

THE MARSHALL TOWNSHIP MUNICIPAL SANITARY

MINIMUM STANDARDS

FOR THE DESIGN AND CONSTRUCTION OF SANITARY SEWER PUMP STATIONS

**ADOPTED 2/25/2014
REVISED AND CURRENT AS OF 2/25/2014**

This document may be purchased at the Authority's Main Office:

**Marshall Township Municipal Sanitary Authority
525 Pleasant Hill Road
Wexford, PA 15090**



**Prepared by
Groundwork Civil**

THE MARSHALL TOWNSHIP MUNICIPAL SANITARY

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FOR THE DESIGN AND CONSTRUCTION OF SANITARY SEWER SYSTEMS

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SECTION 3 RAW SEWAGE PUMPING STATIONS

Note: Sections 1, 2 and 4 are under separate cover.

3.0 PUMP STATIONS

3.1 WET WELL/DRY WELL TYPE PUMPING STATIONS

3.2 WET WELL MOUNTED TYPE PUMPING STATIONS

3.3 STANDBY GENERATOR

3.4 AUTO DIALER

3.5 SUBMERSIBLE SEWER PUMP STATION EQUIPMENT

SECTION 3.0 – PUMPING STATIONS

- A. The following types of pumping stations are the permitted installations by the Authority based on the ultimate build-out of the watershed tributary to the proposed station location.

<u>Type</u>	POTENTIAL WATERSHED BUILD-OUT⁽¹⁾		
	<u>25 or less EDU's</u>	<u>26 – 75 EDU's</u>	<u>Greater than 75 EDU's</u>
Low Pressure Sewer System	X		
Submersible Pump Station	X ⁽²⁾	X ⁽²⁾	
Wet Well Mounted Pump Station		X ⁽²⁾	X ⁽²⁾
Wet Well/Dry Well Pump Station			X

⁽¹⁾ Watershed as determined by the Authority.

⁽²⁾ Permitted use by Authority approval only.

- B. The pump station building shall be of the walk-in type, of the size and dimensions as shown on the Standard Detail Drawings. The building shall be constructed of fiberglass, aluminum, or block/brick with a pitched roof dependent upon the pump station location

and the decision of the Authority. Fencing shall be provided around fiberglass building, but shall not be required for block/brick building.

C. The pump station building shall house at a minimum, the following components:

1. Emergency stand-by power generator.
2. Electrical panels.
3. Door system with width to accommodate generator removal.
4. Lighting.
5. Exhaust fan, louvers, and dampers.
6. Unit heater.
7. Man down switches near floor for emergency.
8. Switches for lights, fan, and unit heater.
9. Receptacles.
10. Chemical system for odor control if required by the Authority.

D. Aluminum enclosures, as specified in Section 3.3.6 of these Minimum Standards may be used only as an alternate with Authority approval. The aluminum enclosure shall meet all applicable building codes and other regulations to the municipality in which it is to be located. Architectural and structural requirements, including but not limited to, foundation design, wall, roofing, insulation, etc., will be as imposed by the Authority.

3.1 **WET WELL/DRY WELL TYPE PUMPING STATIONS**

3.1.1 **GENERAL**

- A. Factory-built, automatic pumping stations, shall have all items necessary for a complete facility, including but not limited to: wet well/dry well system, standby generator, concrete work, site piping, fences and other site work. Each pumping station shall be complete with all needed equipment factory-installed in a welded steel chamber with welded steel entrance tube and with a maintenance lift to provide access.
- B. The principal items of equipment for each pumping station shall include a minimum of two vertical, closed-coupled, motor driven, non-clog pumps; valves; internal piping; flow metering equipment; central control panel with circuit breakers, motor starters and automatic pumping level controls; lighting; sump pump; ventilator; dehumidifier; maintenance lift; tele-metering; standby generator; and all internal wiring and service entrance. Also Authority approved alarm system, heater and wet well aerators are required.
- C. The exterior of the station shall be designed so all welds exposed to ground water after installation are continuous or sealed throughout their length so

that water cannot seep between uncoated steel surfaces. In addition, the structure shall be designed so that sharp corners and similar difficult-to-coat conditions are held to an absolute minimum. The thickness of the steel cylinder shall be determined by the structural requirements for the depth of bury involved and shall be a minimum of 1/4". It shall be the responsibility of the Manufacturer to determine the structural requirements of the shell based on the external loads specified on the plans.

- D. Lifting eyes adequate to support the entire weight of the pump station shall be provided and welded to the station head. Tie-down holes shall be provided for anchoring the discharge line at the point it leaves the station. Lifting loops shall be located on the ceiling of the pump station over each pump at an adequate height to permit a hoist to be used for pump disassembly.
- E. A sump with a wall of 1/4" structural-grade steel plate shall be provided. Where the ductile iron suction and discharge lines pass through the station walls, they shall be reinforced with 1/4" thick steel sleeves, welded inside and out to the station wall. The space between the ductile iron pipes and the steel sleeves shall be packed tight with grout to prevent leakage.

3.1.2 **OPERATING CONDITIONS**

- A. Sewage Pumping Stations shall have a minimum of two pumps capable of delivering raw, unscreened sewage at a rate in accordance with the provisions set forth in the Pennsylvania Sewerage Manual. The maximum allowable speed for the pumps shall be 1760 RPM. All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter.

3.1.3 **PUMP CHAMBER**

- A. The station shall be built by the Manufacturer in two major sections, consisting of the pump chamber and the required section(s) of entrance tube, for ease in shipment and handling. These sections shall be joined at the job site by welding.
- B. The field weld joints shall then be cleaned and heavily coated with Versapox - epoxy resin, provided by the Manufacturer. The pump chamber shall contain all pumps and other equipment and shall be a vertical cylinder of circular cross-section. The top and bottom of the station shall be 3/8" thick. Steel plate shall meet or exceed ASTM A-36 specifications.
- C. Pumping stations shall be as manufactured by Smith and Loveless, Inc., Lexena, Kansas. Substitute equipment will be considered for one reason only: that the equipment is superior or equal in construction and efficiency

to that described in these specifications. **Contractor** shall supply shop drawings of pumping station to the **Authority** for review and evaluation of efficiency and long term operating costs. **Authority** or his designated representative shall be the sole judge as to the acceptability of substitute equipment based upon the results of said evaluation.

3.1.4 **ENTRANCE TUBE**

- A. The entrance tube shall be provided in one or more sections as required and the diameter shall be as shown on the drawings. The entrance tube shall be constructed of structural grade steel plate that meets or exceeds ASTM A-36 specifications. The length shall be adequate to place the cover above the surrounding ground as shown on the drawings. The entrance tube shall be adequately stiffened and the field joints arranged so that the joint may be welded from the outside of the tube with all welding being performed in a down-hand position. The bottom of the tube shall be attached to an angle, shop welded to the head of the pump station. This field joint shall also be weldable in the down-hand position. Two lifting loops shall be provided on each section of entrance tube for handling and installation.
- B. A PVC ventilation duct with inlet vent shall extend from the top of the entrance tube into the station. The inlet vent shall be covered with a screen to exclude rodents and foreign objects.
- C. The entrance tube cover shall be of fiberglass reinforced plastic and shall have a reflective color to reduce heat absorption. The cover shall have a suitable drip lip around the edge and shall be provided with a weatherproof lock of the pin tumbler type which can be opened from the inside without a key. The lock shall be self-locking upon closing the lid.
- D. The fiberglass cover shall have a rung which forms an extension of the access ladder when the cover is latched in the open position. A latch mechanism shall be provided to keep the cover open under any normal load.
- E. The access ladder shall be of heavy aluminum construction and have grooved non-slip rungs spaced on 12" centers.

3.1.5 **MAINTENANCE LIFT**

- A. General - Sewage Pumping Stations shall be equipped with a power operated, chain driven maintenance lift unit, designed and manufactured by the pump station manufacturer to contribute to the personal safety of the operator and to facilitate access to the station. The lift shall have a minimum rated carrying capacity of 440 pounds and, when fully loaded, shall move at a rate not to exceed 25 feet per minute.

- B. Construction - The maintenance lift unit shall consist of a frame welded steel construction, operating on guide rails securely welded to the sides of the ladder in the entrance tube and lift station. The aluminum grating floor of the lift shall have an area of not less than four square feet and shall be easily removable for emergency exit or entrance to the station by means of the ladder. The lift shall be enclosed by framework guards on the both sides securely bolted in place.
- C. The guards shall be of welded steel construction and shall incorporate integral ladder rungs to facilitate entry to and egress from the lift when stopped at the top of the entrance tube. Solid steel toeboards shall be provided across the base of the guard work on both sides. The lift shall be so constructed as to operate with a clearance directly to the front, of at least four inches, measured from any point between the toe board and entrance tube.
- D. The drive unit shall consist of a 3/4 HP, 1800 RPM, 240/480 volt, 3 phase, ball bearing electric motor operating through a self-locking, non-reversible worm gear reduction unit and equipped with an electrically released, mechanically operated brake to stop the lift upon power or control failure and to prevent coasting of the lift during normal operation. The gear reduction unit shall have two output shafts.
- E. The motor and reduction gear unit shall incorporate two drive sprockets on each output shaft so that movement of the lift shall be accomplished by four supporting roller chains. Each chain shall be independently spring-loaded at both ends to prevent slack and to automatically equalize the lifting loads. Each chain shall be capable of supporting the entire weight of the lift plus the maximum rated load of 440 pounds, with a safety factor of not less than eight.
- F. The lift shall be maintained in proper alignment by two needle bearing guide wheels traveling on each side of each of the guide rails. Two additional guide wheel assemblies shall be installed at each guide rail to absorb any side thrust imparted to the lift.
- G. To facilitate electrical connections, an automatic rewind cord reel, complete with heavy-duty, four-conductor jacketed cable shall be located near the bottom of the guide rail ladder assembly in the pump station. The cord reel shall be of ample capacity to permit full travel of the lift, maintaining tension on the cord at all times without undue strain. The cord shall enter the lift through the strain relief bushing which is designed to prevent a strain on the conductors themselves.
- H. To facilitate installation and maintenance, the front of the lift unit shall be removable to gain access to the operating components.

- I. All fabricated steel components of the maintenance lift unit shall be protected from corrosion by a single heavy inert coating of Versapox epoxy resin, excepting chain, sprockets, control panel and gear motor. The dry coating shall contain a minimum of 85% epoxy resin with the balance being pigments and thixotropic agents.
- J. Safety Features and Control - A maintenance lift control panel having a NEMA 12 enclosure shall be provided, securely mounted inside the pump station. Separate motor controllers shall be used for each direction of travel and each controller shall be equipped with thermal overload relays, sized to prevent operation with loads in excess of 150% of rated capacity. The entire maintenance lift unit control system shall operate on 115 volt, single phase, 60 cycle AC service.
- K. The maintenance lift unit shall be equipped with up-down control switches on the lift and on the maintenance lift control panel in the pump station. Control switches shall be of a type that requires constant pressure for operation. A two-position selector switch on the lift shall determine which of the two control switches will control the movement of the lift.
- L. A red-mushroom-head push button marked "**Emergency Stop**" shall be installed on the lift and a pressure-operated safety switch shall be installed under the lift platform. This safety switch shall cover the entire area of the bottom of the lift and operate if the lift is obstructed in its downward travel by a force exceeding four pounds. Both the emergency stop switch and the under-car safety switch shall be normally closed and momentary operation of either switch shall de-energize a normally "**on**" control system to stop movement of the lift in any direction.
- M. Following momentary operation of either switch, the control system will remain de-energized until manually reset by operation of a shielded push button on the lift. Control systems which rely on the closing of contacts or the energizing of a relay to effect stopping will not be permitted.
- N. Two independent sets of travel limit switches shall be installed in the lift mechanism. One pair of limit switches shall be installed in the hoist way and adjusted to stop movement of the lift at each end of its normal travel by interrupting the control circuits of the motor controllers. These switches shall stop the lift in its direction of travel while still allowing movement in the opposite direction.
- O. The second set of limit switches shall be installed in the hoistway and adjusted to prevent further movement of the lift in either direction should the lift not be stopped by the normal travel limit switches. These terminal limit switches shall operate an independent controller to interrupt the power

circuit to both motor controllers. All limit switches shall be of the normally closed, direct mechanical action type.

- P. A centrifugal actuated overspeed governor shall be provided. The governor shall be actuated by the movement of the car in relation to the guide rails. At a prescribed overspeed the governor shall trip two self-locking safety stopping devices. The lift shall have a machine stop as a safety device to stop the car in case of failure of a single chain.
- Q. The lift shall be installed and tested with the station at the factory. The entrance tube sections shall be temporarily assembled together to assure proper alignment of the guide rail ladder assembly when permanent installation in the field is completed.
- R. In order to assure field installation of the entrance tube sections, identical to that arrangement tested at the factory, the sections will be marked during factory testing to designate the proper arrangement.

3.1.6 **WELDING**

All steel in the station structure shall be joined by electric arc welding with fillets of adequate section for the joint involved. Where required to exclude ground water, all welded joints on the exterior of the station shall be continuous throughout their length.

3.1.7 **PROTECTION AGAINST CORROSION**

- A. After welding, all inside and outside surfaces of the structure, pumps and piping shall be steel shot-blasted to a 2-mil minimum profile commercial blast. Immediately after cleaning, a single 6-mil minimum thickness inert coating shall be factory applied to all inside and outside surfaces. The coating shall be Versapox epoxy resin, formulated for abrasion and corrosion resistance. The dry coating shall contain a minimum of 85% epoxy resin with the balance being pigments and thixotropic agents.
- B. A touch-up kit shall be provided for repair of any mars or scratches occurring during installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating. A heavy synthetic rubber mat shall be cemented to the station floor to protect the coating on the steel floor.
- C. Two 17-pound magnesium anode packs shall be provided for cathodic protection. The anode packs shall be provided with 15' long insulated copper leads. Copper lugs shall be provided by the Manufacturer on opposite sides of the station for anode connections.

