

SECTION 11316

SEWAGE GRINDER PUMP SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment and materials required to install and test grinder pump units and polyvinyl chloride (PVC) pressure pipe and PVC gravity pipe, including pump containment basin, electrical connection, electrical control box, pipe, valves, fittings, couplings, adaptors, junction boxes, cleanouts, and accessories, as shown on the Drawings and/or specified herein.
- B. The Contractor's attention is called to the fact that all piping and accessories are not necessarily shown complete on the Drawings, which are more or less schematic. However, the Contractor shall furnish and install all piping indicated or required for proper operation of the equipment or for services requiring such piping.

1.02 QUALITY ASSURANCE

- A. All pumping equipment, pipe, valves, and fittings furnished under this section shall be new, unused, and the manufacturer's current production model. Unit must conform to the best practice known to the trade in design, quality of material, and workmanship. Assemblies, subassemblies, and component parts shall be standard and completely interchangeable. The equipment must conform with all applicable federal state, and local regulations.
- B. At the Engineer's request, the Contractor shall furnish a certificate from the manufacturer of the pipe and fittings that the manufacturer is completely competent and capable of manufacturing PVC pipe and fittings of uniform texture and strength to fully comply with these specifications and has manufactured such pipe in sufficient quantities to meet all normal construction requirements. The manufacturer must have adequate equipment and quality control facilities to be sure that such extrusion of pipe is uniform in texture, dimensions, and strength. All pipe shall be tested at the place of manufacture for all requirements of the latest ASTM and commercial Standard tests, and prior to the laying of the pipe, certified copies of the test reports covering each shipment shall be submitted to the Engineer.

Each length of pipe and each fitting shall have the following data clearly marked on each piece:

1. Nominal size
2. Type and grade of material and ASTM standard
3. SDR, Class, or schedule rating
4. Manufacturer
5. National Sanitation Foundation's seal of approval

1.03 STORAGE AND PROTECTION

- A. PVC piping and accessories shall be stored and protected as follows:
 1. PVC pipe and fittings shall be stored under cover.
 2. All pipe and accessories shall be stored above ground and be fully supported so as not to bend or deflect excessively under its own weight. Height of stacked pipe shall not exceed 4 feet. Bundled pipe shall not be stacked more than two bundles high.
 3. Kinked, flattened, buckled, broken, or otherwise defective pipe and fittings shall not be used and shall be removed from the site.
 4. Pipe shall be handled using nylon slings. Wire rope slings or chains shall not be used.
- B. Sewage grinder pumps shall be stored in accordance with the manufacturer's recommendations.

1.04 SHOP DRAWINGS AND ENGINEERING DATA

- A. The Contractor shall submit complete shop drawings and engineering data to the Engineer in accordance with the requirements of Section 01300, "Submittals" of these Specifications.
- B. Contractor shall submit complete detailed equipment, hydraulic, pneumatic, and electrical diagrams and a functional description of the completely integrated sewage pumping system, as indicated on the Drawings and described herein.

Information shall include but not be limited to:

1. Complete detailed equipment, hydraulic and control diagrams, ventilation, electrical diagrams, and specifications.
2. Dimensions of fiberglass containment basin.
3. Pump data including certified pump efficiency flow and horsepower curves.
4. Complete sectional detail drawings showing the placement of all equipment.
5. Complete and accurate plans and schematics for all electrical and mechanical equipment.
6. Clear and concise instructions for installation, alignment and adjustment of machinery.
7. Instructions for operating equipment under all design conditions.
8. Lubrication, maintenance, and trouble-shooting instructions complete with necessary diagrams and schematics.
9. Complete parts list with exploded schematics.
10. Complete wiring schematics for motors, motor controls, and other electrical components supplied with the pump systems, including interface details of the motor control system starting equipment, wet well sensing and control system, and alarm sensor.

1.05 GUARANTEE

Provide a guarantee against defective equipment, materials, and workmanship in accordance with the requirements of the section entitled "Guarantees and Warranties" of these Specifications.

