STANDARD SPECIFICATIONS FOR
CONSTRUCTING WATER DISTRIBUTION FACILITIES

DIVISION III – CONSTRUCTION SPECIFICATIONS

SECTION 2
GENERAL SPECIFICATIONS FOR WATER PUMPING STATIONS

2.01 SCOPE

These general and detailed specifications form a part of the Contract documents and shall govern the handling and installation of pumping stations and accessories described herein. Existing water distribution facilities are owned and operated by Daphne Utilities, hereinafter referred to as "Owner". All plans, specifications and hydraulic calculations shall bear the seal of a licensed professional engineer reflecting accepted construction practices and design. The construction methods employed in the placement of the pumping stations and appurtenances shall be in accordance with current codes, practices and specifications of the Owner.

These specifications provide general standards for water pumping stations. Current detail requirements shall be coordinated with the Owner at the time of the design.

2.02 LOCATION

Pumping facilities shall be designed to maintain the quality of pumped water. Inaccessible installations or installations subject to flooding shall not be permitted. The site shall be located a minimum of three feet above the 100-year flood elevation, or three feet above the highest recorded flood elevation, whichever is higher. The site shall be accessible at all times and the ground around the site shall be graded for positive drainage. The site shall be adequately protected and lighted.

2.03 PUMPING STATIONS

A. General: Ample space shall be provided for the installation of future pumps if necessary for future development, and for the safe servicing and maintenance of all equipment. All pump stations shall be of durable construction. The finish floor elevation of the pump station shall be at least six inches above the finished site grade. All underground structures shall be waterproofed. All floors shall slope at a minimum of three (3) inches in every ten (10) feet to a suitable drain where necessary. A suitable outlet for drainage from the pumps without discharging onto the floor shall be provided.

B. Equipment Servicing: Pump stations shall be provided with crane-ways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors or other heavy equipment. Openings for floors, roofs or wherever else needed shall be provided for removal of heavy or bulky equipment.

C. Heating/Cooling: Provisions shall be made for the adequate heating and cooling of the pumping station to provide safe and efficient operation of the equipment.

D. Ventilation: Ventilation shall conform to existing local and/or state codes. Adequate ventilation shall be provided for all pumping stations

E. Lighting: Pump stations shall be adequately lighted throughout. All electrical work shall conform to the requirements of the National Electrical Code and to relevant state and/or local codes.

2.04 PUMPS

A. General: The pumping units shall have ample capacity to supply the peak demand against the required distribution system pressure without dangerous overloading. Prime water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent either backpressure or backsiphonage backflow.

B. Motor: Motors shall be a JP shaft, close-coupled pump motor. The motors shall be constructed with cast iron frame, copper windings, squirrel cage induction type, with class F insulation with a limit to a class B temperature rise at rated load and 1.15 Service Factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified. Motors shall be suitable for operation using the utility power available specified herein. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112, Method B.

C. Finish: Exterior surfaces of pumps, piping, and steel framework shall be chemically and mechanically cleaned prior to painting. Exposed surfaces to be coated with a primer-less, high solids, satin finish two-part polyamide epoxy incorporating rust inhibitive additives. The finish coat shall be 4.0 MIL dry film thickness (minimum) after applying two coats, resistant to oil mist exposure and solvent contact. Salt spray exposure test shall be rated to resist blistering, cracking, rusting, delamination of film or no more than 1/32" creepage at scribe after 1500 hours of exposure. The factory finish shall allow for over-coating and touch up after final installation.

2.05 BOOSTER PUMP STATION

A. General: Booster pumps shall provide adequate fire flow and pressure to provide fire protection services. Negative pressure in their suction lines shall not be permitted.

The intake pressure shall be at least 20 psi (140 kPa) when the pump is in normal operation and shall maintain at least 10 psi (70kPa) in the suction line under all operating conditions.

Inline booster pumping stations, underground pumping stations and home booster pumps shall not be allowed in the distribution system unless prior concurrence is obtained from the Owner/Engineer.

The booster pump station shall be one factory built above ground, automatic, pressure booster pump station. The station shall be complete with all equipment specified herein, factory assembled on a structural steel base. In addition to the steel base, principal items of equipment shall include three vertical in-line centrifugal pumps, motors, internal piping, valves, motor control panel and internal wiring.

Site power furnished to pump station shall be 3 phase, 60 hertz, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

B. Equipment:

1. Unitary Responsibility: In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that a single supplier (unitary source) furnishes all system components. The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2. Manufacturer: The specifications depict equipment and materials manufactured by the Gorman-Rupp Company, which are deemed most suitable for the service anticipated. The standard shall be the current Gorman-Rupp Booster Station Skid Package with controls by Dexter Forston or Daphne Utilities' current SCADA provider for the water system. It is not intended, however, to eliminate other products of equal quality and performance.