3.1.8 PUMPS

- A. The pumps shall be vertical, non-clog type of heavy cast iron construction especially designed for the use of mechanical seals. In order to prevent seal wear caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, shaft diameters less than those specified shall not be acceptable. The shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1-7/8" for motor frame sizes 213 through 286; 2-1/8" for motor frame sizes 324 and 326. The dimension from the lowest bearing to the top of the impeller shall not exceed 6".
- B. The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move axially with the thermal expansion of the shaft and shall carry only radial loads. Upper thrust bearings shall not be acceptable.
- C. The shaft shall be a solid stainless steel shaft through the pump and bottom bearing to eliminate corrosion within the pump or the mechanical seal. Removable shaft sleeves shall not be acceptable.
- D. The pump impellers shall be of the enclosed type made of close-grained cast iron and shall be balanced. The impeller shall be keyed and secured to the motor shaft by a suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud. The shroud shall remain full diameter so that close minimum clearance from the shroud to volute is maintained. (In lieu of full diameter shrouds, stainless steel wear rings may be furnished.) Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.
- E. The motor shall be attached to the pump volute by a one-piece cast iron adapter and backhead. The pump shall be arranged so that the rotating element can easily be removed from the volute without disconnecting the seal system or electrical wiring or disassembling the motor, impeller, backhead or seal, so that any foreign object may be removed from the pump or suction elbow. Volute or suction elbow clean-outs will not be an acceptable substitute.
- F. The pump shaft shall be sealed against leakage by a double mechanical seal installed in bronze seal housing constructed in two sections with registered

fit. The housing shall be recessed into the pump back-head and securely fastened thereto with stainless steel cap screws. The inside of the seal housing shall be tapered to facilitate the replacement of the seal parts. The seal shall be of double carbon and ceramic construction with the mating surfaces lapped to a flatness tolerance of one light band. The rotating ceramics shall be held in mating position with the stationary carbons by a stainless steel spring. The seal housing with assembled parts shall be so constructed as to be readily removable from the shaft as a unit and shall be provided with tapped jackscrew openings to assist in removing it from the back-head.

- G. The seal shall be pressurized and lubricated by liquid taken directly from the pump backhead through a filter to the seal housing and introduced between the upper and lower sealing surfaces. The filter shall be of corrosion-resistant materials and shall screen out all solids larger than 50 microns. The seal system shall contain a brass valve connected near the top of the seal housing to permit the relief of any air trapped in the seal unit. A manually operated brass valve shall also be provided to vent the pump volute.
- H. The pump volute shall be free from projections that might cause clogging or interfere with flow through the pump.
- I. The pump shall be supported by a heavy cast iron base with four legs to provide maximum rigidity and balance. The height shall be sufficient to permit the use of an increasing suction elbow which shall be provided when the nominal pump size is smaller than the suction line.
- J. The suction and discharge openings shall be flanged, faced and drilled 125-pound American Standard.

3.1.9 **MOTORS**

- A. The pump motors shall be vertical, solid shaft, NEMA P-base squirrel-cage induction type, suitable for 3 phase, 60 cycle, 240/480 volt electric current. They shall have Class F insulation suitable for temperatures up to 115 degrees C. Motors shall be able to operate at 115% of rated load. The motors shall have normal starting torque and low starting current, as specified for NEMA Design B characteristics. The motors shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.
- B. The motors shall have 1.15 service factor. The service factor shall be reserved for the Owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design condition, nor at any head in the operating range as specified under Operating Conditions.

- C. The motor-pump shaft shall be centered, in relation to the motor base, within .005". The shaft run-out shall be limited to .003".
- D. The motor shaft shall equal or exceed the diameter specified under pumps, at all points from immediately below the top bearing to the top of the impeller. A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housing shall be provided with fittings for lubrication as well as purging old lubricant.
- E. The motor shall be fitted with heavy lifting eyes, each capable of supporting the entire weight of the pump and motor.

3.1.10 **CONTROL**

- A. All control equipment for all items listed in Paragraphs 2.23.10 through 2.23.11 shall be mounted within a NEMA Type 12, dead-front enclosure, fabricated of steel and reinforced as required. The circuit breaker, motor-starter section shall be provided with removable covers, complete with suitable latching devices. All circuit breakers, motor-starter reset buttons and pump control switches shall be mounted so that they are operable without opening the high voltage cabinet. The low voltage, automatic pump control section shall be isolated from the high voltage circuit breaker-motor starter section by a insulating barrier and shall be provided with a hinged access door and latch. The blower, timer, humidistat and thermostat shall be mounted on the face of automatic pump control section door. Pressure switches for control of the pump motors shall be mounted on the side of the cabinet. It shall not be necessary to remove the front of the cabinet to make minor adjustments to the blower timer, etc., or the pressure switches.
- B. A grounding type convenience duplex outlet shall be provided on the side of the cabinet for operation of 115 volt AC devices, NEMA 5-20R configuration.
- C. Thermal magnetic circuit breakers shall be provided for branch disconnect service and over-current protection of all motor, control and auxiliary circuits. Provide full voltage alternating current non-reversing starters, consisting of magnetic starters of types, sizes, ratings and NEMA sizes indicated. Equip starters with electrical interlocks where indicated, molded case circuit breaker or motor circuit protector and voltage/current/frequency monitoring relay(s) which trip all phases of the circuit breaker on specified occurrences of electrical service deviation. Equip starters with block type manual reset overload relays. Starters shall be Square D Class 8536 or approved equivalent.
- D. All switches shall be labeled and a coded wiring diagram shall be provided.

- E. To control the operation of the pumps with variations of liquid level in the wet well, an air bubbler system or pressure transducer system shall be provided. The pressure transducer (transducer system only) shall have a minimum opening of 1-1/2" and be designed specifically for raw water and waste water service in order to minimize maintenance. The Pump Level Control System shall be furnished complete, including two air compressors (bubbler system only), flow indicator, bubbler line (bubbler system only), and a sensitive pressure switch for each pump.
- F. To protect the pressure switches (transducer system only), the pressure transducer, connecting piping and pressure switch diagrams shall be filled with an incompressible liquid. Isolation valves shall be provided in the connecting piping for the transducers to facilitate maintenance.
- G. The two air compressors (bubbler system only) shall be of the close-coupled, oil-less type. Each compressor shall have a minimum capacity of 0.2 cubic feet of free air per minute at 10 PSI. It shall incorporate a single phase, 60 cycle, 115 volt, drip-proof, brushless type, electric motor. A motor driven timer shall be provided to automatically alternate the compressors every five minutes. Wiring and piping of the air compressors shall be so arranged that one compressor may be removed without removing the other compressor from service. If a stored air bubbler system is used, two (2) compressors with tanks shall be provided including an alternator to alternate the compressors. Additionally, a purge system to divert the full tank air pressure to the system shall be provided.
- H. The pressure switches shall be of the mercury-tube type, with sensitive pressure elements and independent high and low adjustments for each pump settable for a maximum on/off time of ten minutes.
- I. An elapsed running time meter for each pump shall be mounted on the face of the control cabinet. Each meter shall display elapsed run time in hours and tenths of hours.
- J. An automatic alternator with manual "On-Off" switch shall be provided to change the sequence of operation of the pumps on the completion of each pumping cycle. Provisions shall also be made for the pumps to operate in parallel, should the level in the wet well continue to rise above the starting level for the low level pump.
- K. Pilot devices shall be heavy duty, oiltight, of the same National Electrical Manufacturer's Association (NEMA) rating as the control panel in which they are housed. Pilot devices shall be comprised of a legend plate, the device operator and the necessary contact block(s) arrangement. Selector switches shall have the appropriate contact sequence(s) as shown. They shall have non-illuminated, standard know operators. Cams shall be field

convertible and knobs shall be black and they shall operate at 120 VAC, unless specified otherwise. Pilot lights shall be self-contained transformer type, push-to-test. Lenses shall be plastic, the color indicated on the drawings. Push buttons shall have non-illuminated operators. They shall be of the momentary contact type, unless specified otherwise. Acceptable manufacturers for pilot devices are: Allen-Bradley, Square D.

- L. Control relays shall be of the general purpose, heavy duty type, rated 10 amperes continuous at 600 VAC. They shall be provided with relay sockets, retainer clips and other accessories necessary to make the relay a complete operational device. Contacts shall be 3 form C configuration. Acceptable manufacturers are:

- 1. Allen-Bradley

- 2. Square D

- M. Timers shall be electromechanical repeat cycle type with time ranges up to 24 hours. Time settings shall be made by knob and pointer adjustment. Timer output shall be a contact closure, contacts rated at 10 amperes continuous, 120 VAC. After output times out, an internal reset circuit shall energize the clutch coil allowing the unit to reset. Acceptable manufacturers are:

- 1. Eagle Signal

- 2. Paragon

- 3. Agastat

- N. The magnetic flow meter shall be of the electro-magnetic induction type and shall produce a DC voltage signal directly proportional to the liquid rate of flow. This type meter shall be used for metering process flows. The magnetic flow meter shall be furnished with a metering tube fabricated from 300 series stainless steel with a nonconductive liner of Teflon. The metering tube shall be field replaceable. Electrodes shall be bullet nose and made of Hastelloy "C" and shall be field replaceable without removing the magmeter from the line. Mechanical cleaning of electrodes shall not be permitted. End connections shall be 150 lb. ANSI flanged steel. The meter shall be sized for the flow range specified. The induction field of the flow meter coils shall produce continuous heating within the meter to prevent sludge and grease build-up. No periodic shutdown for liner cleaning shall be necessary. The ratio of flow velocity to reference voltage signals generated shall be identical for all sizes so that any meter shall be compatible with the secondary readout instruments without the necessity of circuit modifications. The sludge meter shall be designed for operation on 120V,

60Hz power supply. Accuracy of the metering system, including the converter and readout instruments shall be $\pm 1\%$ of full scale for a maximum flow velocity of 3 to 31 feet/second. The meter housing shall be of NEMA 4X design. Signal cable shall be provided by the manufacturer and installed by the **Contractor** between the meter, mounted signal converter and the indicator. Cable length shall be as required by the relative locations of meters and signal converters, and the indicators as shown on the Drawings. Local totalization indication shall be provided at the mag meter. Indicating totalizer shall be a Fischer & Porter Model No.52FT1210BACB, or approved equal. Totalizer shall accept a linear 4-20 mA DC input signal and shall derive its operating power from the input signal. Flow rate shall be shown as percent of full range, and total flow shall be indicated in GALLONS, 8-digit without reset. Flow rate and total flow shall be simultaneously displayed by 0.5-inch high liquid crystal displays (LCD). Accuracy of displays shall be $\pm 0.5\%$ of rate over a 10:1 range. Range shall be as directed by MTMSA. Unit shall be in a NEMA 4X enclosure. Magnetic flow meter shall be Fischer & Porter COPA-X Model 10D1465BE18PD61AW11KW or approved equal.

3.1.11 **DEHUMIDIFIER AND VENTILATING BLOWER**

- A. All ventilating requirements shall conform with the PaDEP - Domestic Waste-Water Facilities Manual.
- B. A dehumidifier assembly with hermetically sealed freon refrigeration type compressor, expansion coil, fan and condenser coil shall be furnished to maintain the relative humidity of the air in the pump chamber low enough to keep the electrical equipment dry and to prevent condensation on the walls.
- C. The moisture removing capability of the dehumidifier will vary with the temperature and relative humidity within the station. The minimum capacity rating at 80F and 68% relative humidity shall be 15.5 pints per day. The maximum capacity at 80F and 90% relative humidity shall be 25 pints per day. The dehumidifier shall be controlled automatically by an adjustable humidistat. The dehumidifier shall be located above the floor on a shelf and the condensate drained to the sump.
- D. Fresh air shall be drawn into the station through the air inlet duct in the entrance tube. The squirrel-cage ventilating blower shall have a minimum capacity of 215 CFM and shall be controlled by a 15-minute cycle timer with a range of 0-100% so as to provide essentially continuous ventilation without exceeding the capabilities of the dehumidifier.
- E. When the entrance cover is raised, the lights and ventilating blower shall be turned on automatically by a spring operated switch mounted just under the cover. A manual switch shall be mounted in the side of the duct just below

the spring operated switch for operation of the lights with the cover closed. The vent lines shall have suitable covers to prevent the entrance of rain or snow and screened openings to prevent the entrance of rocks or other foreign matter.

3.1.12 **LIGHTING**

- A. Minimum lighting shall consist of a twin 40-watt fluorescent lamp fixture provided for the convenience and safety of the operator. The lighting shall provide illumination for all areas in the station. The fixture shall be U.L. listed suitable for installation in wet locations. It shall be firmly secured to the structure and have a vapor tight, polycarbonate lense to insure that the lamps are secure in the fixture.

3.1.13 **SUMP PUMP**

- A. A submersible sump pump with close-coupled, vertical motor shall be installed in the sump. It shall have a minimum capacity of 1000 GPH at design head. The design head this pump will operate against is the static head from the sump to 3' below grade, plus allowance for pipe friction both inside and outside the pump chamber. A mechanical seal on the shaft shall exclude liquid from the motor housing.
- B. The sump pump shall be controlled automatically by a built-in float switch, capable of operation on a 5" differential. It shall discharge into the wet well through a 1-1/4" galvanized steel pipe, with two check valves and a gate valve within the pump chamber. The pipe shall enter the wet well at an elevation just below the frost line. An enclosure of 1/4" heavy galvanized steel mesh shall surround the sump and sump pump to keep out debris.

3.1.14 **PIPING**

- A. Pump suction lines shall be Class 53, plain-end, ductile iron pipe terminating outside the pump chamber, with bronze fitted, disc gate valve inside the chamber. The discharge line from each pump shall be fitted with a bronze fitted check valve and a bronze fitted double-disc gate valve. The diameter of all pipe and valves shall be as required to meet conditions of flow.
- B. The check valves shall be of the springloaded lever type so that the clapper can be lifted to back-flush the pump and suction line. Four-inch, straight-through check valves and increasing check valves up to 6" X 8" shall have stainless steel shafts with double "O" rings and grease fittings at both ends where the shaft passes through the body of the valve. Straight-through check valves 6" and larger and increasing check valves, 6" x 10", shall have stainless steel shaft with non-lubricated packing glands. The common

discharge pipe and the discharge outlet shall be Class 53, plain-end, ductile iron pipe.

- C. The air bubbler line in the station (bubbler system only) as furnished by the station Manufacturer shall be 1/2" nominal tubing, terminating in 1/2" NPT fitting in the entrance tube to accept the 3/4" piping extending to the wet well.