PART 2 - PRODUCTS

2.01 PVC PIPE AND FITTINGS

- A. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.
- B. The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.
- C. No single piece of pipe shall be laid on any project covered by this specification unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inch per foot of length. If the deviation from straightness exceeds this requirement, then the particular piece of pipe shall be rejected for use until it can comply with this provision.
- D. PVC pipe shown on the Drawings to be installed outside of structures or buried underground and used to convey water or wastewater shall have push-on joints or solvent welded joints unless otherwise noted on the Drawings. All pipe material shall be Grade 1, Type 1, polyvinyl chloride (PVC) in accordance with ASTM D 1784, Class 12454-B. All pipe material shall be National Sanitation Foundation approved for use with potable water. Pipe in sizes 1-1/2 inches through 6 inches (1-1/2 inches through 12 inches for corrosive fluids) shall be SDR 21 with 200 psi pressure rating in accordance with ASTM D 2241. Pipe 1-1/4 inches in diameter shall be Schedule 40 PVC, Type 1 in accordance with ASTM D 1785 or SDR 21 when available. Maximum lengths of pipe shall not exceed 20 feet.
- E. All wyes, tees, bends, and adaptors, and any other fittings required or directed by the Engineer shall be Schedule 40 PVC with socket ends and push-on or solvent welded joints, as specified or shown on the Drawings. Fittings shall conform fully to the requirements of ASTM D 2246 in sizes ranging from 1-1/4 through 4 inches in diameter. Fittings larger than 4 inches in diameter shall be cast iron or ductile iron as specified in Section 15062 of these Specifications.

F. Joints

1. Push-On Joints

- a. The joints shall be designed so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment. The push-on joint shall be single rubber gasket joint designed to be assembled by the positioning of a continuous, molded, rubber ring gasket in an annular recess in the pipe or fitting entering pipe into the socket thereby compressing the gasket radially to the pipe to form a positive seal. The gasket and the annular recess shall be so designed and shaped that the gasket is locked in place against displacement as the joint is assembled. Details of the joint design and assembly shall be in accordance with the joint manufacturer's standard practice. The joints shall be designed so as to provide for the thermal expansion or contraction experienced with a total temperature change of at least 75°F in each joint per length of pipe. The joint shall comply with ASTM D 3139. Gasket shall comply with ASTM F 477.
- b. Lubricant furnished for lubricating joints shall be nontoxic, shall not support the growth of bacteria, shall have no deteriorating effects on the gasket or pipe material, and shall not impart color, taste, or odor to water. The lubricant containers shall be labeled with the manufacturer's name.
- c. Gaskets shall meet all applicable requirements of ANSI A21.11. Gasket dimensions shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape as to provide an adequate compressive force against the spigot and socket after assembly to effect a positive seal under all combinations of joint and gasket tolerances. The trade name or trademark, size, mold number, gasket manufacturer's mark and year of manufacture shall be molded in the rubber on the back of the gaskets.

- d. Gaskets shall be vulcanized natural or vulcanized synthetic rubber. No reclaimed rubber shall be used. When two hardnesses of rubber are included in a gasket, the soft and hard portions shall be integrally molded and joined in a strong vulcanized bond. They shall be free of porous areas, foreign material, and visible defects. The required properties of the gasket rubber and the required method of test are given in the following table:

| Property | ASTM Test Method | Main Body of Gasket | Harder Portion (if used) |
|---|--------------------|---------------------|--------------------------|
| Hardness, Durometer "A" | D 676 at 76±6°F | 45-70 | 78-90 |
| Minimum Ultimate Tensile, psi | D 412 | 2,000 | 1,200 |
| Minimum Ultimate Elongation, Percent ¹ | D 412 | 300 | |
| 125 | | | |
| Minimum Aging, Percent ² | D 572 ³ | 60 | 60 |

¹Of original length

²Of original values of tensile and ultimate elongation

³Oxygen pressure method: After 96 hours at 70 ±1°C at 300 + 10 psi

- e. The gasket manufacturer shall set up such quality control procedures as will ensure the gasket's meeting the requirements of this standard. He shall furnish a monthly report of representative quality control test results to the pipe manufacturer.
- f. A sample push-on fitting shall be submitted to the Engineer for examination and approved prior to delivery of any pipe.

2. Solvent welded joints

Joints shall be made in accordance with ASTM Standard D 2672 and assembled in accordance with ASTM Standard D 2855. Furthermore, assembly shall be made in accordance with the manufacturer's

specific recommendations and appropriate safety measures taken when handling and applying solvents.

3. Threaded joints

Joints shall be made with American Standard IPS threads. All joints shall be made up with Teflon thread tape.

