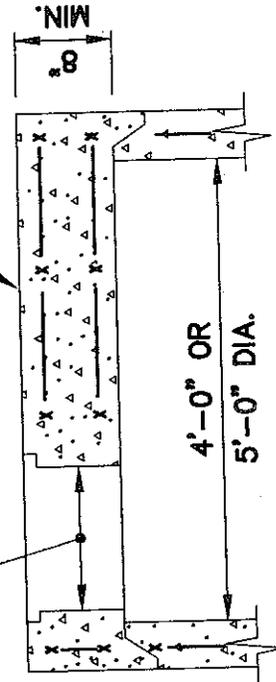
OPENING TO SUIT
FRAME & COVER

STEEL REINFORCING
TO MEET OR EXCEED
H-20 LOADING

PLAN

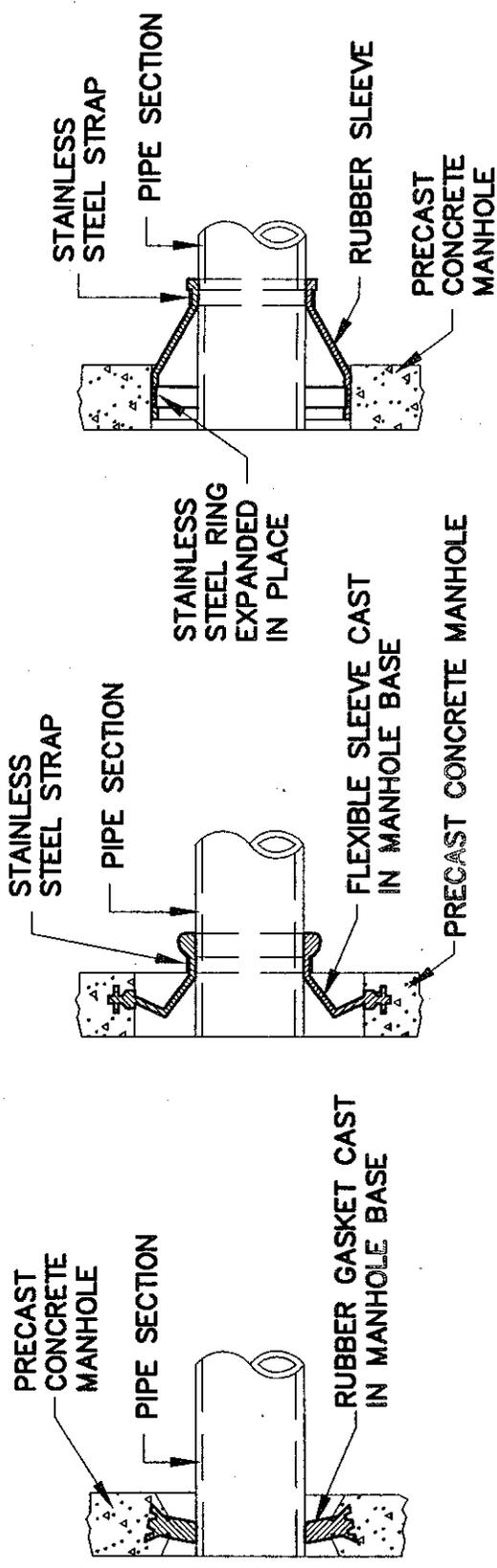
TOP SLAB TO BE USED
WHERE CONE SECTION
CANNOT BE USED OR
WHERE INDICATED
ON THE DRAWINGS

OPENING TO SUIT
FRAME & COVER

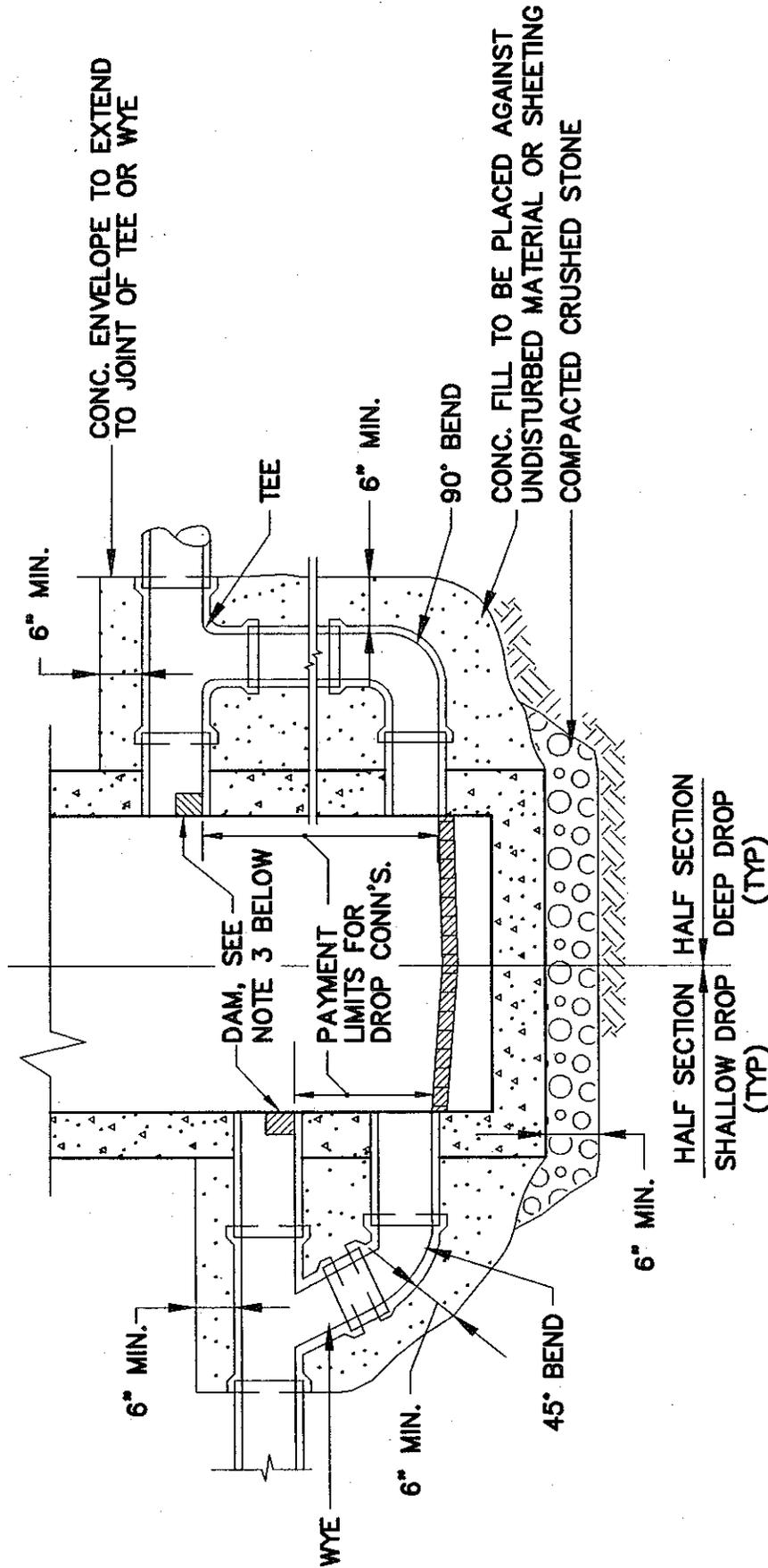


SECTION

MANHOLE TOP SLAB
N.T.C.



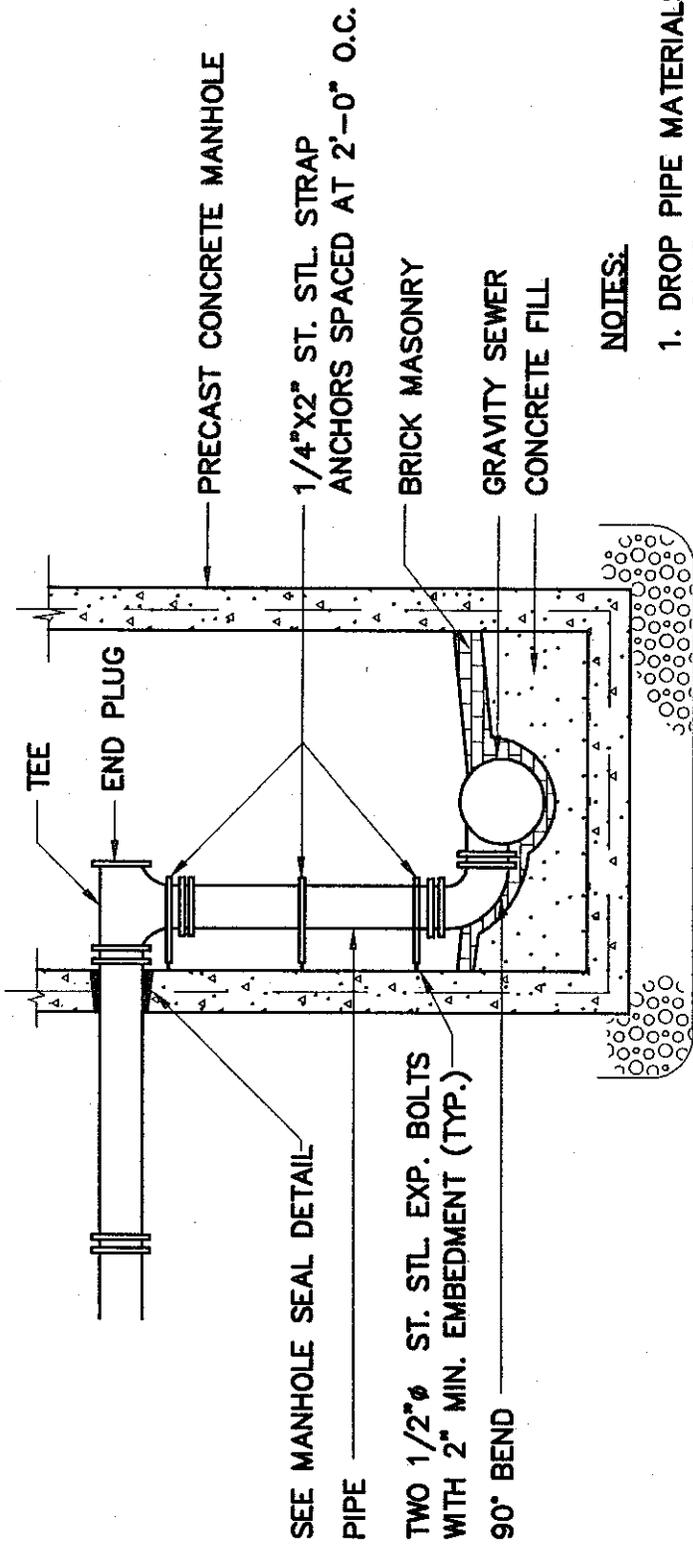
MANHOLE SEAL DETAILS
 N.T.S.