3.1.15 **WIRING**

- A. The pump station shall be completely wired at the factory, except for the service entrance cable and entrance light switch. All wiring in the pump station shall meet the requirements of the latest revision of the National Electrical Code and shall be coded as indicated on the wiring diagram. All wiring outside the panel shall be in conduit, except for 115-volt accessory items, which are provided with connecting insulated service cord. The Manufacturer shall provide conduit from the control panel across the ceiling, and up the entrance tube to receive the service entrance cable. The conduit shall terminate in a threaded conduit connection through the wall of the entrance tube above ground level. The service entrance fused main disconnect (NEMA 4X enclosure), cable, conduit and all necessary appurtenances including proper grounding will be provided and installed by the **Contractor**.
- B. Wire and cable shall be annealed, 98 percent conductivity, soft drawn copper. All wire and cable shall be the product of a single manufacturer. Wire and cable shall be 600 volt class insulation and shall bear the Underwriters' labels unless specified otherwise. All conductors, including 8 AWG and larger sizes, shall be stranded. All conductors, 8 AWG and smaller sizes, shall have a continuous colored outer cover. Insulated wires and cables for installation in interior raceways shall be Type THWN, as manufactured by Anaconda Wire & Cable Company, Rome-Cyprus Cable Company, or approved equivalent. Insulated wire and cable for installation in exterior raceways (above ground or underground) shall be XLP-Type USE, RHH, or RHW, cross-linked polyethylene insulation with temperature rating of 90°C.
- C. Accessory items such as the sump pump, dehumidifier and air compressor shall be plugged into selectively polarized, grounded convenience outlets, located close to their installed position so that such items can be readily removed and serviced if necessary. A 240/120 volt, dry type transformer shall be installed in the pump station, sized to accommodate all single phase load with 10 percent expansion capacity, complete with both primary and secondary protection as needed.

3.1.16 **PRESSURE GAGE**

- A. Each pump station shall have pressure gages installed on the discharge piping between the pump discharge gate valve and the station discharge junction tee. Gages shall read in psig and be graduated to a maximum scale appropriate for the maximum head of the pump station.
- B. Pressure gages shall be located such that they can be easily read from floor level or operating platform.
- C. Pressure gages shall be provided with shutoff cock or valve in sensing line. Compound gages shall be provided where normal operating pressure is at or near atmospheric. Locate pressure sensing tap so as to accurately sense fluid or gas pressure. Provide extension necks on pressure taps in insulated piping, vessels and equipment.
- D. Scale divisions for all pressure gages shall be a maximum of 1 psi for ranges up to 60 psig and a maximum of 2 psi for ranges of 100 psig and 5 psig for ranges of 300 psig and over. All gages except those for testing shall be ANSI B40.1 Grade "A". Accuracy shall be 1% or better of scale range for middle half of scale and 1-1/2% or better for remainder of scale. Scale ranges shall be selected such that normal pressure condition will fall approximately at mid scale. Scale range shall be wide enough to cover all expected extremes but should not exceed more than 15 psig beyond these extremes. Provide pulsation dampeners on all gages installed on discharge of pulsating pumps or reciprocating compressors. Install pressure gages on steam lines with pigtail siphon connection. Provide isolating seals where fluid can injure gage.
- E. All pressure gages shall be Bourdon tube type with minimum of 4-1/2 inch diameter dial, aluminum case, white face with black scale markings, brass or stainless steel movement, phosphor bronze tube and brass or stainless steel socket. Units shall have adjustment provisions for calibration without removing or bending pointer.
- F. Approved manufacturers are Dresser Industrial Instrument Operations, Stratford, CT; U.S. Marshalltown, IA.

3.1.17 **FACTORY TESTS**

- A. All components of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration, for leaks in the piping or seals and for correct operation of the automatic control system and all auxiliary equipment. The pump suction and discharge lines shall be coupled to a reservoir and the pumps shall recirculate water for a least one hour under simulated service conditions. The automatic controls shall be adjusted to start and stop the pumps at approximately the level required by the job conditions. The control panel shall undergo both a dry

logic test and a full operational test with all systems operating. These tests cannot be performed in the field. Test records, certified by a registered professional engineer, shall be provided for the specific pumps furnished. Test-frame results for impeller only will not be acceptable. Each pump shall be tested as a complete unit after installation in the station.

- B. Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor; speed indicator and a vibro-meter capable of measuring both amplitude and frequency.
- C. A description of test equipment must be included with submittal data.

3.1.18 **SPARE PARTS**

A complete replacement pump shaft seal assembly shall be furnished within the lift station. The spare seal container shall include complete installation instructions. A spare filter element for the seal filter shall also be provided, in the same container as the pump shaft seal. Spare volute gaskets for the main pumps shall also be furnished.

3.1.19 **INSTALLATION AND OPERATING INSTRUCTIONS**

- A. Installation of the pump chamber, entrance tube and related appurtenances shall be done in accordance with written instructions provided by the Manufacturer.
- B. The Manufacturer shall further provide a complete and detailed Installation, Operation and Maintenance Manual. This manual shall cover, in addition to installation and general operating procedures, the operation, maintenance, and servicing procedures of the major individual components provided with the pump station. The **Contractor** shall furnish the **Authority** with three (3) bound copies of the Manufacturer's instructions covering installation, operation and maintenance for each pump station.
- C. The Manufacturer shall provide the services of a factory-trained representative to perform initial start-up of the pump station and to instruct the **Authority's** operating personnel in the operation and maintenance of the equipment.

3.1.20 **FIELD TESTS**

- A. After the pump station has been in operation for a period of not less than three (3) weeks, field acceptance tests shall be run, under the direction of the

Authority and Engineer, to demonstrate that the capacities specified and efficiencies guaranteed for each unit can be met.

- B. For the field test the quantity of sewage pumped will be measured by a weir, the power consumption will be measured by watt-hour meters installed on the incoming feeders to the pumping station, and the total head measured by mercury manometers and pressure gauges installed on the pump suction and discharge pipe.
- C. In event it is demonstrated by the test that the capacities specified and efficiencies guaranteed by the pump manufacturer cannot be obtained, the pump manufacturer will be allowed three (3) weeks in which to make any revisions, adjustments or changes he feels necessary. During this period one pump at a time may be taken out of service. When the revisions, adjustments, etc., are completed, the pumps will be operated for a period of not less than two (2) weeks and a second test conducted. The cost of conducting all tests shall be borne by the **Contractor**.
- D. Should the pumps fail to demonstrate during the second test that they comply with the capacities specified and efficiencies guaranteed, the **Contractor** shall, at no cost to the Owner, replace them with pumping units that do comply. Not less than one (1) unit shall be maintained in service during the replacement period.
- E. The **Contractor's** attention is directed to the fact that there may not be sufficient sewage flow available to operate and test the pump station at the time he completed his work. The **Contractor** shall include the cost of supplying sufficient water to start up and test the pump station. After all adjustments have been made by the manufacturer's engineer and the station is ready to operate, the **Contractor** shall test the installations in the presence of the Engineer for final acceptance. The test shall be as hereinbefore specified.
- F. Prior to the final acceptance of the pump station or such time as the station is placed in actual continuous operation, the **Contractor** shall be responsible for the maintenance and operation and all cost thereof shall be paid for by the **Contractor**.

3.1.21 **MANUFACTURER'S EXPERIENCE**

- A. Pump stations shall be the product of a manufacturer who has installed at least twenty installations of equipment similar to that proposed, which have been in successful operation for a period of ten years or more.

3.1.22 **DETAILED EQUIPMENT PLANS AND SPECIFICATIONS**

- A. Prior to the fabrication or purchase of the equipment to be furnished under this contract, the **Contractor** shall submit to the Engineer, in quadruplicate, for approval, manufacturer's detailed specifications and drawings covering the equipment proposed. The specifications and drawings shall show the materials and details of construction of the equipment and its layout in sufficient detail to indicate its relative location and/or incorporation with other facilities. Complete structural, mechanical and electrical drawings shall be submitted to the Engineers for approval. A complete written description of the equipment, as well as bill of materials of major items, and all control items shall be submitted. The mechanical drawings of the station shall show all piping details and equipment. The electrical drawings shall include control panel details, schematic diagrams and connection diagrams of the entire electrical system.

3.1.23 **EQUIPMENT AND WORKMANSHIP GUARANTEE**

- A. The pump station shall be installed under the supervision of experienced personnel in strict accordance with the Manufacturer's instructions. Before the equipment is placed in operation, it shall be inspected by the Manufacturer's engineer who shall make all adjustments required for its successful operation.
- B. All pump station equipment and accessories furnished shall be guaranteed by the **Contractor** and Manufacturer to be free from defects in design, materials or workmanship. The **Contractor** shall replace, without cost to the **Authority**, any parts or equipment which prove to be defective or which show undue wear within one year after the equipment has been placed in satisfactory operation and accepted by the **Authority**.

3.1.24 **PATENTS AND ROYALTY FEES**

- A. Attention is directed to the fact that the **Contractor** shall assume responsibility for all patent and royalty fees on all equipment proposed.

3.1.25 **WET WELLS**

- A. The wet wells shall be constructed as approved by the **Authority** and Engineer. Ladder bars shall be installed as shown on the drawings and in conformance to Standard Drawing 2-40.
- B. The bottom of the wet well shall be filleted with concrete.
- C. Debris baskets with guides shall be furnished and installed in accordance with Standard Drawing 11-7.

- D. Hatchways provided shall be Bilco or equal, size and type as indicated on the drawings. Hatchways shall be provided with a cylinder lock with key way protected by a threaded cover plug.
- E. The manhole cover for the sewage pump station well shall be a 27 inch watertight, flush type manhole cover in accordance with Standard Drawing 2-52.
- F. The foundation slabs shall be monolithic with the pump station foundation slabs. Complete details of the foundation slab and concrete ballast shall be submitted to the Engineer for approval.
- G. The **Contractor** shall furnish all other material, appurtenances, etc., for the complete installation of the wet well in accordance with the drawings approved by the Engineer.

3.1.26 **PUMP STATION SITE PIPING**

- A. All piping required for a complete installation shall be furnished and installed. The influent gravity sewer, pump suction lines, pump discharge lines and force main shall be ductile iron pipe. The sump pump discharge shall be 1-1/4 inch galvanized steel pipe installed as shown on the Manufacturer's drawings. The air bubbler tube (bubbler system only) shall be 3/4 inch Type L copper. The bubbler pipe (bubbler system only) and sump pump discharge shall be supported from a 3 inch by 3 inch by 3/8 inch steel channel angle bracket welded to the outside of the pump station and securely fastened to the wet well wall.
- B. All steel pipe exterior to the station and in contact with the soil or with sewage shall be field coated with one coat of epoxy resin after installation.
- C. The **Contractor** shall restrict his excavation, when required to preserve undisturbed foundations for all piping. The backfill under all piping shall be mechanically tamped to prevent settlement.

3.1.27 **BACKFILL**

- A. Prior to placing the backfill around the pump station after installation, the entire structures shall be wrapped with 15 lb roofing paper to protect the surface from abrasion. **Contractor** shall place No. 2 stone backfill in the area between the dry pit and wet well to insure against settlement, as directed by the **Authority's** Representative.

3.1.28 **PAINTING**

- A. The **Contractor** shall paint the inside of the wet wells and all metal furnished under this Contract. The pump station will be furnished completely painted and shall be touched up in the field as required by field welding, scratches, etc.
- B. The **Contractor's** attention is called to the fact that all paints used shall be of a type suitable for exposure to fumes from sewage. The paints shall be a product of a reputable manufacturer and suited to the service for which they are intended. These specifications call for the use of paints manufactured by the Intertol Company of Newark, New Jersey; however, equivalent paints as manufactured by Pittsburgh Coke and Chemical Company, Koppers Company, or other approved manufacturers will be considered. In all instances, the prime coat shall be compatible with the field coat and all paints shall be applied in strict accord with the manufacturer's recommendations. All material shall be submitted to the Engineers for approval.
- C. All painting shall be performed on smooth, dry, clean surfaces at such times that meet the Engineers' approval. In order that dust proof and neat, workmanlike job be obtained, any faulty workmanship shall be corrected in a manner satisfactory to the "**Authority and Engineer**".
- D. The galvanized wrought iron ladder bars shall not be painted.
- E. All metal except the pump station and as noted in paragraph "d" shall be painted with Inertol Rust-Inhibitive Primer No. 621, shop applied. In event the shop primer coat has been damaged during shipment or erection, such damage shall be touched up with Inertol Quick-Drying Primer No. 626, or Inertol Rust Penetrating Primer No. 622 prior to application of the hereinafter specified paint. All exterior exposed metal work shall receive two finish coats of Glamortex Enamel of a color selected by the Engineers.
- F. The inside of the wet well and metal work inside the wet well shall be painted with two coats of Intertol Standard. The metal work shall receive one additional coat of Interol Standard Thick.

3.2 **WET WELL TYPE PUMPING STATION**

3.2.1 **GENERAL**

- A. Factory-built, automatic pumping stations, shall have all items necessary for a complete facility, including but not limited to: wet well mounted system, building, standby generator and enclosure, concrete work, site piping, fences and other site work. Each pumping station shall be complete with all necessary equipment factory-installed on a pre-cast concrete wet well.

- B. The principal items of equipment for each pumping station shall include a minimum of two vertical, or horizontal close-coupled, motor driven, self priming, non-clog pumps; valves; internal piping; flow metering equipment; central control panel with circuit breakers, motor starters and automatic pumping level controls; ventilating blower; heater; standby generator; and all internal wiring and service entrance. Also Authority approved alarm system and wet well aerators are required.

3.2.2 OPERATING CONDITIONS

- A. Sewage Pumping Stations shall have a minimum of two pumps capable of delivering raw, unscreened sewage at a rate in accordance with the provisions set forth in the Domestic Wastewater Facilities Manual. The maximum allowable speed for the pumps shall be 1760 RPM. All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter. The pump motors shall not be overloaded beyond their nameplate rating, at any head in the operating range.

3.2.3 CONSTRUCTION

- A. The station shall be constructed in one complete, factory-built assembly. It shall be sized to rest on the top of the wet well as detailed in the construction drawings. The station base shall be constructed and designed to insure adequate strength to resist deformation of the structure during shipping, lifting, or handling. The enclosure base shall function at the wet well top and incorporate an access cover, sized for piping connections and to permit access to the wet well from the outside.
- B. An adequate means shall be provided for lifting each pump.
- C. Pumping stations shall be as manufactured by Smith and Loveless, Inc., Lexena, Kansas or Gorman-Rupp Company, Mansfield, Ohio. Substitute equipment will be considered for one reason only: that the equipment is superior or equal in construction and efficiency to that described in these specifications. **Contractor** shall supply shop drawings of pumping station to the **Authority** for review and evaluation of efficiency and long term operating costs. **Authority** or his designated representative shall be the sole judge as to the acceptability of substitute equipment based upon the results of said evaluation.

3.2.4 WELDING

- A. All steel structure members shall be jointed by electric arc welding with welds of adequate section for the joint involved.