2.02 PVC VALVES

- A. Unless otherwise shown or required, all valves, unions, and strainers in PVC piping shall be constructed of Type 1, Grade 1 PVC. Valves shall be NSF approved and shall have a working pressure of 125 psi.
- B. Ball valves shall have double union type body, Teflon seats, Viton or EPDM seals, full diameter port, and solvent-weld ends.
- C. Check valves shall be of the ball type with union body, Viton or EPDM seat, and solvent-weld ends, as manufactured by Chemtrol Division of Celanese Piping Systems, or flapper type with weighted flapper with Buna-N seal and solvent-weld ends allowing a fully-ported opening such as manufactured by Flow Control, Inc., or equal.
- D. Valves for line sizes greater than 3 inches in diameter shall be iron body and specified in the section entitled "Valves" of these Specifications.

2.03 AIR RELEASE VALVES

- A. Air release valves shall have cast iron body, stainless steel float, and stainless steel or bronze trim.
- B. All fasteners, valve handles and nipples shall be stainless steel.
- C. Valve shall be designed for a working pressure of 0 to 150 psi.
- D. Sewage valves shall be Valve and Primer Corporation short body, "APCO 400SWA," Multiplex "Crispin Model S 20X," Val-Matic "Sewage Air Release Valve," or equal. Valves shall be equipped with an elongated

body, 2-inch NPT inlet connection, and a 1/2-inch NPT outlet connection and shall be provided with a 2-inch inlet shut-off valve, 1-inch blowoff valve, and a 1/2-inch back-flush valve with quick-disconnect coupling.

- E. All ferrous metal surfaces shall be field coated with two (2) coats, building to a total of 4.6 mils (dry film thickness) of coal tar epoxy (Glidden "Glid-Guard" Coal Tar Epoxy No. 69740, or equal).

2.04 COMBINATION AIR RELEASE AND VACUUM VALVES

Sewage valve shall be Valve and Primer Corporation short body, "APCO 400/401SWA," Multiplex "Crispin Model S 20AX," Val-Matic "Sewage Air and Vacuum Valve," or equal and shall have attachments as described for air release valve above.

2.05 METER BOXES

- A. Meter boxes in areas subject to traffic shall be of cast iron with a one-piece, heavily ribbed cast iron cover. Covers shall have the word "Sewer" cast on top, if available.

Cast iron meter boxes shall be coated inside and out with two (2) coats of a suitable bituminous coating. Cast iron meter boxes shall be similar and equal to those manufactured by John Bouchard and Sons Company of Nashville, Tennessee, or Clarksville Foundry of Clarksville, Tennessee.

- B. Meter boxes for non-traffic areas shall be a standard plastic box, constructed of high-density polyethylene. The meter box shall be fitted with a black or green lid with a key operating lid or acetal snap catch. If available, the word "Sewer" shall be impregnated in the cover.

Lid shall have a 2-1/2-inch-diameter, 16-gauge steel reflector with dichrometer coating applied to the underside of the lid for electronic detection.

Meter boxes shall be as manufactured by Davis Meter of Thomasville, Georgia, or Ametex, Plymouth Products Division.

- C. The following minimum inside dimensions are required for valves on the corresponding lines:

| Line Size | Minimum Inside Dimensions Rectangular Box |
|-----------|--|
| 1-1/4" | 15-1/2" x 10-1/4" |
| 1-1/2" | 15-1/2" x 10-1/4" |
| 2" | 15-1/2" x 10-1/4" |
| 2-1/2" | 15-1/2" x 10-1/4" |
| 3" | 15-1/2" x 10-1/4" |
| 4"* | 19-7/8" x 13-1/4" C.I. |
| 6"* | 24-1/4" x 13-5/8" C.I. |

*Meter boxes for check valves only. Gate valves for line sizes 4-inch and larger in diameter shall be provided with cast iron valve boxes.

- D. The Contractor shall provide and install meter boxes for each valve and cleanout where specified or shown on the Drawings. The exact field location of the meter box shall be determined by the Owner and shall be located to provide easy access to the servicemen, and not be a hazard to the customer or public, and be reasonably well protected against frost, mechanical damage and tampering.
- E. Extension shall be provided as necessary.
- F. Installation shall be performed in a neat, workmanlike manner, with the elevation of the boxes adjusted so that the lid is flush with the ground surface. Soil around the meter box shall be tamped or settled in place so that hazard is eliminated and further settling is minimized.

