SECTION 02722

SANITARY SEWERAGE SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Installation of sanitary sewerage systems.

1.02 RELATED WORK

A. Section 02221: Trenching, Backfilling and Compaction

B. Section 02305: Boring and Jacking

C. Section 02605: Separation of Piped Utilities

D. Section 03300: Concrete Work

1.03 REQUIREMENTS

A. House connections must be made with Y connection. No saddles or tees will be allowed.

B. Cut sheets will be given to inspector before work begins.

C. Sewer Systems must be cleaned, tested and visually inspected with all repairs made before installation of base asphalt.

D. All brick adjustments to manhole tops are not to be over 18" in depth including frame and cover.

E. No flexible pipe (N-12, A 2000, etc.) will be allowed.

F. On new construction tying to existing system, new line is to be closed off until new system is tested and cleaned, inspector must approve placing in service.

G. A minimum of 24 hours notice will be given to the inspector for all testing.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D-1784.

B. Unless otherwise specified, all PVC pipe and fittings shall conform to ASTM D-3034 and have a Standard Dimension Ratio (SDR) of 26.

C. The gaskets used for joining PVC sewer pipe shall conform to ASTM F-477.

D. All PVC gravity sewer pipe shall be clearly marked with the manufacturer's name, nominal diameter, SDR, ASTM D-3034, and NSF approval seal.

2.02 DUCTILE IRON PIPE AND FITTINGS

A. Pipe:

1. Manufactured in accordance with ANSI A-21.50 (AWWA C-151) and ANSI A-21.10 (AWWA C-110).
2. A cement lining meeting the requirements of ANSI 21.4 (AWWA C-104).
3. A minimum of 1 mil thick bituminous coating on the outside surface.
4. Clearly mark with manufacturer's name, D.I. or Ductile, weight, class or nominal thickness, and casting period.
5. Unless otherwise specified or shown on the plans, ductile iron pipe shall be Class 50 for 200 psi working pressure.

B. Fittings:

1. Fittings 4" – 24": Pressure rated at 350 psi.
2. Fittings 30" – 36": Pressure rated at 250 psi.
3. Joints meeting the requirements of ANSI A-21.11 (AWWA C-111)

2.03 CONCRETE MATERIALS

A. 4000 PSI in accordance with Section 03300.

2.04 IF CASTINGS FOR FRAME AND COVERS

A. Gray iron, Class 30, unless otherwise specified, meeting AASHTO M-108.

B. Cleaned and coated with bituminous paint that will produce an acceptable finish that is not affected by exposure to hot or cold weather.

C. Rings and covers for use on watertight manholes shall be machined to a smooth uniform bearing that will provide a watertight seal.

2.05 PRECAST MANHOLES

A. AASHTO M-199 SR or ASTM C-478.

B. Openings shall be provided for the required number and size pipes and shall be marked to insure installation at proper locations.

C. Use premolded rubber or approved bituminous gaskets at all joints between sections in sanitary sewer manholes.

2.06 MANHOLE STEPS

A. ASTM C-478.

B. Cast Iron Steps: ASTM A-48, Class 30.

C. Aluminum Steps: fabricated from aluminum alloy 6061, T6.

D. Manhole steps shall be corrosion resistant, free from sharp edges, burrs, or other projections, which may be a safety hazard and shall be of sufficient strength to be a live load of 300 pounds imposed at any point.

E. The minimum width of cleat shall be 10 inches.

F. The legs and struts shall be of sufficient length for the cleat to project a minimum clear distance of 4" form the wall when the step is securely imbedded in the manhole wall.

G. The top surface of the cleats shall be designed to prevent foot slippage.

2.07 PIPE ENTRANCE COUPLINGS FOR MANHOLES

A. For pipe diameters 12" and smaller: ASTM C-425.

B. Where flexible pipe is used, the rigid manhole entrance coupling shall be of confined rubber O-ring meeting ASTM C-428 and ASTM D-1869.

C. Other specially designed flexible products such as "KOR-N-SEAL" may be approved where available and where materials meet the requirements of ASTM C-425.

PART 3 EXECUTION

3.01 PREPARATION

A. Prior to laying pipe, prepare a suitable bedding according to Section 02221.

B. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.

C. Swab the interior of the pipe to remove all undesirable material.

D. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

3.02 INSTALLING GRAVITY SANITARY SEWERS

A. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.