3.2.5 **PROTECTION AGAINST CORROSION**

- A. All structural steel surfaces shall be factory blasted with steel grit to remove rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be removed by grinding. Surface preparation shall comply with SSPC-SP6 specifications. Immediately following cleaning, a single 6-mil dry film thickness of Versapox epoxy resin shall be factory applied for abrasion and corrosion resistance.
- B. Stainless steel, aluminum and other corrosion resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components, such as the electrical enclosure, shall be furnished with the original manufacturer's coating.
- C. Finish coating shall be accomplished prior to shipment of the station from the factory and shall comply fully with the intent of these specifications. A touch-up kit shall be provided by the pump station manufacturer for repair of any mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating.

3.2.6 **PUMPS**

- A. The pumps shall be vertical or horizontal, self-priming, non-clog type of heavy cast iron construction, especially designed for the use of mechanical seals.
- B. The pump 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.
- C. The shaft shall be solid stainless or alloy steel through the mechanical seal to eliminate corrosion and abrasive rust particles.
- D. The pump impeller shall be of the enclosed or semi-open type made in cast or ductile iron and shall be balanced. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device or shall be threaded to the pump shaft and secured with a lockscrew. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud.
- E. The pump shall be arranged so that the rotating element can easily be removed from the volute without disconnecting the electrical wiring or

disassembling the motor, impeller, back-head or seal, so that any foreign object may be removed from the pump or suction line.

- F. The pump shaft shall be sealed against leakage by a single mechanical seal. Oil or water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime, in order to allow both the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.
- G. The seal materials shall be as selected by the **Authority**.

3.2.7 **MOTORS**

- A. The pump motors shall be vertical or horizontal, solid shaft, NEMA P-base, squirrel-cage induction type, suitable for 3 phase, 60 cycle, 240/480 volt electric current. They shall have Class F insulation. Insulation temperature shall, however, be limited to Class B. The motors shall have normal starting torque and low-starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.
- B. The motors shall have 1.15 service factor. The service factor shall be reserved for the **Authority's** protection. The motors shall not be overloaded beyond their nameplate rating, at any head in the operating range as specified under Operating Conditions.

3.2.8 **CONTROL**

- A. The control equipment shall be mounted in a NEMA Type 1 enclosure with a removable access cover. The circuit breakers, starter reset buttons, and control switches shall be operable without removing the access cover, for deadfront operation.
- B. A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 115 volt AC devices.
- C. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.
- D. Magnetic across-the-line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give positive

protection. Each single phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided. All motor starters shall be equipped to provide undervoltage release and overload protection on all three phases.

- E. All switches shall be labeled and a coded wiring diagram shall be provided.
- F. To control the operation of the pumps with variations of liquid level in the wet well, an air bubbler system shall be provided. The Pump Level Control System shall be furnished complete, including air compressors, flow indicator and bubbler line.
- G. An elapsed running time meter for each pump shall be mounted on the face of the control cabinet. Each meter shall display elapsed run time in hours and tenths of hours.
- H. An automatic alternator with manual "On-Off" switch shall be provided to change the sequence of operation of the pumps on the completion of each pumping cycle. Provisions shall also be made for the pumps to operate in parallel, should the level in the wet well continue to rise above the starting level for the low level pump.
- I. Pilot devices shall be heavy duty, oil tight, of the same National Electrical Manufacturer's Association (NEMA) rating as the control panel in which they are housed. Pilot devices shall be comprised of a legend plate, the device operator and the necessary contact block (s) arrangement. Selector switches shall have the appropriate contact sequence (s) as shown. They shall have non-illuminated, standard knob operators. Cams shall be field convertible and knobs shall be black and they shall operate at 120 VAC, unless specified otherwise. Pilot lights shall be self-contained transformer type, push-to-test. Lenses shall be plastic, the color indicated on the drawings. Push buttons shall have non-illuminated operators. They shall be of the momentary contact type, unless specified otherwise. Acceptable manufacturers for pilot devices are: Allen-Bradley, Square D
- J. Control relays shall be of the general purpose, heavy duty type, rated 10 amperes continuous at 600 VAC. They shall be provided with relay sockets, retainer clips and other accessories necessary to make the relay a complete operational device. Contacts shall be 3 form C configuration. Acceptable manufacturers are:
 - 1. Allen-Bradley
 - 2. Square D

K. Timers shall be electromechanical repeat cycle type with time ranges up to 24 hours. Time settings shall be made by knob and pointer adjustment. Timer output shall be a contact closure, contacts rated at 10 amperes continuous, 120 VAC. After output times out, an internal reset circuit shall energize the clutch coil allowing the unit to reset. Acceptable manufacturers are:

1. Eagle Signal
2. Paragon
3. Agastat

3.2.9 **MAIN PIPING**

- A. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness. Flanges shall be cast iron Class 125 and comply with ANSI B16.1. The discharge line shall be fitted with a check valve and plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the construction drawing. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks.
- B. Protrusions through the floor shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the volutes or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field connections can be made without disturbing the gas-tight seals.

3.2.10 **FACTORY TESTS**

- A. All components of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration, leaks in the piping or seals and correct operation of the automatic control systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.
- B. Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor;

speed indicator and a vibrometer capable of measuring both amplitude and frequency.

3.2.11 **SPARE PARTS**

- A. A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions. A spare volute and seal gasket shall be provided.

3.2.12 **INSTALLATION**

- A. Installation of the pump chamber shall be done in accordance with the written instructions provided by the manufacturer.
- B. Operating and maintenance manuals shall be furnished, which will include parts lists of components and complete service procedures and troubleshooting guide.
- C. The Manufacturer shall provide the services of a factory-trained representative for a maximum period of one day on-site to perform initial start-up of the pump station and to instruct the **Authority's** personnel in the operating and maintenance of the equipment.

3.2.13 **FIELD TESTS**

- A. After the pump station has been in operation for a period of not less than three (3) weeks, field acceptance tests shall be run, under the direction of the **Authority** and Engineer, to demonstrate that the capacities specified and efficiencies guaranteed for each unit can be met.
- B. For the field test the quantity of sewage pumped will be measured by a weir, the power consumption will be measured by watt-hour meters installed on the incoming feeders to the pumping station, and the total head measured by mercury manometers and pressure gauges installed on the pump suction and discharge pipe.
- C. In event it is demonstrated by the test that the capacities specified and efficiencies guaranteed by the pump manufacturer cannot be obtained, the pump manufacturer will be allowed three (3) weeks in which to make any revisions, adjustments or changes he feels necessary. During this period one pump at a time may be taken out of service. When the revisions, adjustments, etc., are completed, the pumps will be operated for a period of

not less than two (2) weeks and a second test conducted. The cost of conducting all tests shall be borne by the **Contractor**.

- D. Should the pumps fail to demonstrate during the second test that they comply with the capacities specified and efficiencies guaranteed, the **Contractor** shall, at no cost to the **Authority**, replace them with pumping units that do comply. Not less than one (1) unit shall be maintained in service during the replacement period.
- E. The **Contractor's** attention is directed to the fact that there may not be sufficient sewage flow available to operate and test the pump station at the time he completed his work. The **Contractor** shall include the cost of supplying sufficient water to start up and test the pump station. After all adjustments have been made by the manufacturer's engineer and the station is ready to operate, the **Contractor** shall test the installations in the presence of the Engineer for final acceptance. The test shall be as hereinbefore specified.
- F. Prior to the final acceptance of the pump station or such time as the station is placed in actual continuous operation, the **Contractor** shall be responsible for the maintenance and operation and all cost thereof shall be paid for by the **Contractor**.

3.2.14 **MANUFACTURER'S EXPERIENCE**

- A. Pump stations shall be the product of a manufacturer who has installed at least twenty installations of equipment similar to that proposed, which have been in successful operation for a period of ten years or more.

3.2.15 **DETAILED EQUIPMENT PLANS AND SPECIFICATIONS**

- A. Prior to the fabrication or purchase of the equipment to be furnished under this contract, the **Contractor** shall submit to the Engineer, in quadruplicate, for approval, manufacturer's detailed specifications and drawings covering the equipment proposed. The specifications and drawings shall show the materials and details of construction of the equipment and its layout in sufficient detail to indicate its relative location and/or incorporation with other facilities. Complete structural, mechanical and electrical drawings shall be submitted to the Engineer for approval. A complete written description of the equipment, as well as bill of materials of major items, and all control items shall be submitted. The mechanical drawings of the station shall show all piping details and equipment. The electrical drawings shall include control panel details, schematic diagrams and connection diagrams of the entire electrical system.

3.2.16 **GUARANTEE**

- A. The manufacturer of the station shall guarantee for one year from date of start-up, not to exceed eighteen months from date of shipment, that the structure and all equipment he provides will be free from defects in material and workmanship. Warranties and guarantees of the suppliers of various components in lieu of a single source responsibility by the Manufacturer will not be accepted. The Manufacturer shall assume prime responsibility for the guarantee of the station and all components.
- B. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the Manufacturer shall repair or replace, at his discretion, such defective part. He shall further provide, without cost, such labor as may be required to replace, repair or modify major components such as the steel structure, main pumps, main pump motors and main piping manifold. After start-up service has been performed, the labor to replace accessory items, such as the blower, priming pumps, alternator, etc. shall be the responsibility of others.
- C. The repair or replacement of those items normally consumed in service, such as seals, grease, light bulbs, etc. shall be considered as part of routine maintenance and upkeep.
- D. It is not intended that the Manufacturer assume responsibility for contingent liabilities or consequential damages of any nature resulting from defects in design, material, workmanship or delays in delivery, replacement or otherwise.

3.2.17 **WET WELLS**

- A. The wet wells shall be constructed as approved by the **Authority** and Engineer. Ladder bars shall be installed as shown on the drawings and in conformance to Standard Drawing 2-40.
- B. The bottom of the wet well shall be filleted with concrete.
- C. Debris baskets with guides shall be furnished and installed in accordance with Standard Drawing 11-7.
- D. Hatchways provided shall be Bilco or equal, size and type as indicated on the drawings. Hatchways shall be provided with a cylinder lock with key way protected by a threaded cover plug. Access to the wet well shall be from the outside only. The pumps and piping shall be interior with no wet well access.
- E. The pump station base slabs shall have the bottom manhole ring set into the concrete of the base slab. Complete details of the foundation slab and concrete ballast shall be submitted to the Engineer for approval.

- F The **Contractor** shall furnish all other material, appurtenances, etc., for the complete installation of the wet well in accordance with the drawings approved by the Engineer.

3.2.18 **WET WELL VENTILATION**

- A. Adequate ventilation shall be provided for all pump stations. Where the access is below the ground surface, mechanical ventilation is required, so arranged as to independently ventilate the wet well if screens or equipment requiring maintenance are located in the wet well. Switches for operation of ventilation equipment should be marked and located conveniently.
- B. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Air shall be forced into the wet well rather than exhausted from the wet well.

3.2.19 **PUMP STATION SITE PIPING**

- A. All piping required for a complete installation shall be furnished and installed. The influent gravity sewer, pump suction lines, pump discharge lines and force main shall be ductile iron or PVC pipe. The air bubbler tube shall be 3/4 inch Type L copper.
- B. All steel pipe, excluding stainless steel pipe, exterior to the station and in contact with the soil or with sewage shall be field coated with one coat of epoxy resin after installation.
- C. The **Contractor** shall restrict his excavation, when required to preserve undisturbed foundations for all piping. The backfill under all piping shall be mechanically tamped to prevent settlement.

3.2.20 **PAINTING**

- A. The **Contractor** shall paint the inside of the wet wells and all metal furnished under this Contract. The pump station will be furnished completely painted and shall be touched up in the field as required by field welding, scratches, etc.
- B. The **Contractor's** attention is called to the fact that all paints used shall be of a type suitable for exposure to fumes from sewage. The paints shall be a product of a reputable manufacturer and suited to the service for which they are intended. These specifications call for the use of paints manufactured by the Intertol Company of Newark, New Jersey; however, equivalent paints as manufactured by Pittsburgh Coke and Chemical Company, Koppers Company, or other approved manufacturers will be considered. In all

instances, the prime coat shall be compatible with the field coat and all paints shall be applied in strict accord with the manufacturer's recommendations. All material shall be submitted to the Engineer for approval.

- C. All painting shall be performed on smooth, dry, clean surfaces at such times that meet the Engineer's approval. In order that dust proof and neat, workmanlike job be obtained, any faulty workmanship shall be corrected in a manner satisfactory to the "**Authority and Engineer**".
- D. The galvanized wrought iron ladder bars shall not be painted.
- E. All metal except the pump station and as noted in paragraph "d" shall be painted with Inertol Rust-Inhibitive Primer No. 621, shop applied. In event the shop primer coat has been damaged during shipment or erection, such damage shall be touched up with Inertol Quick-Drying Primer No. 626, or Inertol Rust Penetrating Primer No. 622 prior to application of the hereinafter specified paint. All exterior exposed metal work shall receive two finish coats of Glamortex Enamel of a color selected by the Engineer.
- F. The inside of the wet well and metal work inside the wet well shall be painted with two coats of Intertol Standard. The metal work shall receive one additional coat of Intertol Standard Thick.

3.2.21 **ODOR/CORROSION CONTROL**

- A. Odor and corrosion problems can be experienced at various locations throughout the system. To prevent this problem, it is required that proposed pump stations and force mains be designed with provisions to handle and eliminate odor and corrosion causing compounds.
- B. For odor and corrosion control at the pump stations and force mains, the Contractor shall provide a chemical feed system (Chlorine, Ferrous Sulfate, etc.). The feed capacity shall be dependent on the size of the service area and force main length.
- C. The chemical feed system shall include chemical, feed system, piping and controls.

3.2.22 **PUMP STATION BUILDING**

- A. The pump station building shall be of the walk-in type, of the size and dimensions as shown on the Drawings. The building shall be constructed of fiberglass, aluminum or block/brick with a pitched roof dependent upon the pump station location and the decision of the **Authority**. Fencing shall be

provided around fiberglass building, but shall not be required for block/brick building.

- B. The pump station building shall house the pumping system (pumps, piping, panels), chemical system and if required, the Emergency Generator. The building shall come complete with the following components:
1. One (1) garage door and one (1) man door.
 2. Lighting.
 3. Exhaust fan, louvers and dampers.
 4. Unit heater.
 5. Man down switches near floor for emergency.
 6. Switches for lights, fan and unit heater.
 7. Receptacles.