- NOTES:**
1. DROP PIPE TO BE SAME DIAMETER AS SEWER DISCHARGE INTO MANHOLE UNLESS OTHERWISE SHOWN ON DRAWINGS.
 2. DIMENSIONS & CONSTRUCTION OF DROP MANHOLE TO BE SIMILAR TO TYPICAL MANHOLE EXCEPT AS SHOWN.
 3. FOR PVC PIPE, EPOXY HALF PLUG TO PIPE. FOR DI, VC AND RC PIPE, MORTAR AND BRICK IN PIPE.

DROP CONNECTION DETAIL

N.T.S.



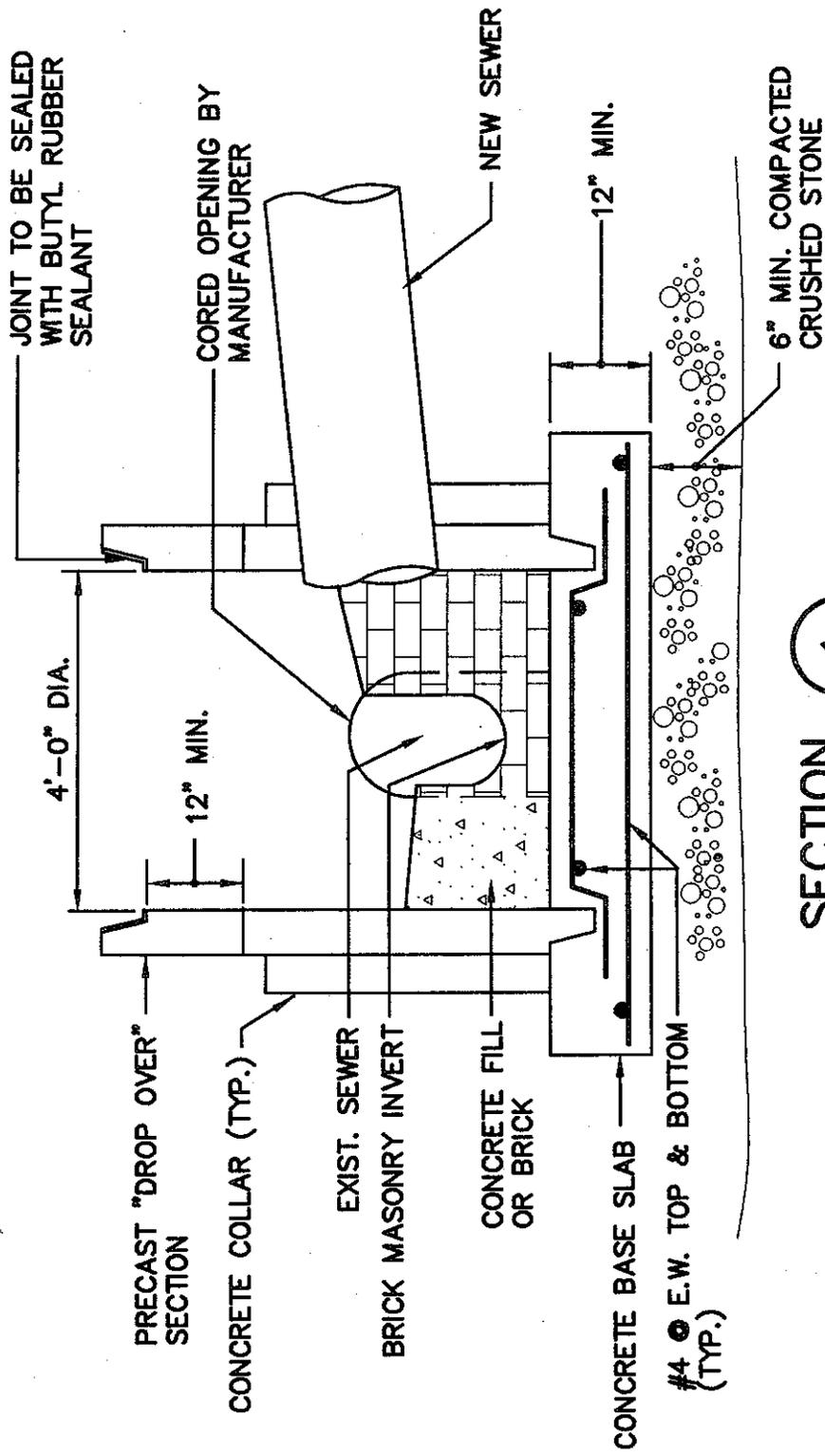
SEE MANHOLE SEAL DETAIL
 PIPE
 TWO 1/2" ϕ ST. STL. EXP. BOLTS
 WITH 2" MIN. EMBEDMENT (TYP.)
 90° BEND

NOTES:

1. DROP PIPE MATERIALS TO BE SAME AS PIPELINE MATERIALS
2. DIMENSIONS & CONSTRUCTION OF MANHOLE TO BE SIMILAR TO TYP. MANHOLE EXCEPT AS SHOWN
3. FOR PIPE UP TO AND INCLUDING 8", USE 4' DIAMETER MANHOLE; OVER USE 5' DIAMETER MANHOLE

INSIDE DROP CONNECTION DETAIL

N.T.S

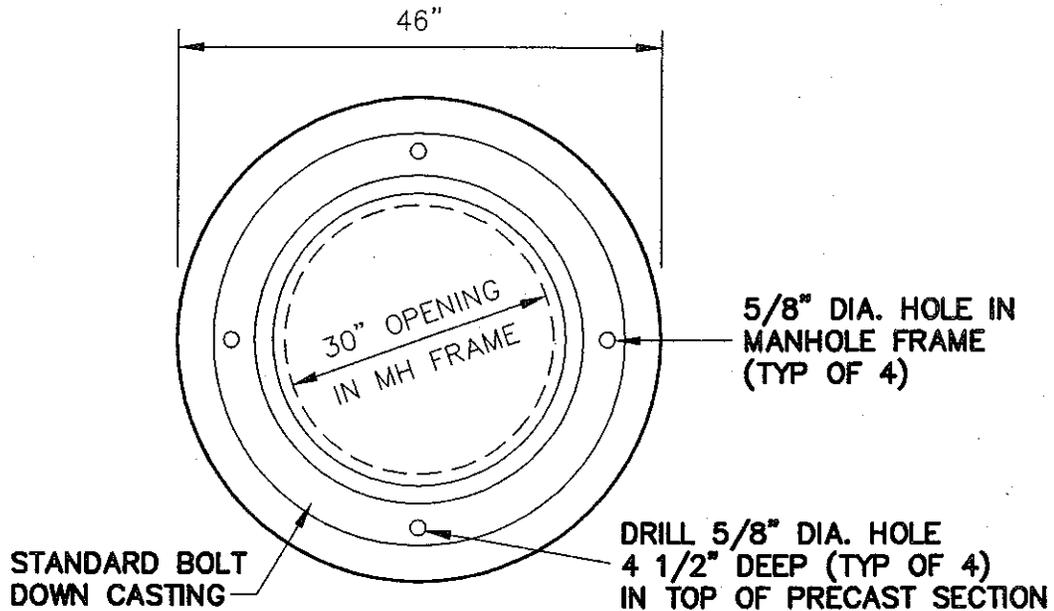
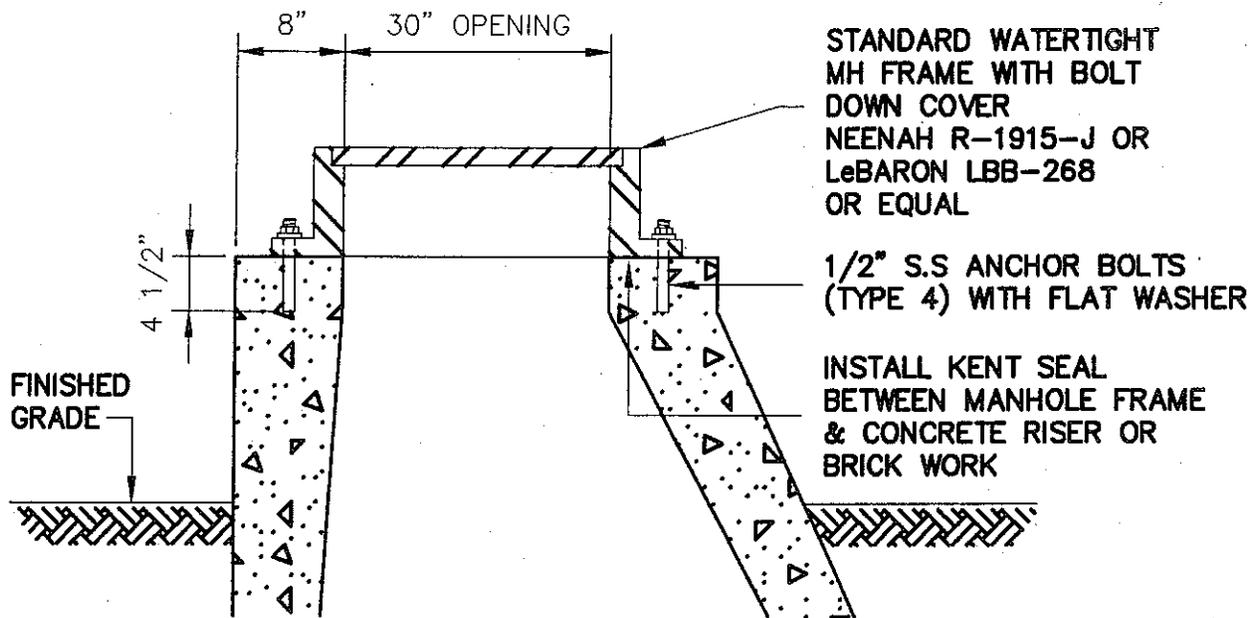