2.06 SEWAGE GRINDER PUMPING SYSTEMS

A. General

1. Sewage grinder pumping stations shall be factory-built automatic stations as approved by the Engineer. The manufacturer of the sewage grinder pumping stations shall have manufactured grinder pump units for a minimum of five (5) years prior to bid date of this contract.

In lieu of five (5) years prior manufacturing experience, the manufacturer shall provide a bond to the Owner to guarantee replacement of the units in the event of failure or unsatisfactory service. The period of time for which the bond is required shall be the same as the experience period of time specified. The manufacturer must have a service representative available for installation consultation during construction and on-site for a minimum of two (2) days during start-up of operation.

2. The pumping equipment must be supplied as a complete unit, and all items furnished by the manufacturer. The principal items of equipment in each pump station shall consist of a cast iron simplex or duplex grinder pump, stainless steel discharge piping, stainless steel pump mounting plates with stainless steel guide rails and hoisting chain or cable, hydraulically sealed stainless steel discharge flange, ball check valve, gate valve or ball valve, steel pump plate cover, fiberglass containment basin, mercury switch level controls, NEMA 4 junction box, NEMA 3R control panel. In addition all fasteners, clips, washers, bolts, etc. within the basin shall also be stainless steel.
3. The sewage grinder pump station shall be as manufactured by Hydr-O-Matic Pump Division of Marley Pump Company; E. F. Myers Co.; Flygt Pump Company, Division of ITT; Peabody Barnes, Inc. of Manfield, Ohio; or Ebara Pump Company, Inc. of Torrance, California.

Pump units constructed of nonmetallic materials will not be acceptable.

B. Operating Conditions

1. Grinder pumps shall be capable of operating against fluctuating total dynamic head.
2. Pump Stations (5hp) - Each pump shall be capable of delivering a minimum rate against a normal rated dynamic head as shown on Drawing No. 7. Pump motor shall be a minimum of 5 hp, single phase, 230 volt, 60 hertz, 3450 rpm (maximum). The pumps shall not overload at any point on the performance curve and shall be free from harmful effects of cavitation at either high or low head.

3. Residential Pumps - Each pump shall be capable of delivering a minimum of 8 gpm against a normal rated total dynamic head of 90 feet with a shut-off of 110 feet. Pump motor shall be a minimum of 2 hp, single phase, 230 volt, 60 hertz, 3,450 rpm (maximum). The pumps shall not overload at any point on the performance curve and shall be free from the harmful effects of cavitation at either high or low head.

C. Pumps and Motors

1. Grinder pumps and motors shall be specifically designed and manufactured to operate in a completely submerged environment in the liquid being pumped. Electrical power cord shall be sealed by use of a cord grip, with individual conductors sealed into the cord cap assembly with epoxy sealant. The cord grip shall have a male taper pipe thread threaded into a final taper pipe thread in a cord cap. The cord cap shall be sealed into the motor housing with a Buna N O-ring, providing an electrical connection that is completely watertight, yet may be easily removed from service.
2. Grinder pumps shall be of the centrifugal type with a combination impeller-grinder assembly. Pump and motor housings shall be cast iron or gray iron. The pump impeller shall be bronze or stainless steel. All fasteners shall be stainless steel.
3. The grinder assembly shall consist of a rotating cutter and a stationary cutting ring on the suction side of the impeller so the cutting assembly discharges directing into the impeller inlet. All cutters, both stationary and rotating, shall be made of hardened and ground stainless steel and shall be adjustable externally to maintain proper clearance. The upper cutter and the stationary cutting ring shall be reversible for longer service life. In the absence of reversible cutters, a spare upper cutter and cutting ring shall be furnished with each grinder pump.
4. The pump-motor shafts shall be supported by permanently oiled upper and lower bearings. Bearings and motors shall be protected from the liquid being pumped by dual mechanical seals consisting of a stationary ceramic seal and two carbon rotating sealing surfaces.

Any water leaking past the lower seal shall be detected by an electric sensing probe mounted in the seal chamber. The probe shall be connected to the alarm light in the control panel.

5. The motor winding and rotor shall be mounted in a sealed submersible type housing which is filled with clean, high-quality dielectric oil for bearing lubrication and to transmit heat from motor winding to outer housing. The motor winding shall be securely held in the housing with machine screws so that it may be removed in the field without the use of heat or a press.