3.2.23 **FLOW METER**

- A. The magnetic flow meter shall be of the electro-magnetic induction type and shall produce a DC voltage signal directly proportional to the liquid rate of flow. This type meter shall be used for metering process flows. The magnetic flow meter shall be furnished with a metering tube fabricated from 300 series stainless steel with a nonconductive liner of Teflon. The metering tube shall be field replaceable. Electrodes shall be bullet nose and made of Hastelloy "C" and shall be field replaceable without removing the magmeter from the line. Mechanical cleaning of electrodes shall not be permitted. End connections shall be 150 lb. ANSI flanged steel. The meter shall be sized for the flow range specified. The induction field of the flow meter coils shall produce continuous heating within the meter to prevent sludge and grease build-up. No periodic shutdown for liner cleaning shall be necessary. The ratio of flow velocity to reference voltage signals generated shall be identical for all sizes so that any meter shall be compatible with the secondary readout instruments without the necessity of circuit modifications. The sludge meter shall be designed for operation on 120V, 60Hz power supply. Accuracy of the metering system, including the converter and readout instruments shall be $\pm 1\%$ of full scale for a maximum flow velocity of 3 to 31 feet/second. The meter housing shall be of NEMA 4X design. Signal cable shall be provided by the manufacturer and installed by the **Contractor** between the meter, mounted signal converter and the indicator. Cable length shall be as required by the relative locations of meters and signal converters, and the indicators as shown on the Drawings.

Local totalization indication shall be provided at the mag meter. Indicating totalizer shall be a Fischer & Porter Model No. 52FT1210BACB, or approved equal. Totalizer shall accept a linear 4-20 mA DC input signal and shall derive its operating power from the input signal. Flow rate shall be shown as percent of full range, and total flow shall be indicated in GALLONS, 8-digit without reset. Flow rate and total flow shall be simultaneously displayed by 0.5-inch high liquid crystal displays (LCD). Accuracy of displays shall be $\pm 0.5\%$ of rate over a 10:1 range. Range shall be as directed by **Authority**. Unit shall be in a NEMA 4X enclosure. Magnetic flow meter shall be Fischer & Porter COPA-X Model 10D1465BE18PD61AW11KW or approved equal.

3.2A **WET WELL MOUNTED TYPE PUMPING STATIONS**

3.2A.1 **GENERAL**

- A. Factory-built, automatic pumping stations, shall have all items necessary for a complete facility, including but not limited to: wet well mounted system, building, standby generator and enclosure, concrete work, site piping, fences and other site work. Each pumping station shall be complete with all necessary equipment factory-installed on a pre-cast concrete wet well.
- B. The principal items of equipment for each pumping station shall include a minimum of two vertical, or horizontal close-coupled, motor driven, self priming, non-clog pumps; valves; internal piping; flow metering equipment; central control panel with circuit breakers, motor starters and automatic pumping level controls; ventilating blower; heater; standby generator; and all internal wiring and service entrance. Also Authority approved alarm system and wet well aerators are required.

3.2A.2 **OPERATING CONDITIONS**

- A. Sewage Pumping Stations shall have a minimum of two pumps capable of delivering raw, unscreened sewage at a rate in accordance with the provisions set forth in the Domestic Wastewater Facilities Manual. The maximum allowable speed for the pumps shall be 1760 RPM. All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter. The pump motors shall not be overloaded beyond their nameplate rating, at any head in the operating range.

3.2A.3 **CONSTRUCTION**

- A. The station shall be constructed in one complete, factory-built assembly. It shall be sized to rest on the top of the wet well as detailed in the construction drawings. The station base shall be constructed and designed to insure adequate strength to resist deformation of the structure during shipping,

lifting, or handling. The enclosure base shall function at the wet well top and incorporate an access cover, sized for piping connections and to permit access to the wet well from the out side.

- B. An adequate means shall be provided for lifting each pump.
- C. Pumping stations shall be as manufactured by Smith and Loveless, Inc., Lexena, Kansas or Gorman-Rupp Company, Mansfield, Ohio. Substitute equipment will be considered for one reason only: that the equipment is superior or equal in construction and efficiency to that described in these specifications. **Contractor** shall supply shop drawings of pumping station to the **Authority** for review and evaluation of efficiency and long term operating costs. **Authority** or his designated representative shall be the sole judge as to the acceptability of substitute equipment based upon the results of said evaluation.

3.2A.4 **WELDING**

- A. All steel structure members shall be jointed by electric arc welding with welds of adequate section for the joint involved.

3.2A.5 **PROTECTION AGAINST CORROSION**

- A. All structural steel surfaces shall be factory blasted with steel grit to remove rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be removed by grinding. Surface preparation shall comply with SSPC-SP6 specifications. Immediately following cleaning, a single 6-mil dry film thickness of Versapox epoxy resin shall be factory applied for abrasion and corrosion resistance.
- B. Stainless steel, aluminum and other corrosion resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components, such as the electrical enclosure, shall be furnished with the original manufacturer's coating.
- C. Finish coating shall be accomplished prior to shipment of the station from the factory and shall comply fully with the intent of these specifications. A touch-up kit shall be provided by the pump station manufacturer for repair of any mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating.

3.2A.6 **PUMPS**

- A. The pumps shall be vertical or horizontal, self-priming, non-clog type of heavy cast iron construction, especially designed for the use of mechanical seals.
- B. The pump 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.
- C. The shaft shall be solid stainless or alloy steel through the mechanical seal to eliminate corrosion and abrasive rust particles.
- D. The pump impeller shall be of the enclosed or semi-open type made in cast or ductile iron and shall be balanced. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device or shall be threaded to the pump shaft and secured with a lock-screw. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud.
- E. The pump shall be arranged so that the rotating element can easily be removed from the volute without disconnecting the electrical wiring or disassembling the motor, impeller, back-head or seal, so that any foreign object may be removed from the pump or suction line.
- F. The pump shaft shall be sealed against leakage by a single mechanical seal. Oil or water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime, in order to allow both the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.
- G. The seal materials shall be as selected by the **Authority**.

3.2A.7 **MOTORS**

- A. The pump motors shall be vertical or horizontal, solid shaft, NEMA P-base, squirrel-cage induction type, suitable for 3 phase, 60 cycle, 240/480 volt electric current. They shall have Class F insulation. Insulation temperature shall, however, be limited to Class B. The motors shall have normal starting torque and low-starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

- B. The motors shall have 1.15 service factor. The service factor shall be reserved for the **Authority's** protection. The motors shall not be overloaded beyond their nameplate rating, at any head in the operating range as specified under Operating Conditions.

3.2A.8 **CONTROL**

- A. The control equipment shall be mounted in a NEMA Type 1 enclosure with a removable access cover. The circuit breakers, starter reset buttons, and control switches shall be operable without removing the access cover, for dead front operation.
- B. A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 115 volt AC devices.
- C. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.
- D. Magnetic across-the-line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give positive protection. Each single phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided. All motor starters shall be equipped to provide undervoltage release and overload protection on all three phases.
- E. All switches shall be labeled and a coded wiring diagram shall be provided.
- F. To control the operation of the pumps with variations of liquid level in the wet well, an air bubbler system shall be provided. The Pump Level Control System shall be furnished complete, including air compressors, flow indicator and bubbler line.
- G. An elapsed running time meter for each pump shall be mounted on the face of the control cabinet. Each meter shall display elapsed run time in hours and tenths of hours.
- H. An automatic alternator with manual "On-Off" switch shall be provided to change the sequence of operation of the pumps on the completion of each pumping cycle. Provisions shall also be made for the pumps to operate in parallel, should the level in the wet well continue to rise above the starting level for the low level pump.
- I. Pilot devices shall be heavy duty, oil tight, of the same National Electrical Manufacturer's Association (NEMA) rating as the control panel in which

they are housed. Pilot devices shall be comprised of a legend plate, the device operator and the necessary contact block (s) arrangement. Selector switches shall have the appropriate contact sequence(s) as shown. They shall have non-illuminated, standard knob operators. Cams shall be field convertible and knobs shall be black and they shall operate at 120 VAC, unless specified otherwise. Pilot lights shall be self-contained transformer type, push-to-test. Lenses shall be plastic, the color indicated on the drawings. Push buttons shall have non-illuminated operators. They shall be of the momentary contact type, unless specified otherwise. Acceptable manufacturers for pilot devices are: Allen-Bradley, Square DJ. Control relays shall be of the general purpose, heavy duty type, rated 10 amperes continuous at 600 VAC. They shall be provided with relay sockets, retainer clips and other accessories necessary to make the relay a complete operational device. Contacts shall be 3 form C configuration.

Acceptable manufacturers are:

1. Allen-Bradley
2. Square DK.

Timers shall be electromechanical repeat cycle type with time ranges up to 24 hours. Time settings shall be made by knob and pointer adjustment. Timer output shall be a contact closure, contacts rated at 10 amperes continuous, 120 VAC. After output times out, an internal reset circuit shall energize the clutch coil allowing the unit to reset.

Acceptable manufacturers are:

1. Eagle Signal
2. Paragon
3. Agastat

3.2A.9 MAIN PIPING

- A. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness. Flanges shall be cast iron Class 125 and comply with ANSI B16.1. The discharge line shall be fitted with a check valve and plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the construction drawing. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. 3-25B. Protrusions through the floor shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet

well. Bolted and sealed joints shall be provided at the volutes or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field connections can be made without disturbing the gas-tight seals.

3.2A.10 **FACTORY TESTS**

- A. All components of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration, leaks in the piping or seals and correct operation of the automatic control systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.
- B. Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor; speed indicator and a vibrometer capable of measuring both amplitude and frequency.

3.2A.11 **SPARE PARTS**

- A. A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions. A spare volute and seal gasket shall be provided.

3.2A.12 **INSTALLATION**

- A. Installation of the pump chamber shall be done in accordance with the written instructions provided by the manufacturer.
- B. Operating and maintenance manuals shall be furnished, which will include parts lists of components and complete service procedures and troubleshooting guide.
- C. The Manufacturer shall provide the services of a factory-trained representative for a maximum period of one day on-site to perform initial start-up of the pump station and to instruct the **Authority's** personnel in the operating and maintenance of the equipment.

3.2A.13 FIELD TESTS

- A. After the pump station has been in operation for a period of not less than three (3) weeks, field acceptance tests shall be run, under the direction of the **Authority** and Engineer, to demonstrate that the capacities specified and efficiencies guaranteed for each unit can be met.
- B. For the field test the quantity of sewage pumped will be measured by a weir, the power consumption will be measured by watt-hour meters installed on the incoming feeders to the pumping station, and the total head measured by mercury manometers and pressure gauges installed on the pump suction and discharge pipe.
- C. In event it is demonstrated by the test that the capacities specified and efficiencies guaranteed by the pump manufacturer cannot be obtained, the pump manufacturer will be allowed three (3) weeks in which to make any revisions, adjustments or changes he feels necessary. During this period one pump at a time may be taken out of service. When the revisions, adjustments, etc., are completed, the pumps will be operated for a period of not less than two (2) weeks and a second test conducted. The cost of conducting all tests shall be borne by the **Contractor**.
- D. Should the pumps fail to demonstrate during the second test that they comply with the capacities specified and efficiencies guaranteed, the **Contractor** shall, at no cost to the **Authority**, replace them with pumping units that do comply. Not less than one (1) unit shall be maintained in service during the replacement period.
- E. The **Contractor's** attention is directed to the fact that there may not be sufficient sewage flow available to operate and test the pump station at the time he completed his work. The **Contractor** shall include the cost of supplying sufficient water to start up and test the pump station. After all adjustments have been made by the manufacturer's engineer and the station is ready to operate, the **Contractor** shall test the installations in the presence of the Engineer for final acceptance. The test shall be as hereinbefore specified.
- F. Prior to the final acceptance of the pump station or such time as the station is placed in actual continuous operation, the **Contractor** shall be responsible for the maintenance and operation and all cost thereof shall be paid for by the **Contractor**.

3.2A.14 MANUFACTURER'S EXPERIENCE

- A. Pump stations shall be the product of a manufacturer who has installed at least twenty installations of equipment similar to that proposed, which have been in successful operation for a period of ten years or more.

3.2A.15 **DETAILED EQUIPMENT PLANS AND SPECIFICATIONS**

- A. Prior to the fabrication or purchase of the equipment to be furnished under this contract, the **Contractor** shall submit to the Engineer, in quadruplicate, for approval, manufacturer's detailed specifications and drawings covering the equipment proposed. The specifications and drawings shall show the materials and details of construction of the equipment and its layout in sufficient detail to indicate its relative location and/or incorporation with other facilities. Complete structural, mechanical and electrical drawings shall be submitted to the Engineer for approval. A complete written description of the equipment, as well as bill of materials of major items, and all control items shall be submitted. The mechanical drawings of the station shall show all piping details and equipment. The electrical drawings shall include control panel details, schematic diagrams and connection diagrams of the entire electrical system.

3.2A.16 **GUARANTEE**

- A. The manufacturer of the station shall guarantee for one year from date of start-up, not to exceed eighteen months from date of shipment, that the structure and all equipment he provides will be free from defects in material and workmanship. Warranties and guarantees of the suppliers of various components in lieu of a single source responsibility by the Manufacturer will not be accepted. The Manufacturer shall assume prime responsibility for the guarantee of the station and all components.
- B. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the Manufacturer shall repair or replace, at his discretion, such defective part. He shall further provide, without cost, such labor as may be required to replace, repair or modify major components such as the steel structure, main pumps, main pump motors and main piping manifold. After start-up service has been performed, the labor to replace accessory items, such as the blower, priming pumps, alternator, etc. shall be the responsibility of others.
- C. The repair or replacement of those items normally consumed in service, such as seals, grease, light bulbs, etc. shall be considered as part of routine maintenance and upkeep.

- D. It is not intended that the Manufacturer assume responsibility for contingent liabilities or consequential damages of any nature resulting from defects in design, material, workmanship or delays in delivery, replacement or otherwise.

3.2A.17 WET WELLS

- A. The wet wells shall be constructed as approved by the **Authority** and Engineer. Ladder bars shall be installed as shown on the drawings and in conformance to Standard Drawing 2-40.
- B. The bottom of the wet well shall be filleted with concrete.
- C. Debris baskets with guides shall be furnished and installed in accordance with Standard Drawing 11-7.
- D. Hatchways provided shall be Bilco or equal, size and type as indicated on the drawings. Hatchways shall be provided with a cylinder lock with key way protected by a threaded cover plug. Access to the wet well shall be from the outside only. The pumps and piping shall be interior with no wet well access.
- E. The pump station base slabs shall have the bottom manhole ring set into the concrete of the base slab. Complete details of the foundation slab and concrete ballast shall be submitted to the Engineer for approval.
- F. The **Contractor** shall furnish all other material, appurtenances, etc., for the complete installation of the wet well in accordance with the drawings approved by the Engineer.