SECTION 1

DROPOVER MANHOLE BASE

N.T.S.

NOTE: THE "DROP OVER" SECTION SHALL BE INDEPENDENTLY SUPPORTED TO ALLOW FOR PROPER CURING OF THE BASE SLAB

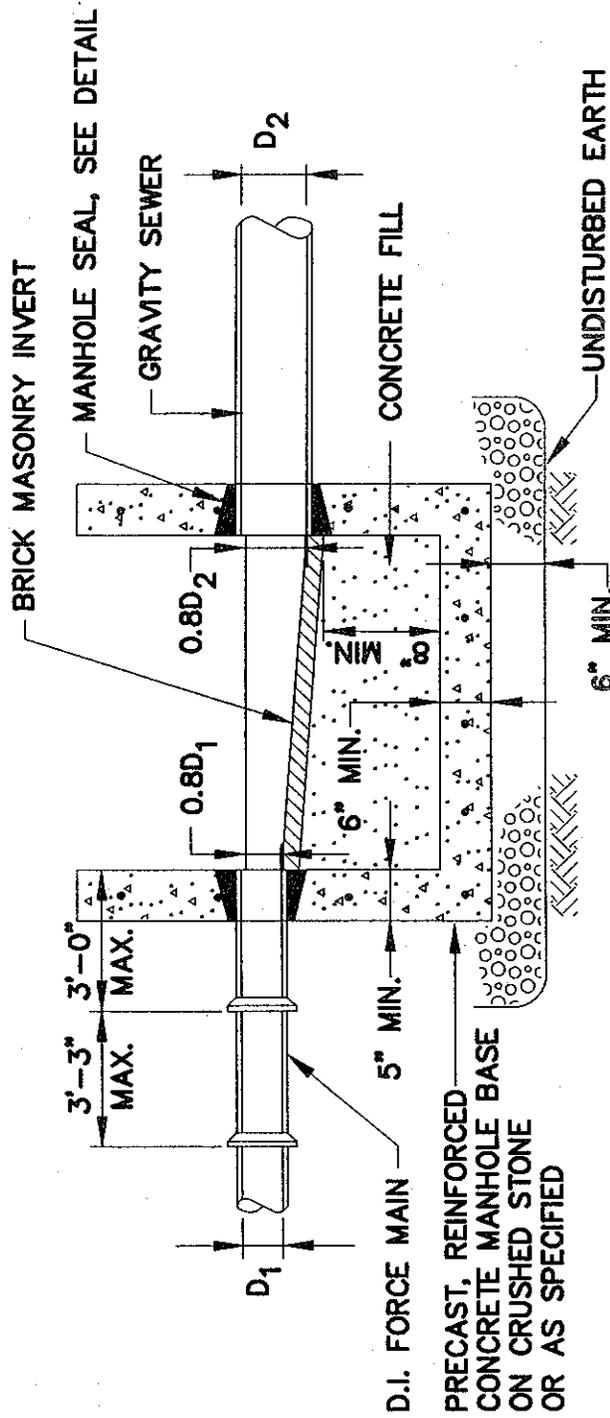


NOTES:

1. S.S. THREADED ROD MUST BE USED TO ANCHOR CASTING.
THE RODS SHALL EXTEND THROUGH INTO THE TOP CONE SECTION.
2. THE ANCHORAGE MATERIAL SHALL BE A TWO COMPONENT POLYESTER RESIN WITH AN ORGANIC PEROXIDE CATALYST. IT SHALL BE SUPPLIED IN A SELF CONTAINED, CONVENTIONAL CELTITE ANCHORBOND CAULKING CARTRIDGE. THE CARTRIDGE SHALL CONTAIN AN INTERNAL MIXING ELEMENT, AND BE SUPPLIED WITH MIXING RODS.

**MANHOLE FRAME & COVER ATTACHMENT DETAIL
IN CROSS COUNTRY AREAS**

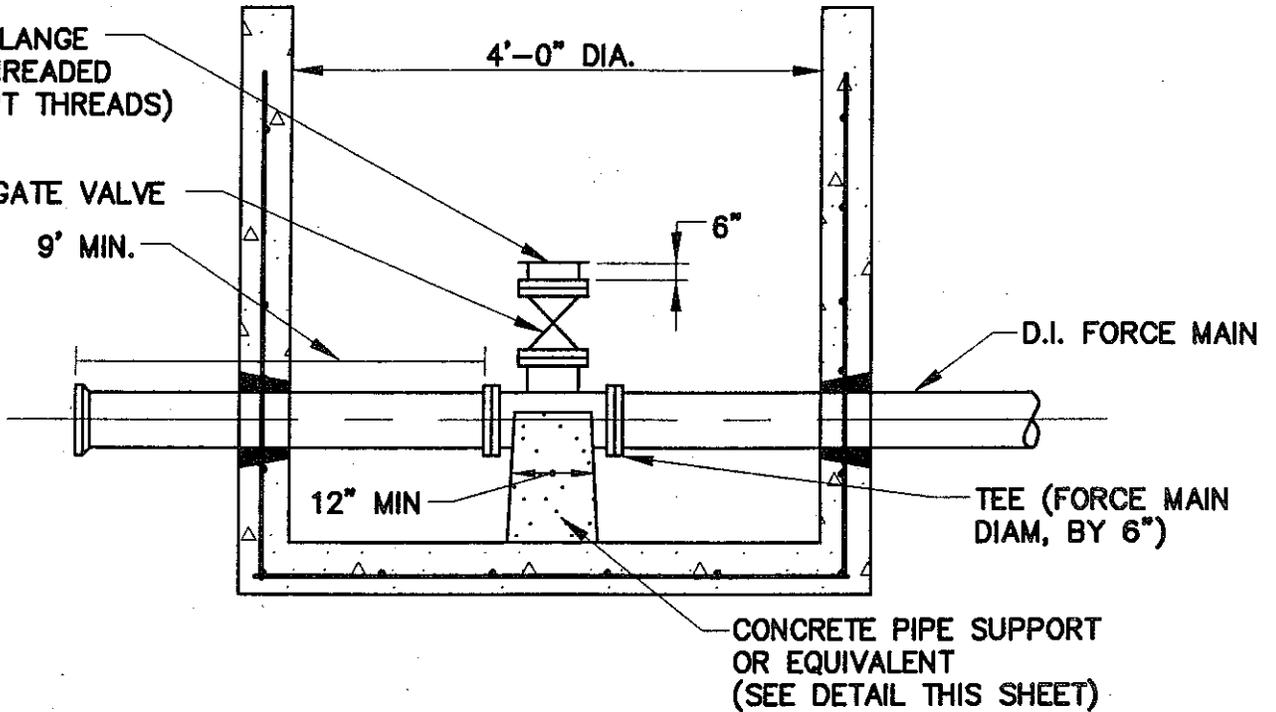
N.T.S.



TYPICAL FORCE MAIN CONNECTION
TO MANHOLE DETAIL
 N.T.S.