1. Where laser equipment is used, provide offset hubs at every manhole location for purposes of checking grade between sections.

2. Where batter boards are used, furnish stakes at intervals of 50 feet along the route of the pipeline.
3. Set stakes at such distance from centerline of excavations as is suitable for the excavating method and machinery used.
4. Provide and use accurately set batter boards at each 50-foot interval in establishing the bottom invert of each pipe laid.

B. Accurately establish the centerline of each pipe using a string stretched between targets and a plumb line extended to the centerline of the pipe.

C. Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject and remove any defective pipe or fitting from the job site.

D. Lay pipe progressively up grade, with bell upstream, in such a manner as to form close, concentric joints with smooth bottom inverts. Joining of all pipe shall be in accordance with manufacturer's specifications.

E. Bed each pipe section in accordance with Section 02221.

F. Unless otherwise specified, provide all gravity sewer lines with a minimum of 4 feet of cover in roadways and 2 feet of cover in open areas, unless ductile iron pipe or concrete encasement is used.

G. Do not allow walking on completed pipelines until backfill has been placed to a depth of at least 6 inches above the crown of the pipe.

H. Keep the interior of the pipe free of all unneeded material, and upon completion of a section between any two manholes it shall be possible to view a complete circle of light when looking through the pipe.

I. When laying pipe ceases, close the open ends of the pipe with a suitable plug for preventing the entrance of foreign materials.

J. Couplings and adapters used for joining dissimilar gravity pipe materials, for repairing and rejoining sections of gravity sewer, and for connecting the first full joint of pipe to a short stub through a manhole wall shall meet the requirements of ASTM C-594.

K. All couplings and adapters for gravity sewer pipe shall be of rubber, plastic and metallic materials that will not be attacked by municipal wastewaters or aggressive elements in the soil and conform to ASTM C-425, Section 5.

3.03 INITIAL PROOF TESTING OF SANITARY SEWERS

A. It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance.

B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, cleanliness and leakage.

C. In the event that four or more reaches fail to satisfactorily pass proof testing procedures, cease pipe laying until deficiencies are identified and corrected.

D. The basis for grade, alignment and cleanliness testing will be visual inspection. Leakage testing will be by means of low-pressure air as specified hereinafter.

E. Proof test flexible pipeline installation for deflection by pulling a "go-no go" test mandrell through the line after the initial backfill is complete to avoid unnecessary dig-ups 5% maximum defection.

3.04 LOW PRESSURE AIR EXFILTRATION TEST

A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 3½ to 2½ PSIG.

B. Times for mixed pipe sizes of varying lengths should be calculated as described in ASTM, C828-76T using formula $t = k\ d/q$ ($q = .0020$).

C. The following times are for one pipe size only:

Minimum Test Time for Various Pipe Sizes
(Based upon ASTM C828-80)

Nominal Pipe Size, in.	T (time) min/100 ft.	Nominal Pipe Size, in.	T (time) min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

3.05 SEWER MANHOLES – GENERAL

A. Unless otherwise specified, all manholes shall have an inside diameter of not less than 4 feet and a vertical wall height of not less than 2.5 feet.

B. The clear opening in the manhole shall be not less than 2.0 feet.

C. Depth of the manhole shall be the vertical distance from the lowest invert in the manhole to the base of the ring.

1. All manholes 8 ft deep or deeper shall be furnished with a cone section.
2. Manholes less than 8 ft deep may be furnished with a flat top.

D. When PVC is installed, secure the pipe to the manhole wall by means of a transite manhole coupling with O-ring assembly, conforming to ASTM C594

1 Use non-shrink grout on pipes or couplings through manhole walls.

E. Apply two applications of bituminous material to the outside of each manhole section prior to backfilling.

F. Backfill manholes with the same material used for pipelines.

3.06 STANDARD PRECAST CONCRETE MANHOLES

A. ASTM C478

B. The base of the manhole shall be 4000 psi condrete not less than 8" in depth with inverts not less than 4" in depth.

C. Shape manhole inverts from 3000 psi concrete to be smooth, accurately shaped, and in accordance with the plans.

D. Inlets and outlets form each manhole shall be finished smooth and flush with the sides of the manhole walls so as not to obstruct the flow of liquid through the manhole.