3.2A.18 WET WELL VENTILATION

- A. Adequate ventilation shall be provided for all pump stations. Where the access is below the ground surface, mechanical ventilation is required, so arranged as to independently ventilate the wet well if screens or equipment requiring maintenance are located in the wet well. Switches for operation of ventilation equipment should be marked and located conveniently.
- B. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Air shall be forced into the wet well rather than exhausted from the wet well.

3.2A.19 PUMP STATION SITE PIPING

- A. All piping required for a complete installation shall be furnished and installed. The influent gravity sewer, pump suction lines, pump discharge lines and force main shall be ductile iron or PVC pipe. The air bubbler tube shall be 3/4 inch Type L copper.
- B. All steel pipe, excluding stainless steel pipe, exterior to the station and in contact with the soil or with sewage shall be field coated with one coat of epoxy resin after installation.
- C. The **Contractor** shall restrict his excavation, when required to preserve undisturbed foundations for all piping. The backfill under all piping shall be mechanically tamped to prevent settlement.

3.2A.20 PAINING

- A. The **Contractor** shall paint the inside of the wet wells and all metal furnished under this Contract. The pump station will be furnished completely painted and shall be touched up in the field as required by field welding, scratches, etc.
- B. The **Contractor's** attention is called to the fact that all paints used shall be of a type suitable for exposure to fumes from sewage. The paints shall be a product of a reputable manufacturer and suited to the service for which they are intended. These specifications call for the use of paints manufactured by the Intertol Company of Newark, New Jersey; however, equivalent paints as manufactured by Pittsburgh Coke and Chemical Company, Koppers Company, or other approved manufacturers will be considered. In all instances, the prime coat shall be compatible with the field coat and all paints shall be applied in strict accord with the manufacturer's recommendations. All material shall be submitted to the Engineer for approval.
- C. All painting shall be performed on smooth, dry, clean surfaces at such times that meet the Engineer's approval. In order that dust proof and neat, workmanlike job be obtained, any faulty workmanship shall be corrected in a manner satisfactory to the "**Authority and Engineer**".
- D. The galvanized wrought iron ladder bars shall not be painted.
- E. All metal except the pump station and as noted in paragraph "d" shall be painted with Inertol Rust-Inhibitive Primer No. 621, shop applied. In event the shop primer coat has been damaged during shipment or erection, such 3-30damage shall be touched up with Inertol Quick-Drying Primer No. 626, or Inertol Rust Penetrating Primer No. 622 prior to application of the hereinafter specified paint. All exterior exposed metal work shall receive two finish coats of Glamortex Enamel of a color selected by the Engineer.

- F. The inside of the wet well and metal work inside the wet well shall be painted with two coats of Intertol Standard. The metal work shall receive one additional coat of Intertol Standard Thick.

3.2A.21 **ODOR/CORROSION CONTROL**

- A. Odor and corrosion problems can be experienced at various locations throughout the system. To prevent this problem, it is required that proposed pump stations and force mains be designed with provisions to handle and eliminate odor and corrosion causing compounds.
- B. For odor and corrosion control at the pump stations and force mains, the Contractor shall provide a chemical feed system (Chlorine, Ferrous Sulfate, etc.). The feed capacity shall be dependent on the size of the service area and force main length.
- C. The chemical feed system shall include chemical, feed system, piping and controls.

3.2A.22 **PUMP STATION BUILDING**

- A. The pump station building shall be of the walk-in type, of the size and dimensions as shown on the Drawings. The building shall be constructed of fiberglass, aluminum or block/brick with a pitched roof dependent upon the pump station location and the decision of the **Authority**. Fencing shall be provided around fiberglass building, but shall not be required for block/brick building.
- B. The pump station building shall house the pumping system (pumps, piping, panels), chemical system and if required, the Emergency Generator. The building shall come complete with the following components:1. One (1) garage door and one (1) man door.2. Lighting.3. Exhaust fan, louvers and dampers.4. Unit heater.5. Man down switches near floor for emergency.6. Switches for lights, fan and unit heater.7. Receptacles.

3.2A.23 **FLOW METER**

- A. The magnetic flow meter shall be of the electro-magnetic induction type and shall produce a DC voltage signal directly proportional to the liquid rate of flow. This type meter shall be used for metering process flows. The magnetic flow meter shall be furnished with a metering tube fabricated from 300 series stainless steel with a nonconductive liner of Teflon. The metering tube shall be field replaceable. Electrodes shall be bullet nose and made of Hastelloy "C" and shall be field replaceable without removing the magmeter from the line. Mechanical cleaning of electrodes shall not be permitted. End connections shall be 150 lb. ANSI flanged steel. The meter shall be

sized for the flow range specified. The induction field of the flow meter coils shall produce continuous heating within the meter to prevent sludge and grease build-up. No periodic shutdown for liner cleaning shall be necessary. The ratio of flow velocity to reference voltage signals generated shall be identical for all sizes so that any meter shall be compatible with the secondary readout instruments without the necessity of circuit modifications. The sludge meter shall be designed for operation on 120V, 60Hz power supply. Accuracy of the metering system, including the converter and readout instruments shall be $\pm 1\%$ of full scale for a maximum flow velocity of 3 to 31 feet/second. The meter housing shall be of NEMA 4X design. Signal cable shall be provided by the manufacturer and installed by the **Contractor** between the meter, mounted signal converter and the indicator. Cable length shall be as required by the relative locations of meters and signal converters, and the indicators as shown on the Drawings. Local totalization indication shall be provided at the mag meter. Indicating totalizer shall be a Fischer & Porter Model No. 52FT1210BACB, or approved equal. Totalizer shall accept a linear 4-20 mA DC input signal and shall derive its operating power from the input signal. Flow rate shall be shown as percent of full range, and total flow shall be indicated in GALLONS, 8-digit without reset. Flow rate and total flow shall be simultaneously displayed by 0.5-inch high liquid crystal displays (LCD). Accuracy of displays shall be $\pm 0.5\%$ of rate over a 10:1 range. Range shall be as directed by **Authority**. Unit shall be in a NEMA 4X enclosure. Magnetic flow meter shall be Fischer & Porter COPA-X Model 10D1465BE18PD61AW11KW or approved equal.

3.3 **STANDBY GENERATOR**

3.3.1 **GENERAL**

- A. The **Contractor** will furnish and install, one complete standby generator system for each pumping station furnished. The principal items of equipment shall include, but not be limited to, the following.

3.3.2 **ENGINE**

- A. Engine shall be a liquid-cooled, natural gas or diesel at the discretion of MTMSA. Diesel unit shall be rated for use with number 2 domestic burner oil. Diesel engine requiring premium fuels will not be considered.
- B. Engine shall be certified as capable of driving a generator with a KW rating adequate to power all pump station pumps and all ancillary equipment housed in the generator enclosure.

- C. Engine shall be capable of driving the generator of this rating continuously for 720 consecutive hours at 100 percent of its specified rating without damage.
- D. The engine shall be capable of starting and assuming its rated load in a period not to exceed 10 seconds.
- E. To maintain environmental quality, the engine shall be designed to, or equipped with suitable emission control equipment to ensure the gaseous exhaust emissions do not exceed applicable EPA standards. The maximum permitted EPA levels shall be at manufacturer's rated speed and load as measured by SAE-J177 and SAE-J215 recommended practices.
- F. Engine equipment shall include the following items:
 - 1. An electric starter.
 - 2. Positive displacement, mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements and dipstick oil level indicator.
 - 3. Fuel filters with replaceable element, and a engine driven, mechanical positive displacement fuel pump. Replaceable dry element air cleaner.
 - 4. Engine speed shall be governed by an electric governor consisting of a magnetic pick-up speed sensor, adjustable electronic control, and an electric actuator mounted integrally with the fuel pump. Automatic engine-generator set frequency regulation shall be adjustable from isochronous to 5% drop. Random frequency variations for constant loads from no load to rated load shall not exceed $\pm 0.25\%$ of rated speed. The governor shall be suitable for paralleling future generator sets with the addition of load sharing controls.
 - 5. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and engine shutdowns:
 - a. Run (green light)
 - b. Overcrank Shutdown (red)
 - c. Overspeed Shutdown (red)
 - d. High Coolant Temperature Shutdown (red)

- e. Low Oil Pressure Shutdown (red)
 - f. Pre-warning for High Coolant Temperature (yellow)
 - g. Pre-warning for Low Oil Pressure (yellow)
 - h. Low Coolant Temperature (yellow light indicated inoperative coolant heater)
 - i. Switch off (flashing red indicates genset not in automatic start mode)
 - j. Low Fuel (yellow)
 - k. Main Fuel (yellow)
 - l. One customer selected fault (red)
- 6. Provide low coolant level shutdown, which shall activate high engine temperature alarm (lamp) and shutdown.
 - 7. Provide engine-mounted battery charging alternator, 24 VDC, 45 ampere minimum, with solid-state voltage regulator.
 - 8. Double valved, in-line thermostatically controlled water jacket heater to aid in quick starting. Heater shall be rated 1500 watts, 120 volts, single phase, 60 Hz.
- G. Engine cooling system shall be comprised of engine mounted radiator with belt-drive fan, coolant pump and thermostat temperature control. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall.
- H. **Contractor** shall provide 50% ethylene glycol antifreeze solution to fill engine cooling system.
- I. A complete exhaust system shall be furnished including a properly sized, critical-grade silencing muffler. Muffler shall be mounted so its weight is not supported by the engine. Flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line. An exhaust condensation trap shall be provided with manual drain valve. All exhaust components shall be properly sized to assure proper operation without excessive back pressure.
- J. Where exhaust pipe and muffler are mounted indoors, proper insulation (Owens-Corning 1-1/2 inch thickness, Kaylo pipe insulation suitable for

1200°F) shall be installed to protect surrounding materials and personnel from exhaust heat build-up. Insulation shall be covered with a smooth surface aluminum jacket secured in place in accordance with the manufacturer's directions. All joints, end, fittings, etc. shall be covered and sealed with .016-inch thickness aluminum covering. Aluminum jacket shall be as manufactured by the Childers Manufacturing Company, or equal as approved by the Engineer. The **Contractor** may use Johns-Manville Metal-ON aluminum pre-jacketed thermobestos in lieu of the separate insulation and jacket is preferred. Metal-On shall be mitered, banded and sealed in strict accordance with the manufacturer's recommendation. Exhaust piping shall be Schedule 40, threaded black steel pipe with tapered threads and shall be assembled with threaded flanges, high temperature gaskets, and pipe fittings. All ells and offsets shall be of the long radius type.

- K. A complete fuel system shall be provided. Fuel system piping shall be black iron pipe above ground and PVC pipe for below grade piping unless specified otherwise. Pipe shall be sized as required for proper fuel flow. Pipe shall include all supply, return, vent and fill lines, along with all fittings.
- L. Main fuel storage tank, gauges, valves, tank filter fittings and float shall be provided. Tanks shall not be galvanized. Main fuel storage tank shall be mounted integral with engine-generator skid mounting.
- M. Fuel shall be supplied to engine with an electric motor driven fuel transfer pump of sufficient lift and capacity to deliver fuel in excess of the maximum fuel consumption rate of the engine.
- N. A low fuel supply sensing device shall be adjusted to signal low fuel level when the tank contains less than a three (3) hour supply.

3.3.3 **GENERATOR**

- A. Generator shall be three-phase, synchronous, bearing type with direct drive centrifugal blower for proper cooling and minimum noise. It shall have brushless exciter. Gear driven generators are not acceptable. Insulation shall meet NEMA standard MG 1-1.65 for Class F. Both the stator and rotor shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and/or abrasion deterioration. General shall incorporate reactive drop compensation.
- B. Generator voltage regulator shall be solid-state design. Voltage regulation shall be $\pm 1\%$ from no load to full rated load. Readily accessible voltage drop, voltage level and voltage gain controls shall be provided. Voltage level adjustment, via a rheostat, shall be a minimum of $\pm 5\%$ from rated value. The solid-state regulator module shall be shock mounted and epoxy

encapsulated for protection against vibration and atmospheric deterioration. The voltage regulator shall be of an asynchronous pulse width modulated design that is insensitive to severe load induced wave shape distortion from SCR or thyristor circuits such as those used in battery charging (UPS) and motor speed control equipment.

- C. The generator, exciter and voltage regulator shall be designed and manufactured by the engine-generator set manufacturer to insure that the characteristics shall be matched to the torque curve of the prime mover.

3.3.4 AUXILIARY EQUIPMENT

- A. A generator-mounted control panel for the generator system shall be provided. The panel shall be factory built, wired and tested. Panel enclosure shall be NEMA 1, gasketed, unless specified otherwise. The control panel shall include, but not be limited to, the following equipment:
 - 1. Remote, two-wire control stop-start terminals.
 - 2. AC voltmeter, 2-1/2 inch size, 2% accuracy.
 - 3. AC ammeter, 2-1/2 inch size, 2% accuracy.
 - 4. Frequency meter, 2-1/2 inch size, dial type.
 - 5. Panel illumination lights and switches.
 - 6. Voltage level adjustment rheostat.
 - 7. Engine oil pressure gauge.
 - 8. Engine coolant temperature gauge.
 - 9. Dry contacts for remote alarms wired to terminal strips.
 - 10. Fault indicators for low oil pressure, high coolant temperature, overspeed and overcrank. Automatic engine shutdown for these conditions.
 - 11. Manual selector switch: RUN-STOP-REMOTE.
 - 12. Fault reset switch to clear fault indications and allow restarting of the engine after shut-down faults.

13. Line circuit breaker.

14. Running time meter.

- B. Starting batteries shall be provided for the generator system. They shall be mounted in a corrosion resistant battery rack within the generator system skid base. They shall be sized to permit starting three times in succession without recharging. Battery cables shall be included.
- C. A battery charger shall be provided. It shall be a fully automatic, two rate, silicon controlled rectifier type for both equalizing and float charging the starting batteries. The charger shall include solid-state voltage regulator for control of the SCR bridge rectifier, surge suppressor for rectifier protection and current limited power transformer. The charger shall have an ammeter to show the rate of charge, a pilot light to indicate when high rate of charge is being applied and an alarm contact to close on low battery voltage. Charger shall be inherently self-protected against shorted or reversed battery connections. Charger shall be housed in a separate NEMA 2, gasketed, wall mounted enclosure.

3.3.5 ACCEPTABLE GENERATOR MANUFACTURERS

- A. The Generator system shall be as manufactured by ONAN, 240/480 VAC, 3 Phase, 4 Wire, 60 Hz or approved equal.