6" BLIND FLANGE
WITH 3" THREADED
NIPPLE (NPT THREADS)
AND CAP

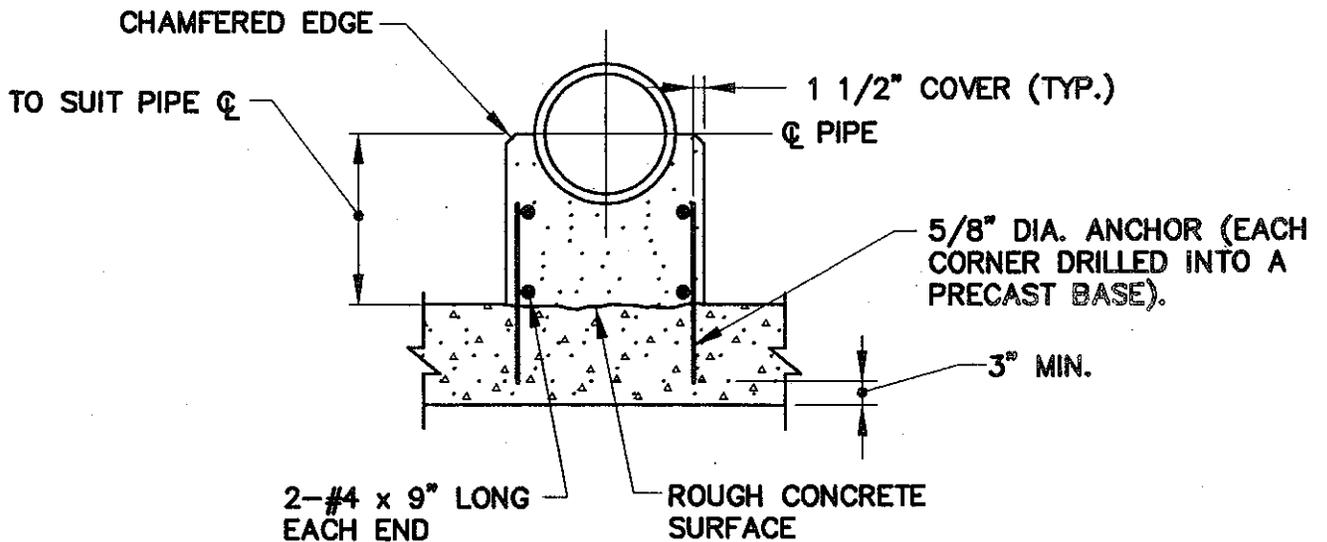
6" GATE VALVE
9' MIN.



NOTE: ALL MANHOLE MATERIALS TO BE AS SHOWN
ON TYPICAL PRECAST MANHOLE DETAIL.

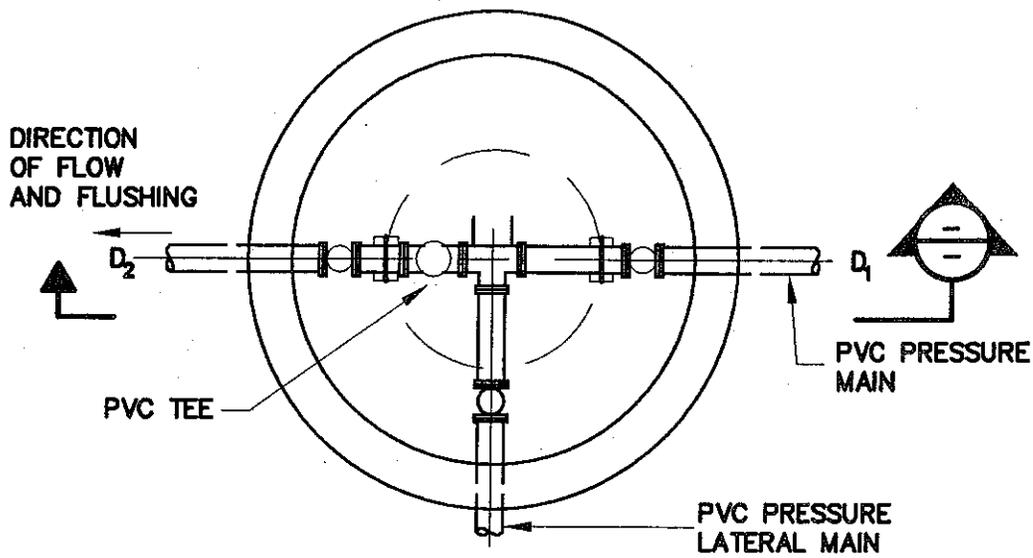
FORCE MAIN CLEANOUT MANHOLE DETAIL

N.T.S.

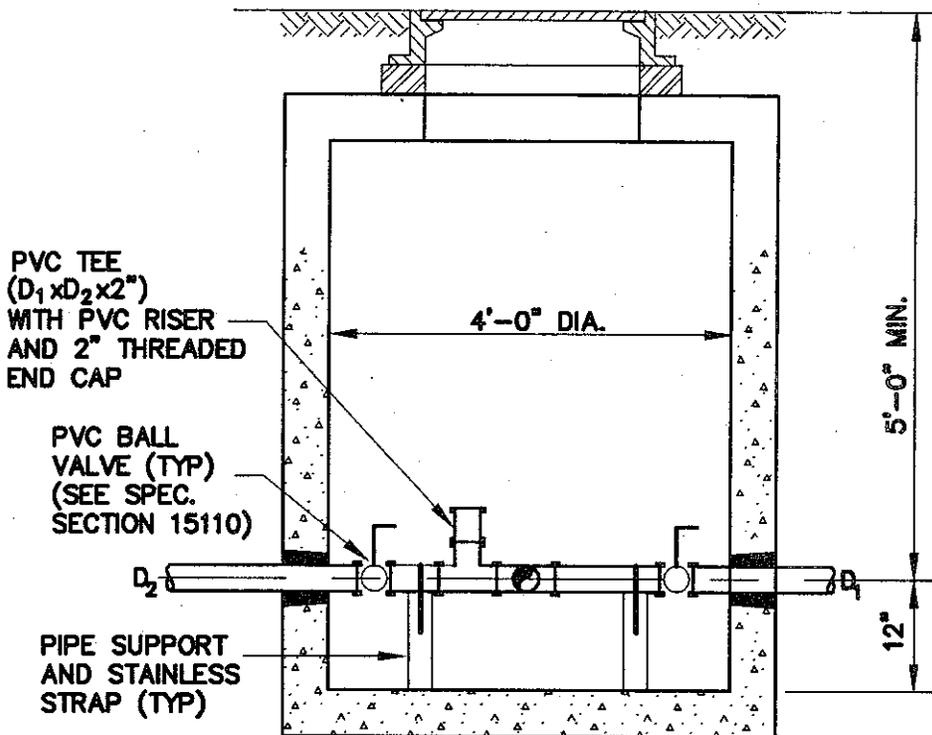


CONCRETE PIPE SUPPORT

N.T.S.



PLAN

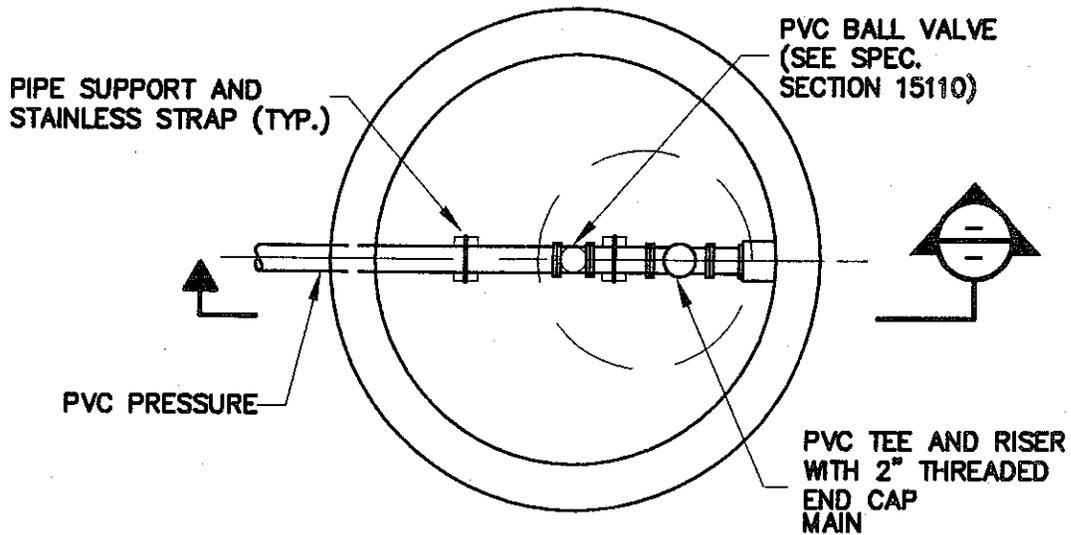


SECTION 

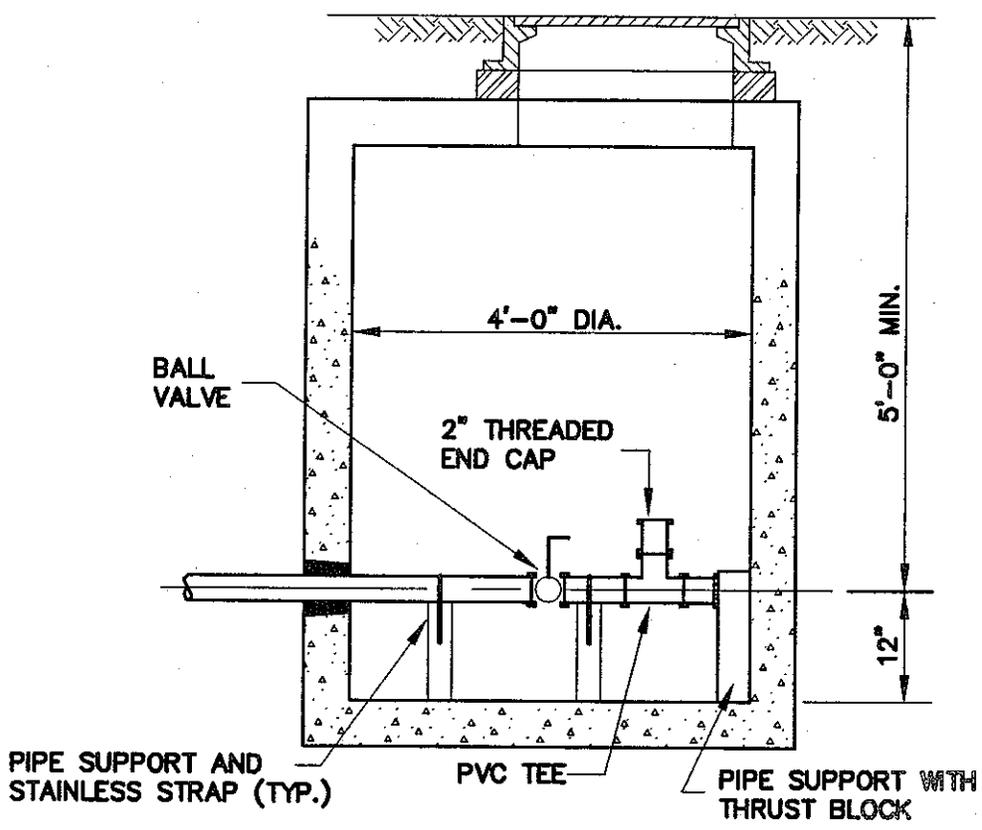
NOTES:

1. ALL MANHOLE COMPONENTS TO BE AS SHOWN ON TYPICAL PRECAST MANHOLE DETAIL.
2. PROVIDE ADAPTING FITTINGS AS REQUIRED.

INLINE FLUSHING CONNECTION \ PRESSURE LATERAL TO PRESSURE MAIN CONNECTION DETAIL
 N.T.S.