3. Materials:

   a. Pump Casing: Casing shall be close grain cast iron type ASTM 48, Class 40, designed for heavy duty service. Casing shall incorporate the following features:

      i. The casing shall be horizontally split, (dual) (single) volute type of the back pull-out design with the suction and discharge flanges cast integrally with the lower half in order that the upper part may be removed for inspection of the rotating element without disturbing pipe connections. Removal of the rotating assembly shall require a vertical lift of no more than 6". The joint between halves of the casing shall be heavily flanged and bolted, and provided with dowel pins to insure accurate alignment.

      ii. The upper half-casing flange shall have tapped holes for jack screws. The interior shall be smooth and free from surface defects.

iii. Thickness, diameter, and drilling dimensions of suction flanges shall be Class (125) (250) ANSI B16.1 standard. Discharge flanges shall be Class (125) (250) ANSI B16.1 standard. Suction and discharge connections shall be displaced 180 degrees with centerlines concentric to the same horizontal plane. Casings shall be drilled and tapped for priming, gauge, and drain connections. Suitable lifting lugs or eyebolts shall be provided.

iv. Pump support feet shall be cast integrally with the lower half of the pump casing. The bolt pattern shall be a standard 125-lb. pipe flange arrangement that shall allow the use of common pipe and flanges to support the pump at any desired elevation without elaborate fabrication of support structures.

b. Impeller: Impeller shall be of the single suction enclosed type made entirely of ASTM B584-836 die cast bronze, finished smooth all over and of ample strength and stiffness for maintaining the maximum capacity of the unit. Design must incorporate the following features:

i. The impeller shall be statically and dynamically balanced and shall be keyed to the shaft in addition to an impeller nut to securely hold it in axial position on the shaft.

ii. Balance holes on the back side of the impeller shall be provided to reduce thrust with the hydraulic balancing of pressures.

c. Wear Rings: Replaceable wear rings, made of ASTM B505-927 bronze, shall be installed in the volute and volute cover. The rings shall be locked against rotation.

d. Pump/Motor Shaft: The shaft shall be made of AISI 1045 alloy steel and accurately machined over its entire length. The first critical speed of the rotating assembly shall occur at not less than 150% of the rated speed.

i. The shaft shall be protected by an ASTM B148-954 bronze shaft sleeve, which shall be keyed to the shaft with a stainless steel key and shall be sealed with an o-ring to prevent leakage between the shaft and shaft sleeve.

e. Stuffing Boxes (Mechanically Sealed): The stuffing boxes shall be provided with mechanical seals having incorporated the following features:

i. Stuffing boxes shall accept packing or mechanical seals without modification to the stuffing box.

ii. Mechanical seals shall be furnished with a carbon seal ring, ceramic mating ring, viton elastomers and 316 stainless steel metal parts.

iii. Mechanical seals shall be rated for 250 PSIG pressure. The elastomers shall be rated for temperatures ranging from –20 degrees F to 400 degrees F.

iv. Pump shaft sleeves shall be furnished with a pre-machined groove designed to accept a setting ring that shall eliminate the need for set collars or stop collars. Seals requiring stop or set collars are not acceptable.

v. The rotating seal ring shall be provided with a 360 degree rubber encasement to provide a positive drive for the seal face without the need for metal drive notches which may cause face distortion or notch wear. The seal rings shall be permanently fixed in place and full flatness maintained by a precision crimp in the outer seal case.

vi. The mechanical seal shall be of a convoluted design that permits free movement providing constant adjustment for shaft endplay and seal facewear. Positive face contact with the stationary seat maintained at all times.

vii. To insure positive sealing by free movement of the seal head, the seal shall feature a hex style outer shell and drive band which shall absorb start-up and running torque and shall eliminate in stress on the diaphragm. Metal components shall freely engage and shall not be subject to lock down due to friction wear.

viii. Suitably valved connecting lines or passages shall be provided on the upper half casing leading from the discharge volute to the stuffing box for lubricating the stuffing boxes with the liquid being pumped.

f. Bearings: Bearings shall be of the anti-friction and grease lubricated type with the following features:

i. The bearing configuration shall consist of one single row deep grooved anti-friction bearing on the inboard side and two single row angular contact and anti-friction bearings mounted back to back on the outboard side. The inboard bearing shall be designed to take the radial thrust loads. The two single row angular contact anti-friction bearings mounted back to back on the outboard side shall be designed to take a combination of leads, both radial and axial and hold the rotor in axial alignment.

ii. Bearings shall have a minimum rated service life of 40,000 hours in accordance with standards of the Bearings Manufacturers Association through out the specified operating range. Bearings housings shall be rigidly supported by suitable brackets, which shall be cast integrally with the lower half of the pump casing.