3.3.6 ALUMINUM ENCLOSURE

- A. Enclosure shall be weatherproof, walk-in type with rigidity wind test equal to 150 mph. Roof loading shall be equal to 50 lbs./sq./ft. Floor loading shall be 200 lbs./sq. ft. of equally distributed load. Enclosure shall be designed to meet NEC Code for working space about electrical equipment, BOCA Basic Building Code and BOCA Basic Mechanical Code.
- B. Enclosure shall consist of a roof, underframe, two (2) side walls and two (2) end walls of pre-painted aluminum stressed-skin semi-monocoque construction.
- C. Enclosure roof shall be one piece, cambered; sheet thickness shall be .040", 3003 aluminum alloy with 1/8" extruded aluminum recessed side and end rails of 6061-76 alloy. Roof bows shall be 6061-T6 extruded aluminum "I" beams spaced 24" on center. Roof shall be reinforced to carry additional loads when required.
- D. Corner castings shall be cast aluminum.

- E. Posts for side and end walls shall be 1/8" x 1-1/2" x 3-1/2" extruded aluminum hat sections on 24" centers. Panels shall be .045" thick aluminum sheet, mill pre-painted riveted 3" on center. Rub rails shall be heavy duty 6061-T6 extruded aluminum attached to underframe. Corner posts shall be 6061-T6 extruded aluminum alloy 1/8" x 5/8" radius corners. Steel tie down frame for anchoring to the concrete slab.
- F. Enclosure underframe shall include a 12" high perimeter-type channel to encompass the single wall 200 gallon sub-base fuel storage tank, underframe shall also include 10 gauge fabricated steel crossmembers on 12" centers. Crossmembers to be overlaid with 3/4" tongue and groove exterior fir plywood subfloor surfaced with 1/8" thick diamond plate steel.
- G. Door frame shall be welded aluminum consisting of 6061-T6 alloy 1/8" x 4-1/2" x 1-1/2", riveted to side panels.
- H. Personnel door shall have extruded aluminum frame with .045" pre-painted aluminum panels inside and out, fully gasketed to form a weather-tight perimeter seal. Door shall have forged aluminum hinges with stainless steel pin and nylon bushings.
- I. Enclosure shall be provided with four (4) 20,000 lb. steel lift rings, welded and bolted to the enclosure tie down frame.
- J. Enclosure shall have a bolt in place, removable, end wall panel located at the exhaust or intake end wall. It shall be provided for equipment installation.
- K. Enclosure shall be provided with intake and exhaust ventilation louvers and insect screens. They shall be motorized, of all aluminum construction. Louvers shall be properly sized to allow sufficient engine combustion and radiator cooling air flow with a 0.5" water column maximum restriction.
- L. Enclosure interior lining shall be mill finished aluminum panels. 1.5" semi-rigid fiberglass insulation shall be included.
- M. For diesel generators only, enclosure shall contain a single wall construction, 200 gallon sub-base fuel storage tank with fuel level gauge and low fuel alarm contacts.
- N. One 10 lb. A-B-C dry chemical fire extinguisher shall be provided.

3.3.7 ACCEPTABLE ALUMINUM ENCLOSURE MANUFACTURERS

- A. Subject to compliance with the requirements of this specification, the aluminum enclosure shall be Pritchard Brown or approved equal.

3.3.8 AUTOMATIC TRANSFER EQUIPMENT

- A. The automatic transfer switch shall be rated for 3 Pole, 240/480 Volt, 60 Hertz, with solid neutral. It shall be sized to carry the entire load at the pump station per the output of the engine-generator.
- B. Transfer switches shall be rated to carry 100 percent of their rated current continuously when in an enclosure. The short circuit withstand and closing ratings shall be 30,000 AMP. RMS. Transfer switches which must be derated when installed in an enclosure (due to integral overcurrent devices or any other reasons) do not meet this specification. Transfer switches shall be rated for continuous operation in ambient temperatures of -40°C (-40°F) to 67°C (152°F).
- C. Transfer switches shall be over center operation, double-throw construction, positively electrically and mechanically interlocked by a simple mechanical beam to prevent simultaneous closing (for break before make operation), and mechanically held in both normal positions.
- D. Transfer switches shall be quick-break, quick-make operation so that the speed of opening and closing is not controlled by an operator during manual operation. Transfer switches shall provide a center "Programmed Transition" position for manual switching. Transfer switches shall be approved for manual operation under full load by integral mounted, permanently attached, high dielectric, manual operating handles. Manual operating handles, which are normally stored and must be installed for manual operation, do not meet this specification.
- E. The electrical operating means shall be a direct-acting, constant force in both directions, bi-directional linear induction motor to provide minimum friction, straight-line switch action. Motor output shall be applied directly to the switching mechanism without the use of gears, cams, or other complex mechanical linkage methods. Transfer switches using solenoid operators and relying upon gravity, weights, or momentum for closing in either position do not meet this specification. Transfer switches shall not contain any integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses. Transfer switches using magnetically operated contactors do not meet this specification. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching.
- F. Manual operating handles and controls (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and non-key operated control switches located on the outside of the cabinet do not meet this specification.

- G. Unless noted or specified otherwise, each transfer switch shall be mounted in separate NEMA 1 cabinet enclosures with key-locking front doors.
- H. Maximum transfer time in either direction shall be six (6) cycles, except where the "Programmed Transition" feature is furnished.
- I. All transfer switches shall have transparent protective covers to protect operating personnel during manual operation, and to allow an operator to visually determine that the main contacts are "Open" or "Closed".
- J. The main switch contacts shall be of the no maintenance type and high-pressure silver cadmium oxide to resist burning and pitting for long life operation. All switches shall have arc chutes of heat absorbing material and metal leaves for positive extinguishing of arcs quickly and effectively; arc chutes shall have insulating covers to prevent inter-phase flashover.
- K. Transfer switches shall have two (2) S.P.D.T. (Single Pole Double Throw), normally open and two (2) normally closed isolated contacts rated at 10 Amp, 600 volts auxiliary switch on both the normal and emergency-sides, operated by the transfer switch. These auxiliary contacts shall be factory wired to an easy access terminal block and may be used to monitor the transfer switch position for controlling indicator lamps, to signal a remote indicating panel for system operations or other peripheral equipment.
- L. Complete AL-CU (Aluminum-Copper) lugs, U.L. Listed and CSA Certified, shall be provided for both normal and emergency load positions. Load connections shall be field changeable either from top-to-bottom or bottom-to-top. Wiring space at normal, emergency, and load lugs inside the transfer switch cabinet shall comply with 1990 NEC Table 373-6(b). Full rated neutral bar with lugs for normal, standby, and load neutral conductors shall be provided inside the cabinet.
- M. Control accessories, either electronic or relay, shall be mounted in a separate smaller cabinet mounted on the inside of the main cabinet door. This is to allow for ease of service when the main cabinet lockable door is opened, but to prevent access by unauthorized personnel.
- N. The electronic control, undervoltage and time delay modules, shall be a printed circuit board for ease of service. The solid-state undervoltage sensors shall simultaneously monitor all phases of the normal and all phases of the emergency power sources to provide field adjustable range sensors for specific applications. Voltage pickup settings shall be adjustable from a minimum of 85% to a maximum of 100% of nominal voltage. Voltage dropout settings shall be adjustable from a minimum of 74% to a maximum of 90% of the pickup setting with a fixed dropout time delay of 0.5 second. Voltage sensors shall be of the temperature compensated type, for maximum

deviation over the temperature range of -32°C (25°F) to 79°C (175°F). Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase of the normal or standby power source, even where motor feedback voltage exist.

- O. The Over-voltage and Frequency Sensing control shall be a printed circuit board for ease of service. The solid-state overvoltage sensors shall simultaneously monitor all phases of the normal and all phases of the emergency power sources to provide field adjustable ranges of voltage pickup and dropout and time delays. Frequency sensors shall simultaneously monitor all phases of the normal and standby power sources to provide field adjustable ranges of frequency pickup and dropout and time delays.
- P. The transfer switch shall be equipped with "programmed transition" feature with adjustable time of 0.5 to 5 seconds whereby, the transfer switch will assume a neutral position when transferring in either direction. An in phase monitor in lieu of programmed transition is not acceptable.
- Q. Controls shall signal the standby power system to start upon signal from normal sources voltage sensors. Solid-state time delay transfer, adjustable from 0 to 120 seconds start shall avoid nuisance start-ups on momentary voltage dips or interruptions.
- R. The transfer switch shall retransfer the load to the normal source after normal power restoration. The retransfer solid state time delay is adjustable allowing the normal source to stabilize before retransfer.
- S. The controls shall provide an automatic retransfer of the load from the standby source to the normal source if the emergency source fails when the normal source is available. The transfer switch operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred.
- T. Controls shall provide built-in "Control Mode Status" indicators. The indicators shall allow the operator to determine that the controls are properly sequencing and shall assist in determining the sequence of any malfunctions that might occur.
- U. Main cabinet front door mounted controls and indicator lamps shall consist of AC Voltmeter, Ammeter, Frequency Meter with phase selector switch, meters shall be connected to the load side, oil-tight, neon position indicator lamps (Normal - White and STANDBY - Amber) and key-operated Test and Selector switches to provide the following functions:
 - 1. Test Switch:

- a. TEST - Simulated normal source power loss to control unit for testing engine-generator set capability, including transfer of load if so equipped. Control system shall provide for system test without load transfer when specified.
- b. NORMAL - Normal operating position and also restores the system to standby operation; and if load was transferred, retransfers load from standby to normal source after test and time delays.
- c. RETRANSFER - Spring-loaded monetary position of switch, that overrides retransfer time delay to cause the immediate return to the normal source after a test or actual power outage.

3.3.9 **ACCEPTABLE TRANSFER SWITCH MANUFACTURER**

- A. The Automatic Transfer Switch shall be manufactured by the manufacturer of the engine-generator set, ONAN Utility to Generator Set Model 240/480 Volts, 3 phase, 4 wire, 60 Hz AC or approved equal.

3.3.10 **TEST**

- A. A complete test including all generator and transfer switch functions will be performed before system is shipped to jobsite. This should ensure smooth one-day startup at jobsite. Factory test will not meet this requirement because the completed system is not tested.

3.3.11 **MANUFACTURER'S EXPERIENCE**

- A. The standby generator shall be a product of a manufacturer who has installed at least twenty installations of equipment similar to that proposed, which have been in successful operation for a period of ten years or more.

3.3.12 **DETAILED EQUIPMENT PLANS AND SPECIFICATIONS**

- A. Prior to the fabrication or purchase of the equipment to be furnished, the **Contractor** shall submit to the **Authority** and Engineer, in quadruplicate, for approval, manufacturer's detailed specifications and drawings covering the equipment proposed. The specifications and drawings shall show the materials and details of construction of the equipment and its layout in sufficient detail to indicate its relative location and/or incorporation with other facilities. Complete structural, mechanical and electrical drawings shall be submitted to the **Authority** and Engineer for approval. A complete

written description of the equipment, as well as bill of materials of major items, and all control items shall be submitted. The electrical drawings shall include control panel details, schematic diagrams and connection diagrams of the entire electrical system.

3.3.13 **EQUIPMENT AND WORKMANSHIP GUARANTEE**

- A. The standby generator system shall be installed under the supervision of experienced personnel in strict accordance with the manufacturer's instructions. Before the equipment is placed in operation, it shall be inspected by the manufacturer's engineer who shall make all adjustments required for its successful operation.
- B. All equipment and accessories furnished shall be guaranteed by the **Contractor** and Manufacturer to be free from defects in design, materials or workmanship. The **Contractor** shall replace, without cost to the **Authority**, any parts of equipment which prove to be defective or which show undue wear within one year after the equipment has been placed in satisfactory operation and accepted by the **Authority**. Additionally, the generator and the transfer switch shall have a pro-rated, five (5) year, or fifteen hundred (1500) hour warranty. Normal wearing items such as light bulbs, batteries, etc., are not to be covered by the warranty.

3.3.14 **CONNECTION TO POWER SOURCE**

- A. The **Contractor** shall install a power connection at the pump station site in accordance with Standard Drawing 16-39. The exact location shall be subject to Engineer's approval. The **Contractor** shall provide all necessary connections, appurtenances, etc. to make the complete connections of power source to standby generator to pump station as approved by the Engineer.

3.4 **AUTO DIALER**

3.4.1 **DESCRIPTION & PHONE NUMBER DIALING**

- A. The dialer shall be a solid state component capable of dialing from one to eight phone numbers, each up to 16 digits in length. Phone numbers are to be entered via the system's keyboard. Standard pulse dialing or Touch Tone DTMF dialing shall be selected at the keyboard. **Contractor** shall furnish and install auto-dialer (as described below) and telephone service (pole included), complete and operational. Auto dialer shall be Model CB-4 "Chatterbox" by RACO Manufacturing and Engineering Co., Emeryville CA, or **Authority** approved equal.

3.4.2 **ADDITIONAL FIELD PROGRAMMING CAPABILITIES**

- A. User Programmable Speech: Alarm and normal messages for each channel shall be programmable from a standard 230 word vocabulary.
- B. Remote Programming: The dialer shall permit user to change any user entered programming (except speech messages) from any touch tone phone. User shall also be able to cause a ninth phone number to be called on command to test system and phone line integrity.
- C. Alarm response delay: .1 to 999.9 seconds.
- D. Delay between alarm call outs: .1 to 99.9 minutes.
- E. Alarm reset time: Programmable 0.1 to 99 hours or "NO RESET".
- F. Incoming ring response (answer) delay: 1 to 20 rings.
- G. Number of message repetitions: Programmable 1 -20 repetitions of the message.
- H. Station ID number.
- I. Input alarm Criteria: Each channel shall be independently configured for "Alarm On Open Circuit", "Alarm On Closed Circuit", or "No Alarm" - report on inquiry only, or in lieu of alarming, accumulate equipment running time.
- J. Auto-call Test: When enabled, the unit shall place a single round of test calls, both at the time this function is enabled and also at regular subsequent intervals until this function is disabled at the keyboard. The voice shall identify these calls as test calls.
- K. Run Time Meter: Each channel shall be keyboard programmable to accumulate and report the number of hours that its input contacts have been closed.

3.4.3 **NONVOLATILE PROGRAM MEMORY RETENTION**

- A. User-entered programming shall be kept intact even when all power is removed for up to ten years.

3.4.4 **ACKNOWLEDGEMENT**

- A. Acknowledgement of an alarm phone call is to be accomplished by pressing a Touch tone "9" as the alarm call is being received, and/or by returning a phone call to the unit after receiving an alarm call, at the user's choice.