PLAN

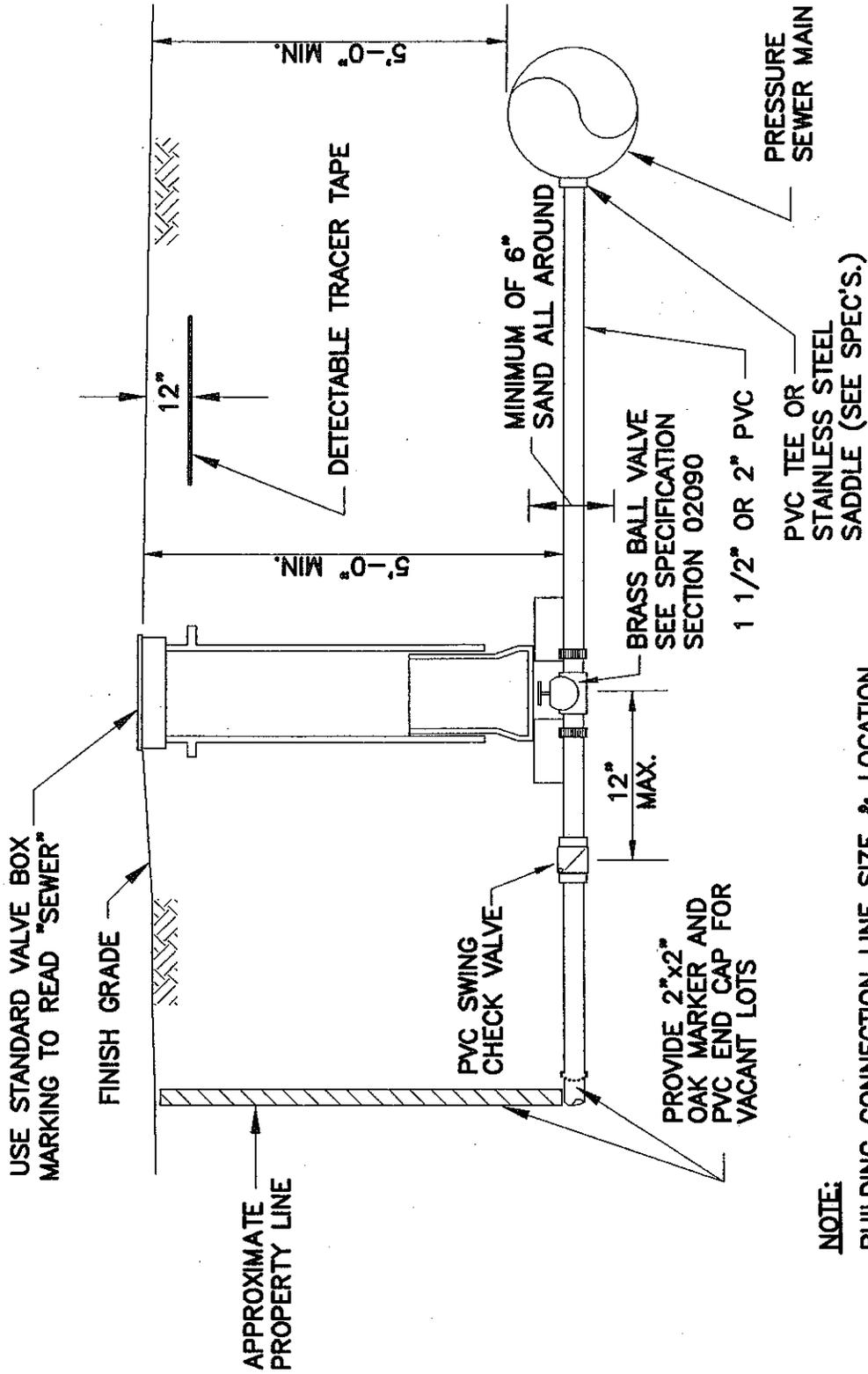


SECTION 

NOTES:

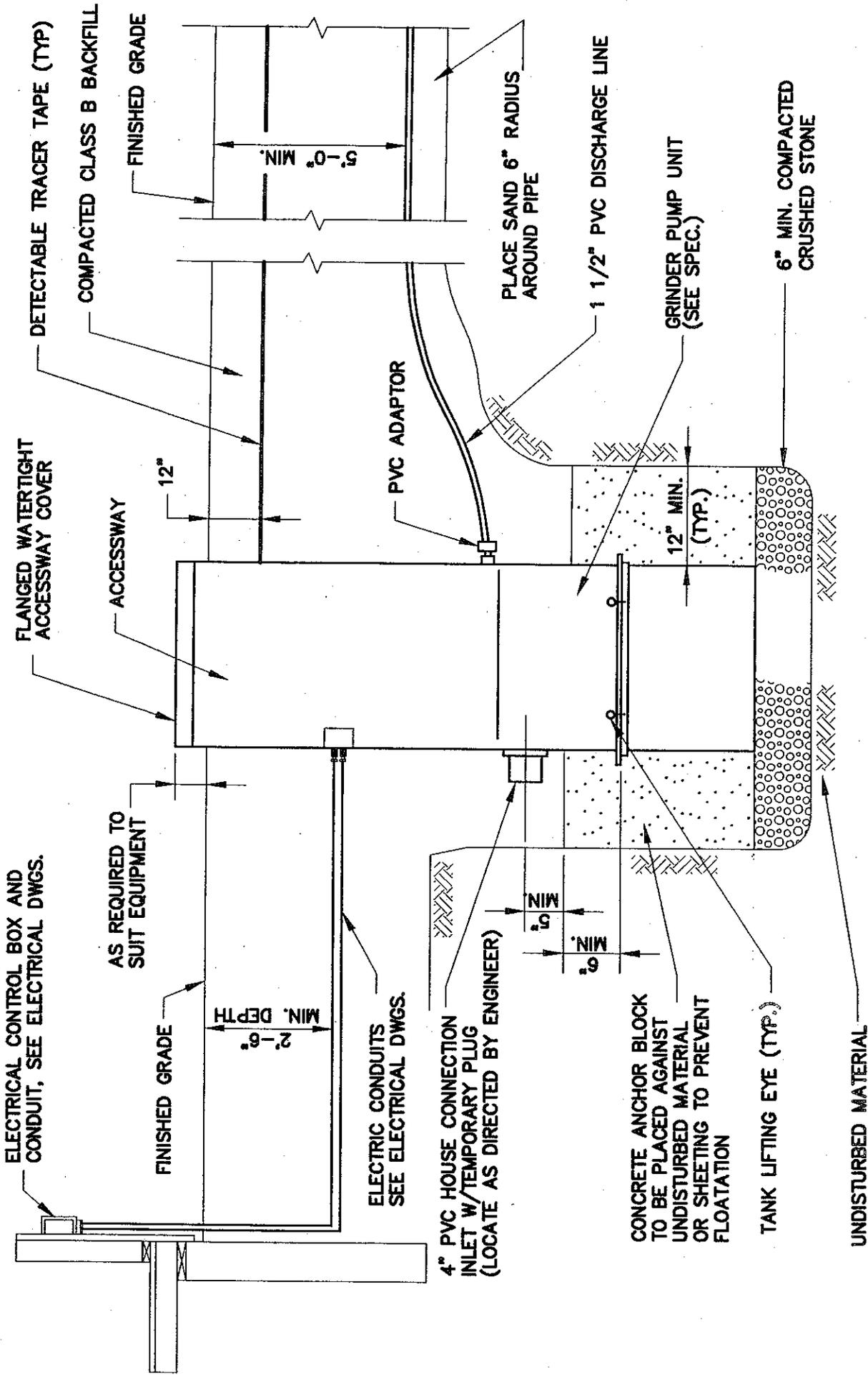
1. ALL MANHOLE COMPONENTS TO BE AS SHOWN ON TYPICAL PRECAST MANHOLE DETAIL.
2. PROVIDE ADAPTING FITTINGS AS REQUIRED.

PRESSURE SEWER TERMINAL FLUSHING CONNECTION
N.T.S.