4. Pressure Control:

a. Control Panel:

i. The control panel shall incorporate a pressure control system using pressure switches and time as a basis for sequencing the pumps. The system pressure switch shall be a bourdon tube type having independent start and stop setpoints. The pressure switch shall have a rating of 10-300 PSI and shall have a burst rating of 400 PSI. The pressure switch should be mounted on a wing panel adjacent to the control panel, facing forward, to give the operator easy access to the set point controls.

ii. The control panel shall include adjustable combination on/off delay timers for each pump. The timers selected should have contacts rated 1-amperes minimum at 120 volts non-inductive. The on delay time should be adjustable from 0.6-160 seconds and the off delay time should be adjustable from 15 seconds - 640 minutes.

iii. The control panel shall incorporate a low suction control system that will interrupt operation of the pumps if a critical low suction event occurs. The low suction pressure switch shall be a bourdon tube type having a rating of 5-150 PSI and be mounted on a wing panel adjacent to the control panel, facing forward, to give the operator easy access to the controls. The pressure switch shall have independent setpoints, the lower setting being the low suction setting and the higher setting being the reset point. The low suction control shall also incorporate an adjustable timer, 0.6-60 seconds, to delay low suction shutdown due to momentary nuisance dips in suction pressure. There shall also be a pilot light mounted to the front of the enclosure that will illuminate upon low suction pressure. There shall also be a set of C-form contacts to remotely alarm the low suction condition. Both the low suction pilot light and the remote alarm contacts shall reset automatically upon restoration of the suction pressure to the reset point on the pressure switch. The pressure control system will automatically restore the pumps to the run mode after the low suction condition is reset.

iv. The pressure control system shall work in conjunction with an alternator relay to select first one pump, then the second pump, to run as "Lead" pump. Alternation will occur at the end of each pumping cycle.

5. Electrical:

a. Panel Enclosure:

i. Electrical control equipment shall be mounted within a NEMA 4X Stainless Steel control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.

ii. Controls are to include an Allen-Bradley SLC 503 PLC with Panelview 550 touch screen (if required).

iii. All control devices and instruments shall be mounted using threaded fasteners, and shall be clearly labeled to indicate function.

b. Branch Components:

i. Motor branch components to be of highest industrial quality, secured to the sub-plate with machine screw and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount any component.

ii. Circuit Breakers and Operating Mechanisms:

1) A properly sized heavy-duty circuit breaker, with RMS interrupting rating of 14,000 amperes at 460 volts, shall be furnished for each pump motor.

2) An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in “OFF” position.

iii. Controls for Duty pumps to include Allen-Bradley PowerFlex 70 variable frequency drives (if required). High Flow pump control to include a PowerFlex 700 variable frequency drive (if required).

iv. Overload relays to be block-type mounted to each motor starter having trip indication with trip free operation. Pressing the overload-reset lever shall not actuate the control contact until after the overload spindle has reset. Resetting the overload reset lever will cause a snap-action control contact to reset, thus re-establishing a control circuit. Overload relays to be manual reset only. The overload relay shall provide NEMA class 10 trip times and will be selected in accordance with the actual motor name plate data.

v. An overload-reset push button, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.

c. Control Circuit:

i. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

ii. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the pressure sensing system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.

1) Pump alternation **(IN PLC)**. The station operator to select automatic alternation of pumps, to select pump number one to be "lead" for each pumping cycle, or to select pump number two to be "lead" pump for each pumping cycle.

2) Elapsed time indication (IN PLC) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours". An integral pilot light shall be wired in parallel to indicate that the motor is energized and should be running.

3) A duplex ground fault receptacle providing 115 VAC, 60 Hz, single- phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

d. UL Label Requirement:

Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

e. Transient Voltage Surge Suppressor:

The control panels shall be equipped with a transient voltage surge suppressor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps, and a Joule rating of 1500.

f. Pump Start Delay: (IN PLC)

The control circuit for pumps #2 and #3 shall be equipped with a time delay o prevent simultaneous motor starts.

g. Auxiliary Power Transformer:

The pump station shall be equipped with a 3 KVA step-down transformer to supply 115 VAC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.

h. Wiring:

i. The pump station as furnished by the manufacturer shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to the remote alarm devices.

ii. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electrical Code (NEC).

iii. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

1) Line and Load Circuits,
AC or DC power Black

2) AC Control Circuit Less Than Line Voltage ..... Red
3) DC Control Circuit ..... Blue
4) Interlock Control Circuit From External Source ..... Yellow
5) Equipment Grounding Conductor ..... Green
6) Current Carrying Ground ..... White
7) Hot With Circuit Breaker Open ..... Orange

iv. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14-gauge minimum. Motor branch wiring shall be 10-gauge minimum.