3.4.5 **SYNTHESIZED VOICE**

- A. The Automatic Telephone Dialer is to communicate via a highly intelligible solid state voice synthesizer (magnetic tape loops will not be used) with an identification of its location and the specific alarm condition (s) that exist.

3.4.6 **INPUT MONITORING FUNCTION**

- A. The unit shall continuously monitor the presence of AC power and the status of four contact closure inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs.

3.4.7 **ALARM MESSAGE**

- A. Upon initiating an alarm phone call, the system is to "speak" only to those channels that are currently in "alarm status".

3.4.8 **INQUIRY MESSAGE AND FUNCTION**

- A. Inquiry phone calls can be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status. Further, by pressing the Touch Tone "0", the user may hear all user-entered programming and diagnostic counts (Cumulative counts of Call In Count, Dial Out Count, Acknowledged Alarm Count, Power Off Alarm Count). All this information shall be available by keyboard inquiry at the unit as well.

3.4.9 **POWER BATTERY BACKUP**

- A. Normal power shall be 105-135 VAC, 15 watts maximum. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The battery is to be capable of keeping the product operating, and user programming intact, for a minimum of six continuous hours in the event of power failure. Shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger" to minimize recharge time and maximize battery life available.

3.4.10 **PHONE LINE**

- A. The dialer is to operate on a standard rotary pulse or Touch Tone "dialup" phone line (direct leased line not to be required) and is to be F.C.C. approved. A regular private line is to be provided. Connection to the telephone is through an industry standard 4-pin modular jack (RJ-11).

3.4.11 **INTEGRAL SURGE PROTECTION**

- A. Gas tube **and** solid state surge protection is to be provided on **all** inputs, including power, phone and signal lines. These protectors are to be **integrally incorporated** into the main circuit board for maximum protection. Protectors mounted external to the main circuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

3.4.12 **WARRANTY**

- A. The dialer shall be covered by a two (2) year warranty covering parts and labor performed at the factory.

3.4.13 **MODULAR UPGRADES**

- A. The system shall include expansion connectors to accommodate field upgrades for additional dry contract inputs, remote supervisory control, remote reprogramming, analog input and communication with remote printers and computers.

3.4.14 **ADDITIONAL FEATURES:**

- A. **SEALED SWITCHES, LED INDICATORS, ALARM DISABLE WARNING, TALK-THROUGH:**
1. All keyboard and front panel switches all be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Phone Call in Progress, Unacknowledged Alarm, Acknowledged Alarm, AC Power Present, AC Power Failure, and Low or Discharging or Recharging Battery. On any Inquiry telephone call or On-Site status check, the voice shall provide specific warning if no dialout phone numbers are entered, or if the alarm switch is in the "disable" position, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote phone to listen to local sounds and to have a two-way conversation with personnel at the dialer.

3.4.15 **SPECIAL ORDER ITEMS**

- A. The following options shall also be provided:
1. NEMA 4X (sealed) enclosure.

2. 425 word user programmable speech (195 more than standard).
3. 24 extra contact channels (32 total).
4. 1 analog channel.
5. 24 hour battery backup life (6 hours standard).
6. Remote supervisory control (4 or 8 outputs).

3.5 SUBMERSIBLE SEWER PUMP STATION EQUIPMENT

3.5.1 GENERAL

- A. The equipment shall include submersible sewage pumps, discharge connections, guide rails and brackets, electrical cable, cable holder assembly, mounting hardware, NEMA 7 junction box, liquid level sensors, pump control panel, access hatches, and all other appurtenant equipment as shown on the Standard Detail Drawing Number FIG-1 and specified herein for a complete and operable pumping system. Provide any appropriate adapter, connector, or coupling as required to adapt the specified discharge pipe material or pipe size external to the wet well.
- B. The pump station shall consist of two pumps installed in a precast concrete manhole (wet well) with all the appurtenant equipment described herein. The pumps shall be removable by the means of permanently installed stainless steel guide rails.
- C. The arrangement of the pumps and accessory equipment shown on the Standard Detail Drawing Number FIG-1 is based on the equipment of a particular manufacturer.
- D. Each system shall consist of submersible non-clog wastewater pumps, level control system, and pump control panel, all as shown on Standard Detail Drawing Number FIG-1 and specified herein.
- E. Each pump shall be equipped with a submersible explosion-proof electric motor connected for operation on 3/60/230 service. An adequate length of submersible cable suitable for submersible pump applications shall be furnished with each pump. The power cable shall be sized according to NEC and ICEA standards.
- F. Each pump shall be fitted with an adequate length of stainless steel lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight. A centering post will be properly positioned in the top

concrete slab of the station to accommodate the installation of a davit hoist. A davit hoist shall be furnished.

- G. The pumps shall be automatically and firmly connected to a discharge elbow connection, guided by not less than two guide bars extending from the top of the station wet well to the discharge connection. The discharge elbow connection shall be supplied by the pump manufacturer. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact. No portion of the pump shall bear directly on the wet well floor.
- H. A grout base shall be installed for each discharge elbow connection. Grout base configuration shall be as recommended by the manufacturer.

3.5.2 OPERATING CONDITIONS

- A. Each pump shall be capable of delivering the required flow rate capacity of raw, unscreened sewage against the designed total dynamic head.
- B. The maximum allowable operating speed shall be 1,150 rpm. The minimum rated horsepower shall not be less than 15 and shall be non-overloading at any point of the pump curve. The pump motors shall be explosion-proof and shall be suitable for operation of a 3/60/240 electrical supply.

3.5.3 PUMP CONSTRUCTION

- A. Major pump components, including volute, shall be of gray cast iron, Class 30, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel or brass construction. Pumps shall be painted with a water based air dry enamel of 2.0 mil minimum thickness.
- B. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with nitrile or Viton rubber O-Rings.
- C. The pump shaft shall be the extension of the motor shaft and shall be stainless steel.
- D. Impellers shall be of gray cast iron, Class 30, dynamically balanced, non-clogging design with pump out vanes on the back side. They shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Impellers shall be capable of passing a minimum 3-inch diameter solid.

- E. A wear ring system shall be used to provide effluent sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with an axial stainless steel ring insert that is drive fitted to the volute inlet. The impeller shall also have an axial stainless steel wear ring heat shrink fitted onto the suction inlet of the impeller.

3.5.4 MOTORS

- A. Pump motors shall be induction type with a squirrel-cage rotor, shell type design, housed in an air-filled, watertight chamber. The stator windings and stator leads shall be insulated with moisture resistant Class F insulation and have a 1.15 service factor. Motors shall be UL listed for Class 1, Division 1, Groups C and D explosion-proof hazardous locations.
- B. The motor shall be designed for continuous duty, capable of up to 10 evenly spaced starts per hour. Thermal switches shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel.
- C. The motor service factor shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. The power cable, thermal switch wiring and moisture detection wiring shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box external to the wet well, without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber.

3.5.5 BEARINGS

- A. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces.

3.5.6 MECHANICAL SEAL

- A. Each pump shall be provided with a tandem mechanical shaft seal system. The seal materials shall be carbon for the rotating faces and ceramic for the stationary faces, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and all elastomer parts to be of Buna-N.
- B. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil

expansion capacity. The motor shall be able to operate dry without damage while pumping under load.

3.5.7 PROTECTION

- A. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.
- B. Two moisture detection probes shall be installed so that they will detect moisture in either the seal or stator cavity measuring either the seal or stator cavity measuring resistivity between the probes. They shall be wired internally to the control cable connection at the top of the motor. O-ring sealed inspection plugs shall be provided in the mechanical seal oil chamber for ease in inspection, draining, and filling of oil.
- C. The leaking seal shall be connected to a control monitoring unit designed to be mounted in the control panel. Thermal switches shall be connected in series with the starter.

3.5.8 GUIDE RAIL SYSTEM

- A. Each pump shall be equipped with a stainless steel guide rail system for installing and removing the pump. Each system shall consist of two minimum size 1 1/2-inches Schedule 40 stainless steel guide rails, a cast iron base elbow anchored to the wet well floor, and a bronze moveable portion which attaches to the pump and is free to ride up and down the guide rails.
- B. An O-ring pressed into a dove-tailed groove on the tapered face of the moveable portion shall allow for a positive mating of the moveable portion to the stationary base elbow, unless otherwise approved by the Authority.
- C. The guide rails shall attached to the base elbow at one end and to a stainless steel guide cap which in turn attaches to the wet well top slab at the other end. The guide rails shall not carry any of the pump weight. An intermediate guide pipe bracket shall be included and installed in accordance with the manufacturer's recommendations.
- D. An adequate length of stainless steel lifting chain shall be supplied for removing the pumps. The chain shall be of sufficient length and shall include an adequate number of lifting rings for easy removal.
- E. A safety chain hook assembly shall be installed to secure the pump lifting chain in place at the top of the wet well manhole.

3.5.9 PUMP CONTROL SYSTEM

- A. The automatic pump control system shall be furnished by the pump manufacturer and installed as shown on the Standard Detail Drawing Number FIG-1 and specified herein. The control system shall consist of a pump control panel and four (4) level sensor floats, or Authority approved equal.
- B. The automatic pump control system shall be constructed to NEMA 4X standards. The incoming power supply at the pump station shall be 3/60/230. The control system shall control the pumps based on liquid levels.
- C. The pumping system shall be set up to have one level pump and one standby pump. After each pump cycle, the lead pump shall alternate. Both pumps shall normally be in the auto position. If the lead pump fails when it is designated by level to run, a normally open dry contact in the control panel shall close and the standby pump shall automatically start.
- D. The pump control panel shall include the following:
 - 1. HOA controls for each pump.
 - 2. NEMA 4X enclosure.
 - 3. Circuit breaker for each pump.
 - 4. Motor starters for each pump. Starters shall have overload relays with ambient compensated, quick trip characteristics sized for the motors being used with manual reset. Starters shall have one auxiliary contact minimum.
 - 5. Level sensors to start and stop pumps as required and for high level alarm.
 - 6. Control power circuit breaker.
 - 7. Automatic electric alternator to change pumping sequence after each cycle.
 - 8. Pump "running" lights.
 - 9. Control panel door shall be equipped with catch and lock. Two milled keys shall be furnished with each lock.
 - 10. Red seal failure light for each pump.
 - 11. Alarm switch for on-off and test.

12. Panel to be located inside the generator building.
13. Separate auxiliary circuit breakers for alarm and control circuits.
14. Auxiliary alarm contracts – terminal block and dry contacts for remote alarm.
15. 100 watt condensation heater.
16. Non-resettable elapsed time (hour) meter for each pump.
17. Loss of phase protection for each pump.
18. Close coupled duplex receptacle.
19. 120-volt power circuits for magnetic flowmeter and transmitter. Provide either circuit breakers or fused disconnect type terminals.
20. NEMA 4 alarm light mounted on top of the control panel (100 watts).

E. All components shall be clearly identified by suitable nameplates.

F. Provide the necessary level sensors to start and stop all pumps as required. Level sensors shall be of the mercury tube type sealed in a polyurethane float and weighted to hold position in the wet well. One float shall be provided to start the lead pump, one for high level alarm, and one float to stop the pump. The level sensors shall be the suspended type which shall hang from a bracket mounted above the liquid level. Mounting elevations shall be as shown on the drawings. Level sensors shall be adjustable from the bracket. Level sensors shall be furnished with an adequate length of submersible electrical cable for each sensor to reach the junction box without splices. Level sensors shall be listed by Underwriter's Laboratories and bear the UL label. Other pump control systems shall be approved by the Authority.

G. Detailed electrical diagrams showing the panel enclosure and wiring arrangement shall be submitted for approval. Pump control panel shall be mounted on an equipment rack.

H. An auto-dialer system shall be installed in accordance with Section: Auto Dialer of these Minimum Standards. Installation of an extra input shall be provided with a timer/totalizing "gallons pumped" capabilities.

I. Installation of necessary electrical conduit seals.

J. Emergency standby power generator and building must be provided per Section 3.3 of these Minimum Standards.

3.5.10 ALUMINUM ACCESS HATCH

- A. Furnish and install a double leaf aluminum access hatch in the top slab of the pump station wet well.. The position and size of the hatch will be designed as necessary to accommodate pump removal and access to the debris basket.
- B. Access hatch shall be Type JD-AL as manufactured by the Bilco Company, New Haven, CN, or approved equal. The size shall be as approved by the Authority. Door leaf shall be ¼-inches aluminum diamond pattern plate to withstand a live load of 300 lbs per sq. ft. Channel frame shall be ¼-inch aluminum with an anchor flange around the perimeter. Doors shall be equipped with heavy forged brass hinges, stainless steel pins, spring operators for easy operation, and an automatic hold-open arm with release handle. A snap lock with removable handle shall be provided. A 1 1/2-inch drainage coupling shall be located in one corner of the channel frame. Hardware shall be cadmium plated and factory finish shall be "Mill finish with bituminous coating applied to the exterior of the frame." Manufacture shall guarantee proper operation and against defects in material or workmanship for a period of five years.

3.5.11 PAINTING

- A. All surfaces of the pumps coming into contact with sewage, other than stainless steel, shall be protected by an approved factory applied sewage resistant coating. Touch-up paint shall be provided by the manufacturer to repair damaged paint coatings in the field.

3.5.12 VALVE PIT AND PIPING

- A. The pit shall be properly sized to accommodate installation of the necessary valving. For valving requirements, refer to Section 2.22 of these Minimum Standards.
- B. Access hatch shall be provided for the valve pit.

3.5.13 MANUFACTURER'S SERVICES

- A. The pumps and appurtenances shall be installed under the supervision of experienced personnel in strict accordance with the manufacturer's instructions. Before the equipment is placed in operation, it shall be inspected by a qualified representative of the manufacturer who shall make all adjustments required for its successful operation.

- B. The manufacturer's engineer shall instruct the Authority's personnel in the operation, adjustment and maintenance of the pumps, controls, and accessories for a period of one (1) day.

3.5.14 SPARE PARTS

- A. One spare pump complete with motor shall be provided to the Authority.
- B. Other suggested spare parts as recommended by the pump manufacturer shall be provided to the Authority.

3.5.15 EQUIPMENT AND WORKMANSHIP GUARANTEE

- A. All equipment and accessories shall be guaranteed to be free from defects in design, materials or workmanship. Any parts or equipment which prove to be defective or which show undue wear within eighteen (18) months after the equipment has been placed in satisfactory operation and accepted by the Authority shall be replaced.