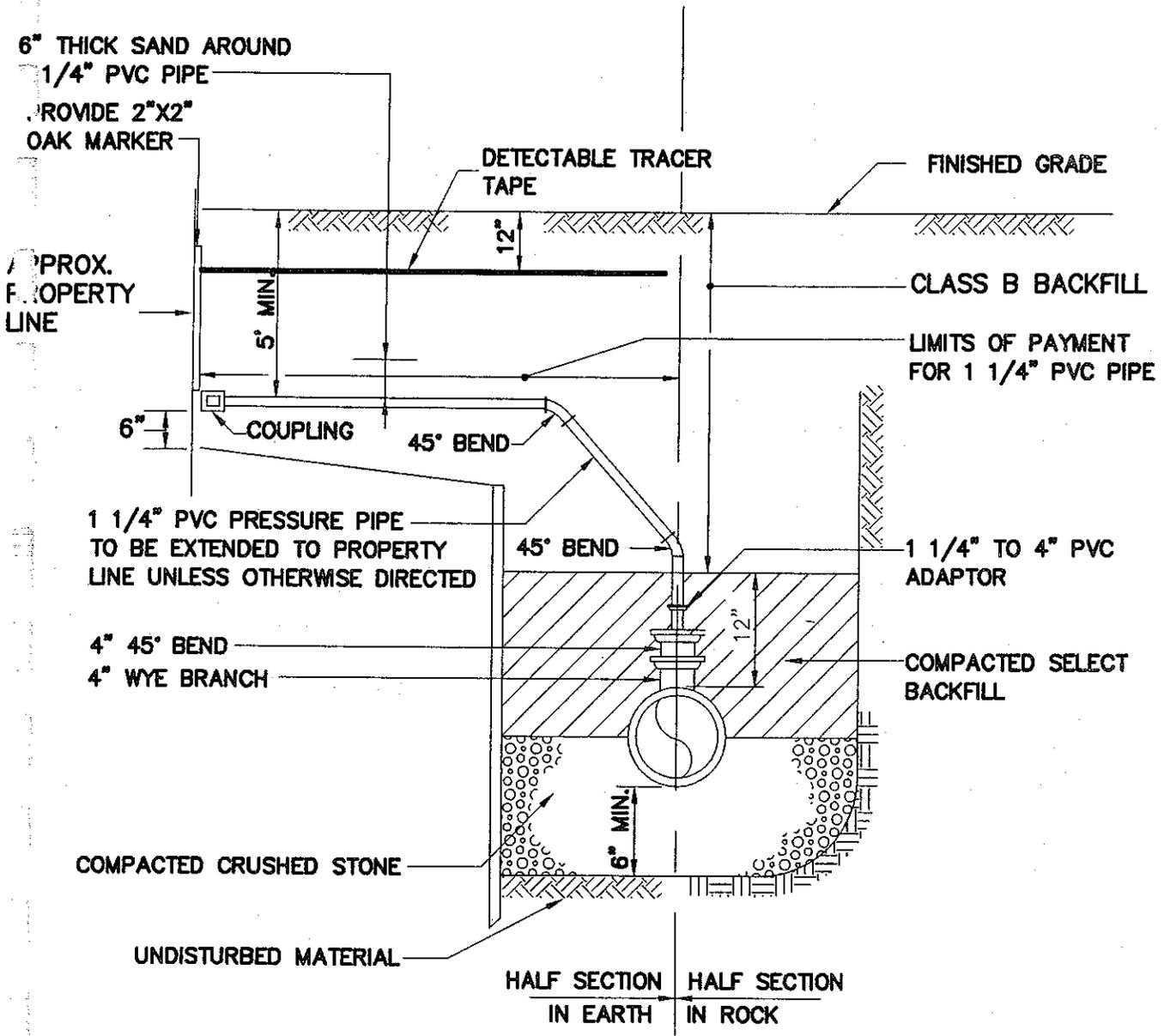


NOTE:
 BUILDING CONNECTION LINE SIZE & LOCATION
 SHOWN ON PLAN SHEETS

TYPICAL PRESSURE BUILDING CONNECTION DETAIL
 N.T.S.



TYPICAL GRINDER PUMP INSTALLATION
N.T.S.



NOTE:

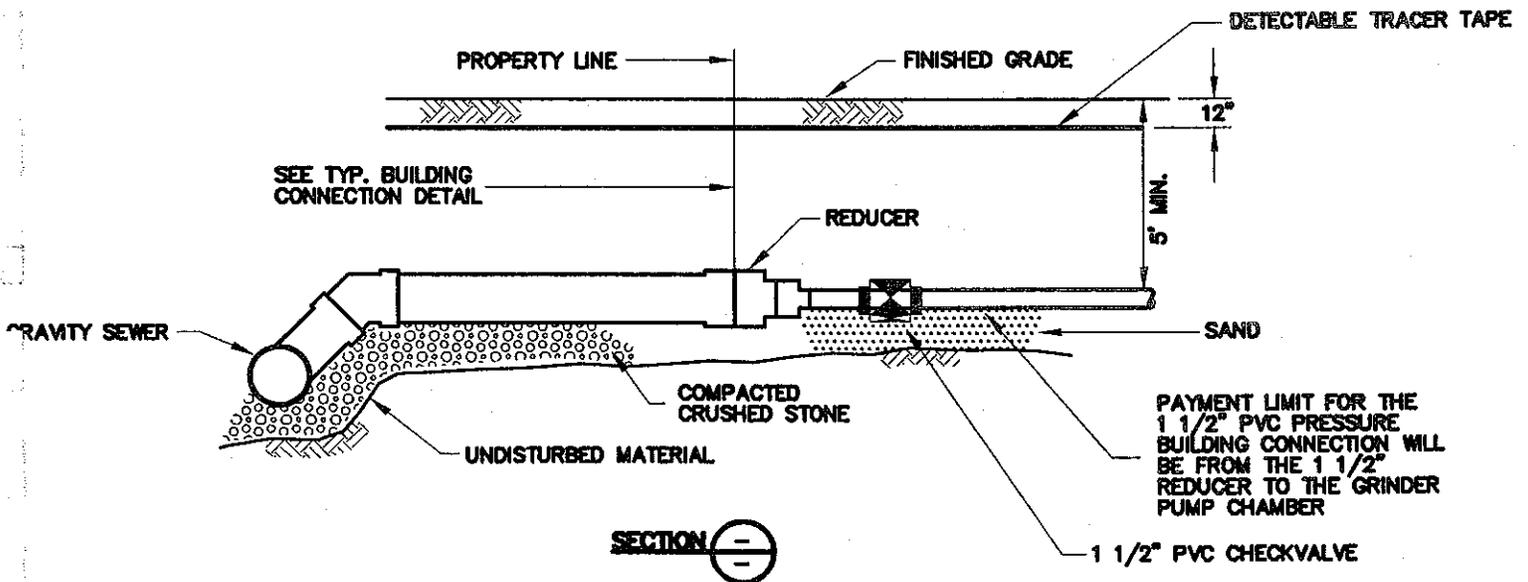
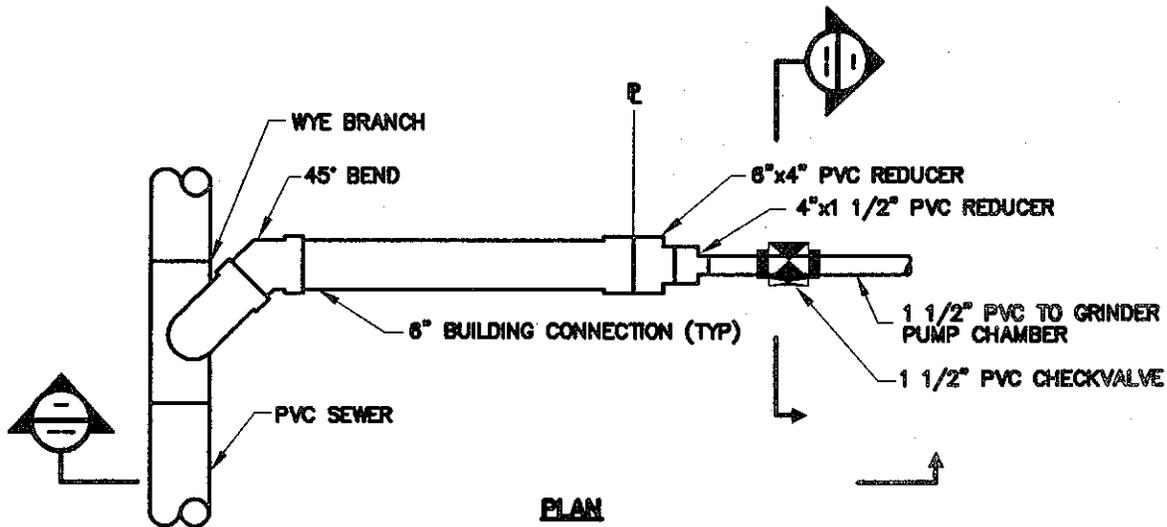
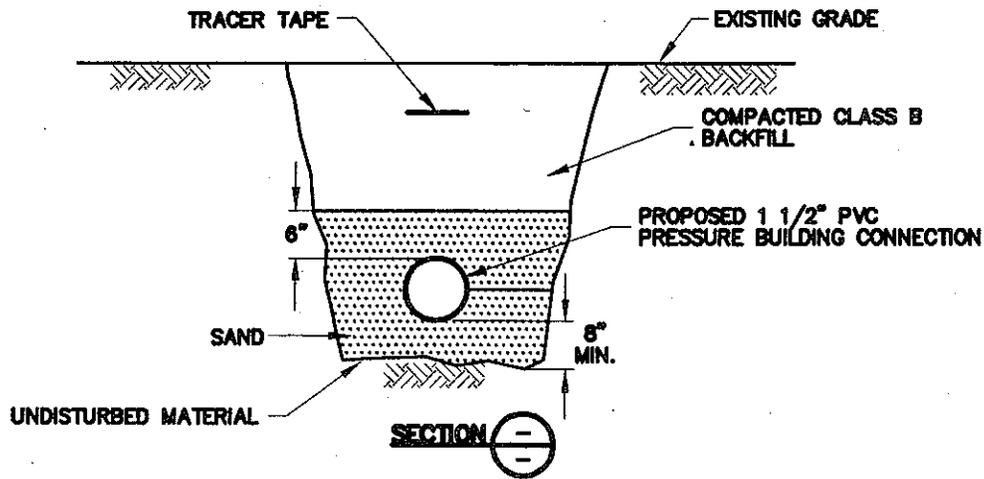
1. CONFORM TO SEWER TRENCH DETAIL UNLESS OTHERWISE INDICATED

NOTE TO DESIGNER:

DIAM. OF BUILDING CONNECTION
CAN VARY WITH DESIGN
REQUIREMENTS AND PUMP
SELECTION.