An alternate design allows the use of an air-filled motor housed in a watertight container and fitted with suitable external vanes for rapid and efficient motor cooling. The motor shall be protected by a heat sensor thermostat to stop motor in the event of overheating. Thermostat shall reset automatically when the motor cools.

D. Liquid Level Controls

Pump on and off levels shall be controlled by mercury float switches. Float switches shall be hermetically sealed in a polyurethane ball. Pump on shall also be controlled by a 12-hour timer to reduce septicity in the containment basin.

Micro switches shall be activated by a magnet sealed in the housing and shall have displacement weight mounts on corrosion-proof cable with adjustable heights.

A third control switch is required to activate a red alarm light, indicating high water level in the sump or pump seal failure. For duplex pumping systems an additional control switch is required as an override to activate both pumps, and an alternator is required to regulate pump operation.

E. Containment Basin (Sump) - Residential Only

The basin shall be a minimum of 24 inches in diameter for a simplex pumping station and 30 inches in diameter for duplex systems. The height of the sump shall be as shown on the Drawings.

The sump shall be constructed of fiberglass reinforced polyester resin molded to assure a smooth interior surface. The basin walls shall be 1/4 inch thick (minimum).

The basin shall have a heavy rib or flange extended around the base on which concrete can be placed and anchored to prevent flotation.

The basin shall be fitted with a steel cover secured in place with cap screws and sealed with caulking or a rubber gasket.

Cover shall be a minimum of 3/16-inch-thick steel coated with baked enamel. No appurtenances other than cap screw shall extend above the steel cover.

The basin shall be provided with a basin inlet flange with O-ring seal or approved caulking type seal for 4-1/2-inch O.D. plastic pipe. The flange shall be mounted in the field at the inlet height required by the installation. Electrical conduit and discharge pipe shall be provided with connections as shown on the Drawings.

F. Lifting Device

Each pump basin shall be fitted with a lifting device to allow the pump to be removed from the containment basin for service without having to disconnect or disturb permanent piping or electrical connections. The lifting device shall include upper and lower guide rails with necessary supports to attach the rails to the basin.

Guide rails, guides and lifting cable shall be stainless steel of the size recommended by the manufacturer for each size pump.

G. Concrete Foundation

Each station shall have a concrete foundation formed and bolted to the base as indicated on the Drawings.

H. Electrical Control Panel

Contractor shall install, at location remote from the pumping station, a NEMA 3R waterproof enclosure on a pedestal or on the side of the building being served, as shown on the Drawings. Location of control panel shall be as close as possible to the pump station. A lock hasp shall be provided on the panel door and a red alarm light shall be mounted on the panel. A lockable, external disconnect switch shall be mounted between the customer's breaker box and the pump control panel.

A circuit breaker shall be provided for each pump along with magnetic starter, overload protection, manual reset buttons H-O-A switches, and 115-volt control circuit or a transformer to supply 24 volts for the control circuit.

Terminal strip shall be provided for connecting pump and control wires; additional terminals shall be supplied for alarm.

Float switches shall be hung in the containment basin supported by cable held to a NEMA 4 junction box.

All junction boxes shall be constructed of PVC and mounted in a manner that will allow the removal of the motor without the discharge piping hitting the junction box.

Junction box and float hanger shall be mounted within 12 inches of top of pump station.

I. Underground Conduit

1. Contractor shall connect the remote control panel with the pumping station by means of underground conduit. No additional junction boxes shall be allowed between the control panel and the NEMA 4 junction box at the pumping station.
2. Rigid metal conduit - not used.
3. Rigid nonmetallic conduit shall be installed for all conduit both above ground and underground and shall be Schedule 80 polyvinyl chloride (PVC) electrical conduit rated for 90°C. It shall be listed by Underwriters Laboratories in conformance with the National Electrical Code. The same manufacturer shall produce the conduit, the conduit fittings, the elbows, and the joint cement. Conduits shall be as manufactured by Carlon, Borg-Warner, or equal. Burial shall conform to all local codes. In the event PVC conduit is used, the Contractor shall pull a separate grounding wire from the control panel to the pump station.
4. Where conduits terminate in steel or cast NEMA 4 enclosures with no factory-installed threaded hubs, a threaded hub shall be installed equal to Myers Electric Products, Inc., Type ST or STG; Appleton Electric Company, Type HUB; Crouse-Hinds, Type HUB; or equal.