E. When possible, the base of the manhole shall be poured on dry, consolidated and undisturbed soil.

F. When wet or unconsolidated material occurs or when over-excavation of the base occurs, provide a sub base with a minimum of 12" of Class I, granular material, well compacted with mechanical tamping equipment.

G. When completed, the manhole shall be free from channel obstructions and leakage.

H. Seal joints between sections with a rubber O-ring or "RAM-NEK" gasket as shown on the Plans.

3.07 "CAST-IN-PLACE" CONCRETE MANHOLES

A. Manholes shall conform to the dimensions outlined on the plans.

B. The vertical forms, wall spacers, steps and placing cone must be carefully positioned and firmly clamped in place before any placement is made.

C. The wall spacers must be located 90 degrees from each other.

D. Use 4000 psi concrete with a maximum slump of 4" per Section 03300.

E. First place approximately ½ yard of concrete evenly around the walls and vibrate until there is a minimum slope of 60 degrees from the bottom of the forms to the bearing surface both inside and outside of the manhole.

F. When this is complete and before additional concrete is added, vibrate the concrete on each side of each pipe.

G. Deposit additional concrete in evenly distributed layers of about 18" with each layer vibrated to bond it to the preceding layer.

H. Raise the wall spacers as the placements are made, with the area from which the spacer is withdrawn being carefully vibrated.

I. Excessive vibration is to be avoided.

J. A maximum of 2% Calcium Chloride may be added to the concrete, at the Contractor's option, to speed the set.

K. Remove the forms as soon as the concrete has sufficiently set, but not within 6 hours of pouring and not without approval.

L. Excessive honeycombs will be cause for rejection of the manhole. Honeycombs and other imperfections shall be mortared as soon as possible after form removal so that a proper bond will take place.

M. Form marks and offsets of up to 1" will be permitted on the outside surface of the manhole.

N. Form marks and offsets up to ½" will be permitted inside of the manhole.

O. All offsets on the inside surface of the manhole will be smoothed and plastered so there is no projection or irregularity capable of scratching a worker or catching and holding water or solid materials.

P. Honeycomb will be plastered with mortar, consisting of two parts of masonry sand to one part Portland cement, immediately upon removal of the forms.

3.08 MANHOLE STEPS

A. Set manhole steps at intervals of 15 inches along the wall of the manhole.

B. The treads of the steps shall be free from mortar or other material when the manhole is completed.

C. In pre-cast manholes, the holes left to receive the steps shall be mortared smooth following placement of the steps.

3.09 MANHOLE RINGS AND COVERS

A. Grout manhole rings and covers in place with cement mortar.

B. The bearing surfaces between cast rings and covers shall be machined, fitted together, and match marked to prevent rocking.

C. All castings shall be of the types, dimensions, and weights as shown on the Plans and shall be free of faults, cracks, blowholes, or other defects.

D. Castings to be installed with lugs perpendicular to curbs.

3.10 DROP MANHOLE ASSEMBLIES

A. Drop manhole assemblies shall be constructed as outlined on the plans.

B. The material used in the drop pipe construction shall be ductile iron and 4000 psi concrete.

3.11 SEWER SERVICE ASSEMBLIES

A. Where shown on the plans or located in the field, install fittings for individual service assemblies.

1. The standard collector tap shall consist of a wye connected with a 6-inch diameter branch.
2. Use vertical risers when the depth of the collector line is greater than 8 feet or when their use will facilitate connection of individual services.
3. Plug the ends of tee branches not to be used immediately with stoppers of the same material and joints used on the collector lines.

B. Where shown on the plans or located in the field, install collector saddles by attaching to the sewer main by stainless steel bands secured by 2 bronze or stainless steel bolts, with a minimum diameter of 3/8".

C. Service pipe shall be a minimum 6" diameter and shall be installed as shown in the Plans.

1. Plug the ends of service pipe and cover the same as for collectors and interceptors (where possible).
2. The minimum grade on service pipes shall be 1% or 1/8" per foot.

D. The location shall be marked by "S" chiseled in the face of the curb and have a 2" PVC marker pipe installed at end of service line extending from service pipe to 4 ft above grade.

3.12 MANHOLE TESTING

A. Vacuum test shall be conducted on newly constructed manholes. Preliminary manhole testing shall take place following construction after all connections are made, and before backfilling. Test results derived from this test will allow for necessary repairs to be completed before further construction proceeds and hinders such repairs.