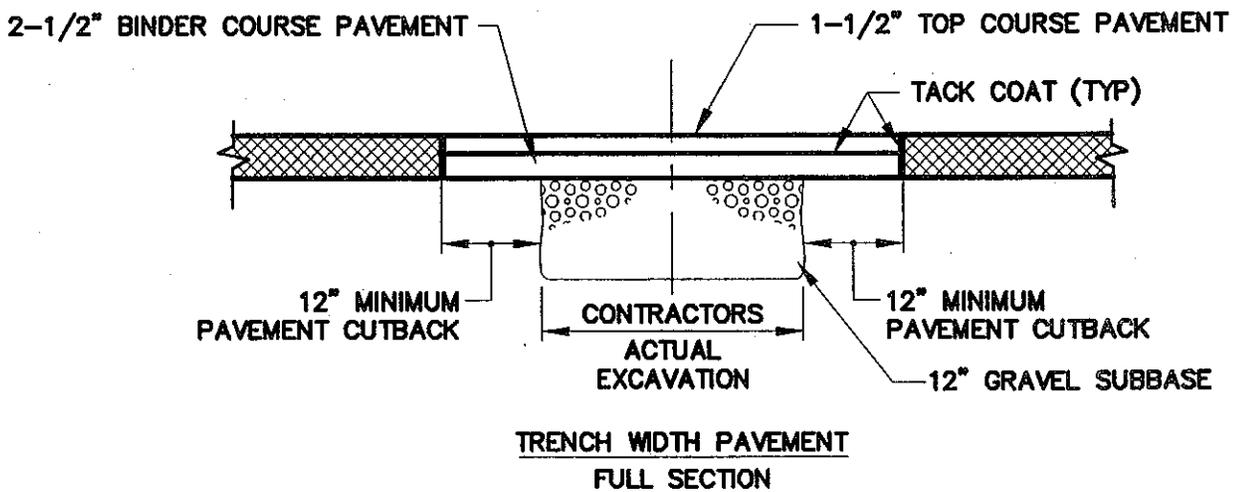
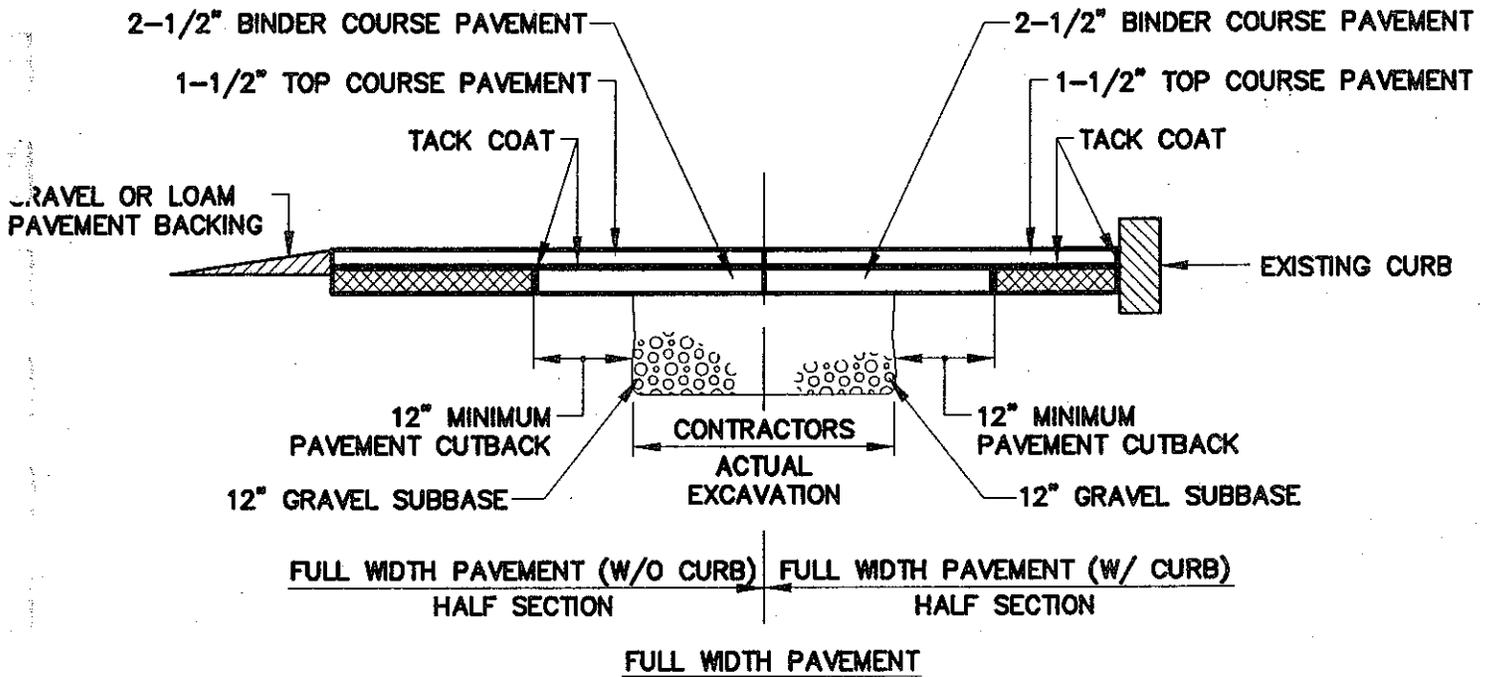
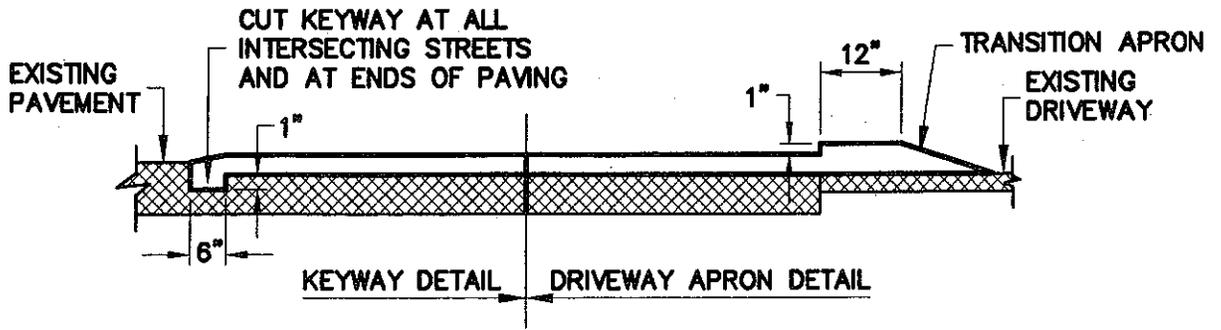
**PVC PRESSURE BUILDING CONNECTION
TO GRAVITY SEWER DETAIL**

N.T.S.

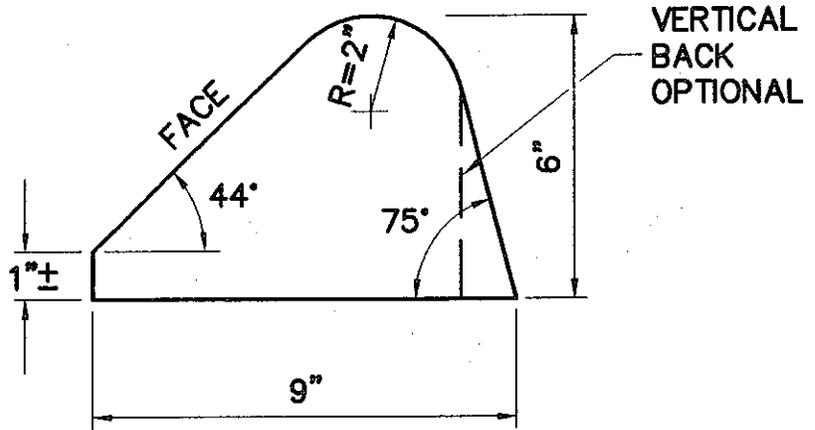


PVC PRESSURE BUILDING CONNECTION TO GRAVITY SEWER DETAIL
 N.T.S.