5. All conduits terminating at motor control centers shall be suitably grounded to the motor control center ground bus using grounded type insulated bushings equal to O.Z. Electrical Manufacturing Company, BLB or IGB; Appleton, Type BIB; Thomas and Betts, 3800 Series; or equal.
6. Size of conduit and conductor shall be as shown on the Drawings.

J. Conductors

1. Conductors shall be Class B concentric stranded, soft or annealed, uncoated copper free from kinks and defects in accordance with ASTM B 3 or B 8.
2. Conductors should have a conductivity not less than 97 percent.
3. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2-foot intervals.
4. All wires shall conform to the latest standards of the ASTM and IPCEA and shall be tested for their full length by these standards.
5. Insulation thickness shall be not less than that specified by the National Electrical Code.
6. All control circuit wiring and all wiring No. 8 AWG and larger shall be stranded. Lighting branch circuits No. 12 and No. 10 AWG may be solid. Wiring shall be stranded as follows:
 - a. No. 14 through No. 2 AWG shall have a minimum of 7 strands.
 - b. No. 1 through No. 4/0 AWG shall have a minimum of 19 strands.
 - c. No. 250 MCM through No. 500 MCM shall have a minimum of 37 strands.
7. All circuits except control and instrumentation circuits shall have a separate grounding conductor carried in the conduit.

PART 3 - EXECUTION

3.01 INSTALLATION AND TESTING OF PVC PIPE, FITTINGS, AND VALVES

- A. All provisions with respect to trenching, backfilling, bedding, and pipe laying shall conform to the applicable requirements of the section entitled "Earthwork" of these Specifications.
- B. Contractor is responsible for locating and tapping into the existing line between the house and septic tank and installing pipe from wye to the grinder pump as shown on the Drawings. Care shall be taken to maintain flow to the septic tank until the system has been approved to accept this flow.
- C. When a joint consists of a PVC flange and a metal flange, the metal flange shall be flat faced and furnished with a full face resilient gasket.
- D. PVC valves shall be installed with the flow arrow in the proper direction. Union nuts on PVC valves shall be tightened only hand tight in accordance with manufacturer's instructions. Spare O-ring seals and seats shall be furnished with each PVC valve.
- E. Where specifically shown or called for on the Drawings, service line taps into PVC pipe shall be made using tapping saddle constructed for use on PVC pipe. The saddle shall be constructed of bronze or brass, shall have all stainless steel bolts or screws, and have a resilient rubber gasket to provide a positive, watertight seal.
- F. PVC pipe laid under ground shall have a minimum of 48 inches of cover in traffic areas and 30 inches of cover in non-traffic areas.
- G. Field Testing
 - 1. After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.

2. All piping shall be subject to a hydrostatic gauge pressure equal to the rated pressure class of the pipe being tested. The allowable leakage shall be as shown in Table 1. The duration of the test shall be a minimum of 2 hours.
3. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
4. All piping shall be securely anchored and restrained against movement prior to application of test pressures. Prior to the pressure test, pipe laid in trenches shall be partially backfilled adequately to secure the pipe during the test. All joints, fittings, and valves will be left open where possible. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test.
5. Before applying the specified test pressure, all air shall be expelled from the pipe. If blow-offs or air release valves are not available at the high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
6. Any excessive leakage developing during the test shall be corrected at the Contractor's expense. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility meeting the specified leakage limits.
7. After all tests on any section have been completed to the satisfaction of the Engineer, the Contractor shall carefully clean, blow out, and drain the line of all water to prevent the freezing of the same. The Contractor shall all demonstrate to the satisfaction of the Engineer that any and all lines are free from obstructions and foreign material.
8. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and any other material required to conduct the tests.

9.

TABLE 1
ALLOWABLE LEAKAGE
U.S. Gallons per 100 Joints per Hour

| Pipe Diameter (inches) | <u>Test Pressure (psi)</u> | | | |
|---------------------------|----------------------------|------|------|------|
| | 50 | 100 | 150 | 200 |
| 4 or less | 0.35 | 0.50 | 0.60 | 0.75 |
| 6 | 0.53 | 0.75 | 0.90 | 1.10 |
| 8 | 0.70 | 1.00 | 1.20 | 1.40 |
| 10* | 0.88 | 1.25 | 1.50 | 1.75 |
| 12* | 1.05 | 1.50 | 1.80 | 2.10 |

*Single-gasket coupling is one joint. Twin-gasket coupling is two joints.