B. Equipment

1. Manhole Vacuum tester assembly and vacuum pumps manufactured any Cherne Industries or approved equal.
2. Pneumatic plugs, as manufactured by Cherne Industries or approved equal. These plugs shall have a sealing strength equal to or greater than the diameter of the connecting pipe to be sealed.

C. Procedures

1. Before entering any manhole, follow all local, state, and federal safety precautions.
2. Plug all manhole entrances and exits other than the manhole top access using suitably sized pneumatic or mechanical pipeline plugs and follow all manufacturer's recommendations and warnings for proper and safe installation of such plugs. Make sure such plugs are properly rated for the pressures required for the test. The standard test of 10" Hg. (mercury) is equivalent to approximately 5 PSIG (.03 bar) backpressure. Unless such plugs are mechanically restrained, it is recommended that the plugs are used with a minimum two times (2x) safety factor or a minimum of 10 PSIG (0.7) bar) backpressure usage rating.

   CAUTION: BRACE INVERTS IF LINES ENTERING THE MANHOLE HAVE NOT BEEN BACKFILLED TO PREVENT PIPE FROM BEING DISLODGED AND PULLED INTO THE MANHOLE.

3. Install the vacuum tester head assembly at the top access of manhole. Adjust the cross brace to insure that the inflatable sealing element inflates and seals against the straight top section of the manhole if possible.
4. Attach the vacuum pump assembly to the proper connection on the test assembly. Make sure the vacuum inlet/outlet valve is in the closed position.
5. Following safety precautions and manufacturer's instructions, inflate sealing element to the recommended maximum inflation pressure.

   CAUTION: DO NOT OVERINFLATE!

6. Start the vacuum pump assembly engine and allow preset RPM to stabilize.
7. Open the inlet/outlet ball valve and evacuate the manhole to 10" Hg. (approximately negative 5 PSIG, 0.3 bar).

CAUTION: DO NOT PRESSURIZE MANHOLE! THIS MAY RESULT IN MANHOLE DAMAGE AND/OR RESULT IN MANHOLE TEST HEAD DISLODGING FROM MANHOLE INLET!

8. Close vacuum inlet/outlet ball valve and monitor vacuum for specified test period (see table). If vacuum does not drop in excess of 1" Hg., manhole is considered acceptable and the manhole passes the test. If manhole fails the test, complete necessary repairs and repeat test procedures until satisfactory results are obtained.

Depth of Manhole (Feet)	Manhole Diameter (inches) Time (seconds)		
	48"	60"	72"
8	14	18	23
10	17	23	28
14	25	32	40
16	28	37	45
18	32	41	51
20	35	46	57
22	39	51	62
24	42	55	68
26	46	60	74
28	49	64	80
30	53	69	85

Repeat all the above test procedure after backfilling manhole for final acceptance test.

3.13 FACTORY BUILD 6' X 6' ABOVE GROUND FIBERGLASS PUMPING STATION WITH DUPLEX

A. Sewer Pumping Station

1. The station shall be built in three major sections, consisting of the wet well, steel base to support the pumps and a fiberglass enclosure.
2. The station enclosure shall contain all pumps and equipment. The enclosure shall be square with flat sides, which have doors, removable panel or other means to permit easy service access to any quadrant of the station interior. The roof section shall be easily removed for major service requirements. All exposed hardware shall be of a tamperproof design.
3. The station enclosure shall be manufactured of molded fiberglass reinforced orthopthalic polyester resins in a ratio of 30% glass and 70% resin. 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 insure long life. They must be impervious to microorganisms, mildew, mold, fungus and completely non-corrosive inside and outside.
4. Tamperproof retaining devices shall be provided to secure the enclosure side panels, to the station frame. One side panel shall have a locking access door for quick entry to the motor control center enclosure. This access door shall have a piano-type hinge and two-point latching mechanism.
5. The enclosure shall have mechanical ventilation capable of an air change in 30 minutes and be set by timing clock variable from 0 to 6 hours or other approved means.
6. The station base shall be of steel plate capable of supporting the pumps and appurtances. Bolt anchors shall be used to securely mount the plate and enclosure to the wet well. Provision for drainage inside and outside shall be provided.