PAYMENT LIMIT FOR THE 1 1/2" PVC PRESSURE BUILDING CONNECTION WILL BE FROM THE 1 1/2" REDUCER TO THE GRINDER PUMP CHAMBER

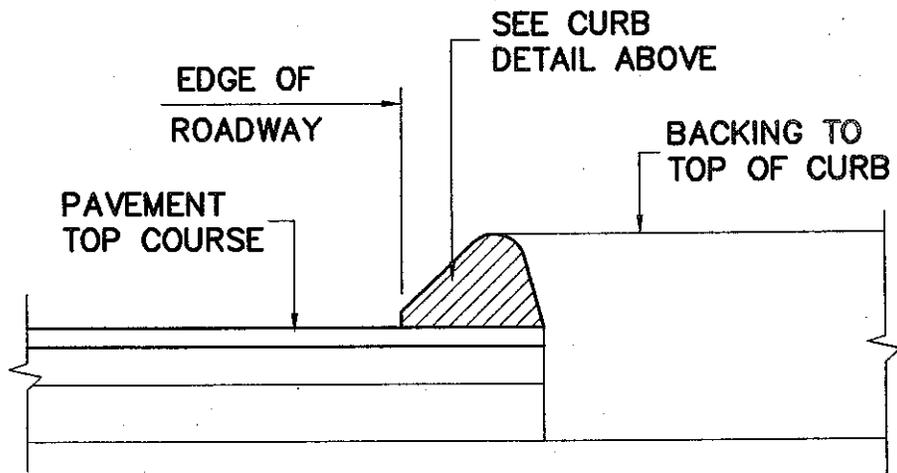


PAVEMENT REPLACEMENT DETAILS
 N.T.S.



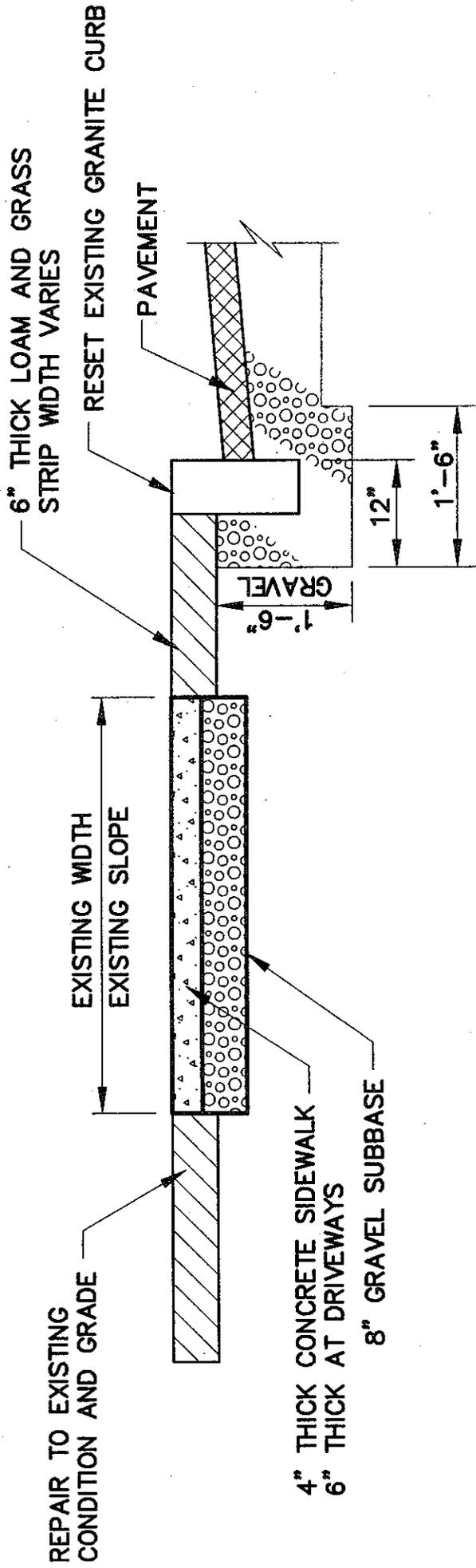
CURB DETAIL

CURB IS TYPE-2 PER MASS.
DPW CONSTRUCTION STANDARDS



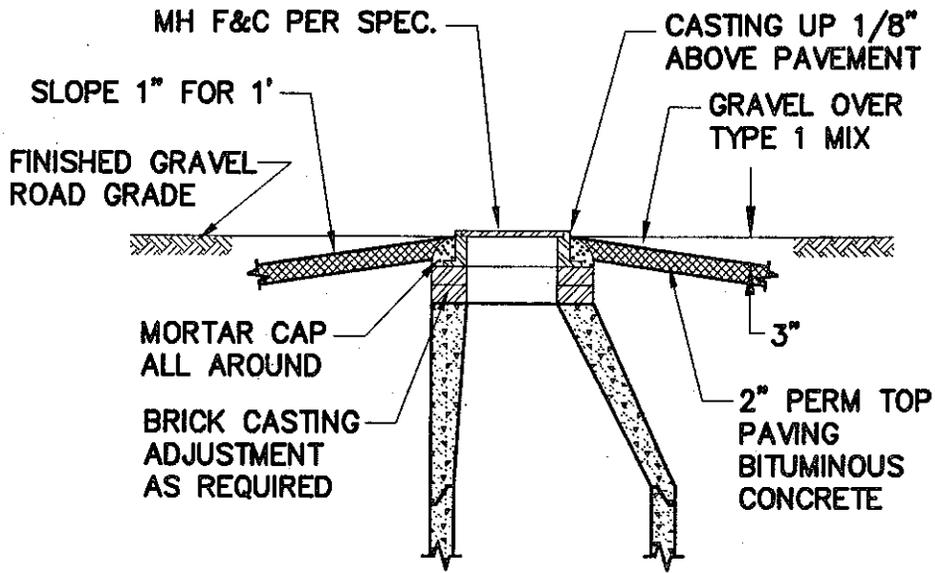
BITUMINOUS CONCRETE CURB

N.T.S.

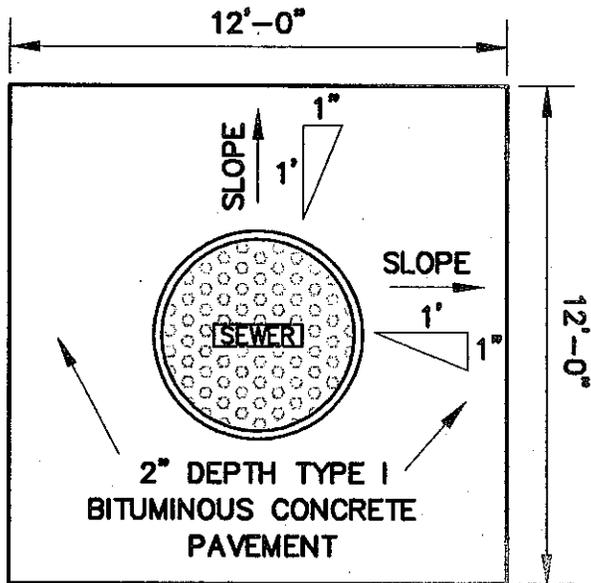


TYPICAL SECTION THROUGH
CONCRETE SIDEWALK

N.T.S.



SECTION
N.T.S.



PLAN
N.T.S.

NOTE:

NOT TO BE USED ON ROADS WITHIN FLOOD PLAIN AREA

ASPHALT PAD AROUND MANHOLES

ON GRAVEL ROADS

N.T.S.

APPENDIX B

DESIGN CRITERIA

TOWN OF TYNGSBOROUGH
DESIGN CRITERIA

Gravity Sewers

Pipe: Minimum pipe size for building connections is 6-inch
Minimum pipe size for mainline sewers is 8-inch

Slope: Minimum slope for the following pipe sizes:

<u>Pipe Diameter (inches)</u>	<u>Minimum Slope(ft./ft.)</u>
6	0.0049
8	0.0040
10	0.0028
12	0.0022
15	0.0015

(These slopes assume pipe flowing full or half full with $n=.013$)

Velocity: Designed for velocities between 2-10 feet per second for pipe flowing full.

Cover: Minimum cover (from crown of pipe) under a traveled way is typically 8 feet.
Minimum cover (from crown of pipe) cross country is 4.5 feet. Insulation will be required where less than 4.5-feet of cover is provided.
18-inch clearance between crown of sewer and invert of existing utilities.

n factor: Manning's "n" for PVC pipe on this project will be 0.009.

Manholes

Spacing: Maximum acceptable distance between manholes shall be 300 feet.

Inverts: All manhole inlets and outlets shall be designed true to grade and alignment with a minimum of a one-tenth (0.1), foot drop between the lowest inlet and the outlet.

Force Main

Velocity: Designed for velocities between 3-5 feet per second.

Cover: Minimum cover is 4.5 feet. Insulation will be required where less than 4.5-feet of cover is

provided.

18-inch clearance where possible between force main and existing utilities, otherwise concrete cradles will be required.

Cleanouts: Between 500 and 1,000 feet.

Air & Vacuum Release Structures: Required at all high points of force main. Automatic valves have caused problems in wastewater force mains and will be avoided if possible by either maintaining a positive slope or by providing a manual air release to an adjacent gravity manhole (see details).

Pump Stations

- A. Average daily flow (ADF) = 3.4 persons per home x 68 gallons per capita per day.
- B. Peak flows = Average Daily Flow x Peaking Factor taken from "Peak on Maximum Day" line in the attached table from ASCE Manual of Engineering Practice No. 37. (For average flows less than .01 MGD, a peaking factor of 5.7 is maintained.)
- C. Infiltration/Inflow (I/I) is assumed to be 250 gal per day per inch diameter per mile of sewer. I/I values are never peaked themselves but are rather added to the calculated average and peak flows.
- D. Preferred force main velocity = 3 to 5 feet per second. Minimum force main diameter is 4-inches except in extreme low flow areas where grinder pumps are utilized.
- E. Wet wells are designed to have an average pumping cycle time between starts of 15 minutes (4 starts per hour under average flow conditions). Wet well levels are measured by a continuously purged bubbler pipe system. (Mercury floats have proved to be a maintenance problem and are no longer recommended.)
- F. Each of the pumps in the duplex system shall be constant speed, capable of handling the peak station design flows.
- G. Pump station buildings façade shall be approved by the Owner prior to the installation.