3.02 INSTALLATION AND TESTING OF SEWAGE GRINDER PUMPING SYSTEMS

- A. Installation of the sewage grinder pumping system shall be in accordance with written instructions provided by the manufacturer.

- B. The manufacturer shall also provide seven copies of an operation and maintenance manual covering general operating procedures, operation, maintenance, and servicing procedures of the major individual components, and a trouble-shooting guide.

- C. The Contractor shall provide the services of a technical representative of the equipment manufacturer to supervise the final adjustments of the system, perform such operating tests as will assure the Engineer that the equipment is in proper adjustment and satisfactory operating condition, and to instruct and train the Owner's operating personnel in the use of the equipment for a minimum of one (1) day. This service shall be rendered after installation of the equipment has been completed and the entire project is ready for operation.

- D. The complete sewage grinder pumping system shall be in good working order before it is turned over to the Owner for acceptance and operation.

3.03 INSTALLATION AND TESTING OF ELECTRICAL SERVICE

- A. No existing electrical service shall be interrupted without the permission of the Owner.
- B. All equipment shall be mounted using approved bolts, anchors, and fasteners. Adhesives shall not be used to mount electrical devices.
- C. Panel boards installed against concrete or basement walls which may become damp shall be separated from the wall by 1/4-inch spacers.
- D. Installation shall be in conformance with the manufacturer's recommendations and instructions and in conformance with all local codes.
- E. After installation, circuit breakers shall be checked for proper operation and all connections checked for tightness and security.
- F. All cables and leads shall be tested for continuity and power.
- G. During construction, all installed conduits shall be temporarily plugged, capped, or otherwise protected from the entrance of dust, trash, moisture, etc., and to prevent any conduits from becoming clogged. No conductor shall be pulled in until all work that might cause damage to the conduit or conductors has been completed.
- H. Conduit straps or brackets secured to concrete, brick, or masonry shall be by means of expansion bolts, toggle bolts, or approved drill anchors. No wood plugs will be permitted.
- I. Conduits supported from building walls shall be installed with at least 1/4-inch clearance from the wall using pipe spacers equal to Appleton Electric Company, T&B Company, Steel City, or equal. Clamp back to prevent the accumulation of dirt and moisture behind the conduit.
- J. Field bending of polyvinyl chloride conduit shall be made with appropriate equipment. No torches or flame-type devices shall be used.
- K. When joints are to be made with polyvinyl chloride conduit, the conduit shall be cut with a fine-tooth saw and deburred. Conduit ends shall be wiped clean of dust, dirt, and shavings and shall be dry. A solvent cement shall be applied to bond the joint. The joint shall be watertight.

- L. Conduit shall be installed in accordance with the manufacturer's specifications and recommendations and shall conform to all local codes.
- M. After installation, conductors shall not have dents, scars, cuts, pressure indentations, abraded areas, etc.
- N. Conductors 600 volts and below shall not be bent to a radius less than 12 times the cable diameter. Conductors above 600 volts shall not be bent to a radius less than 24 times the cable diameter.
- O. Conductors may be coated with talc, soapstone, Ideal "Yellow 77" or "Wire Lube," Electro-Compound "YER-EAS," or equal, to facilitate pulling into raceways, but in no case may they be greased or coated with any substance injurious to conductor installation and strongest component of conductors, normally the metallic conductors themselves and not on the insulation jacket. When installing cable in conduit with pulling eye attached to copper conductor, the tension shall not exceed 0.008 pound per circular mil area of the conductor not 5,000 pounds, whichever is smaller. When a basket grip is used over the outer jacket of the cable, the maximum pulling tension shall not exceed 0.008 pound per circular mil area of the conductor not 1,000 pounds, whichever is smaller. In no case shall pulling tensions recommended by the wire manufacturer be exceeded. The maximum sidewall pressure exerted on the insulation and sheath at a cable bend shall not exceed 300 pounds per foot of conduit bending radius. Conductors shall not be pulled "through" any outlet, conduit or box. Separate "pulls" shall be made on each side of such point.
- P. Contractor is responsible for installation of electrical service from grinder pump to an electrical control panel, also installed by Contractor. Contractor also is responsible for providing power to the control panel from property owner's existing fuse box. All electrical work must be approved by the City's electrical inspector.

END OF SECTION