7. The wet well itself shall be sized according to engineering practices and anticipated maximum flows. Construction of the wet well shall be the same as for sewer manholes except for the distance from the flow line to the bottom of the wet well.
8. The pumps shall be "T" series as manufactured by the Gorman-Rupp Company or equal specifically designed for the pumping of raw unscreened sewerage and capable of passing a three (3) inch diameter spherical solid. The shaft seal shall be the double floating, self-aligning, oil lubricated, and mechanical type. The stationary and rotating sealing members shall be of tungsten-titanium carbide alloy. The impellor shall be two vane, semi-open, and non-clog, cast in ductile iron and accessible through a removable cover plate. The pumps shall incorporate removable, molded, one piece, suction check valves.

B. Operating Conditions

1. See the Construction Drawings

C. Station Piping

1. The station suction and discharge valving and fittings shall be complete to that point where the contractor connects the riser pipes to the suction elbows and ties in the force main to the discharge outlet. The discharge check valves shall be water style swing checks with resilient seats and outside arm and spring as manufactured by the Price Valve Company or equal. The discharge shut off valve shall be gate type meeting AWWA C-500 with a wheel for operation. Said valve shall be located on the discharge side of the check valves. The pumps shall be equipped with air relief valves to permit automatic repriming.

D. Control Panel

1. The control panel shall consist of a circuit breaker and magnetic starter for each pump motor actuated by mercury tube enclosed float switches with sufficient leads to adjust the liquid level in the wet well. The control assembly shall provide means to operate each pump manually or automatically. When in the automatic mode, the control assembly shall provide a means to automatically alternate the "lead" and "Log" pumps after each pumping cycle.

2. All components shall meet the National Electric Code (NEC)

E. Control Enclosure

1. The motor and controls enclosure shall be mounted in suitable sized enclosures. Each enclosure shall be J.I.C. type, steel construction with continuously welded seams. Enclosure door shall be gasketed with neoprene and equipped with a continuous hinge and captivated closing hardware.

F. Operation

1. The mercury type float switches shall continuously operate to monitor the wet well liquid level and control operation of the pumps according to the level variations. The

system shall actuate pump motors on an alternating "LEAD" – "LAG" basis, with independently adjustable lead pump and lag pump start levels. One pump motor shall be actuated when wet well liquid rises to pre-set "lead pump start" level, and shall be shut down when wet well liquid level has been pumped down to the pre-set "stop" level. If after the lead pump motor has been actuated and the level rises to level to start the "lag" pump, both pumps shall continue to operate in parallel until the wet well liquid falls to pre-set "stop" level.

2. The "Lag" pump operation shall be independent of "Lead" pump operation. Circuitry which provides "lay" pump operations contingent on proper "Lead" pump circuit operation is not acceptable.

G. Components

1. All motor branch circuit breakers, motor starters and control relays shall be securely fastened to the removable back panel with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
2. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors. Operation handles for the disconnect mechanism shall be located on the exterior of the motor control center door, with interlocks which permit the door to be opened only when the circuit breakers are in the "OFF" position.
3. All motor starters shall be manufactured by Furnas Electric or approved equal. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload relays shall be manual reset and shall not provide means for converting to automatic reset.
4. Pump alternator relay shall be of electrical/mechanical industrial design, class 47, as manufactured by Furnas Electric, or approved equal.

H. Time Meters

1. The panel shall be equipped with elapsed time meters to indicate total running time of each pump in "hours" and "tenths of hours". Elapsed time meters shall be HK series as manufactured by Eagle Signal, or approved equal.

I. Gauging

1. Each pump shall be equipped with a suction compound gauge. Gauges shall be glycerin-filled type, graduated in "P.S.I." and "inches of mercury".

J. Heater

1. The heater shall be a Titam "Milkhouse Style" type NO. 2H934 or equal. The heater shall be 1300/1500 with a high BTU rating of 5120. The fan shall be heavy duty and the cabinet shall be made from 20-gauge steel with two-tone gray enamel finish. The heater shall also contain an automatic thermostat with an off position and automatic tip over.

K. Auxiliary Receptacle

1. A 115VAC 15 AMP Duplex Receptacle shall be inside the pump station enclosure. The receptacle shall have a weather proof cover and be GFI (Ground Fault Interrupter) protected.

END OF SECTION