v. Motor branch and other power conductors shall not be loaded above 60 degrees C temperature rating, on circuits of 100 amperes or less, nor above 75 degrees C on circuits over 100 amperes. Wires must be clearly numbered at each in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

vi. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

i. Conduit:

i. Factory installed conduit shall conform to the following requirements:

1) All conduit and fittings to be UL listed.
2) Liquid tight flexible metal conduit to be constructed of smooth, flexible, galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
3) Conduit to be supported in accordance with articles 346, 347 and 350 of the National Electrical Code.
4) Conduit shall be sized according to the National Electrical Code.

j. Grounding:

i. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding-mounting surface before making final connection.

ii. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

k. Equipment Marking:

i. Permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:

1) Equipment Serial Number
2) Supply Voltage, Phase and Frequency
3) Current Rating of the Minimum Main Conductor
4) Electrical Wiring Diagram Number
5) Motor Horsepower and Full Load Current
6) Motor Overload Heater Element
7) Motor Circuit Breaker Trip Current Rating
8) Name and Location of Equipment Manufacturer

ii. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

iii. Switches, indicators and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

6. Pump Control Valve:

a. The booster pump control valve shall be designed for installation on the discharge of booster pumps to eliminate starting and stopping surges caused by the pump. The valve shall be equipped with a built-in lift type check feature to prevent reverse flow, operating independently of the solenoid control and shall be comprised of the following:

i. Main Valve:

1) The valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern. A resilient synthetic rubber disc shall have a rectangular cross section and shall be retained on three and one-half

sides to assure proper gripping under extreme hydraulic conditions. The two piece stainless steel valve stem shall be guided by three bearings located in the cover, intermediate body, and seat.

2) The main valve shall consist of two distinct operating chambers that are detachable and completely independent of the flow through the main valve body.

3) The valve shall consist of four components: the body with seat installed, the power unit body with center bearing, the cover with the bearing installed, and the diaphragm assembly. The valve body, power unit body and cover shall be of cast material. Ductile Iron is standard and other materials shall be available. No fabrication or welding shall be used in the manufacturing process. The diaphragm assembly shall be the only moving part and shall form a seal between the two operating chambers. Packing glands and/or stuffing boxes are not permitted. There shall be no pistons operating the main valve or pilot controls. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding line shocks due to abnormal pump stoppage. No hourglass-shaped disc retainers shall be permitted and no V-type disc guides shall be used.

4) The diaphragm assembly containing a non-magnetic two piece stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided by three bearings; in the valve cover, the power unit body, and an integral bearing in the valve seat. The built-in lift type check is designed to prevent pressure reversal caused by power failure. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary.

5) The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 p.s.i. per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity.

6) The diaphragm shall be fully supported in the valve body and cover by machined surfaces that support no less than one half of the total surface area of the diaphragm in either the fully open or fully closed position.

7) The main valve seat, the power unit body and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Components, including cast material, shall be of North American manufacture.

8) The valve manufacturer shall warranty the valve to be free of defects in material and workmanship for a period of three years from date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.

9) The valve manufacturer shall be able to supply a complete line of equipment from 2" through 16" sizes and a complete selection of complementary equipment.

ii. Pilot Control System:

The valve operation shall be controlled by an externally mounted pilot control system with a four-way solenoid operated pilot. The solenoid shall be designed to operate on either AC or DC current and have a manual operator installed.

Pilot system includes: four-way solenoid pilot valve, opening and closing speed controls, shut off valves, strainers and CVS-1 shuttle valve to provide the highest available operating pressure to the pilot system.

iii. Limit Switch:

1) An adjustable limit switch assembly shall be mounted on the main valve, connected to the main valve stem. The limit switch shall be actuated by opening, or closing, of the valve and easily adjusted to operate at any point of the valve's travel. The limit switch will be used to complete the pump off cycle. The actuating point of the limit switch shall be adjustable.

2) A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

7. Serviceability:

a. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

b. No special tools shall be required for replacement of any components within the pump.

2.06 APPURTENANCES

A. Valving: Pumps shall be adequately valved to permit satisfactory operation, maintenance and repair of the equipment. Each pump shall have a positive-acting check valve on the discharge side between the pump and the shut-off valve.

Check valves shall have ductile iron body with Buna-N liner. Aluminum bronze or ductile iron disc plates and dual stainless steel internal springs. Check valve bodies shall be designed for installation between ANSI B16.1 Class 125 flanges. Swing check valves requiring reversal of flow for closure shall not be acceptable. Valves shall be Crane Centerline Series 800 or approved equal. Isolation valves shall be butterfly type with resilient seat designed for installation between ANSI B16.1 Class 125 flanges. Valves shall have cast iron body with Buna-N liner. Ductile iron disc with one-piece stainless steel shaft and PTFE bushings. Butterfly valves shall be Crane Centerline Series 200 or Owner/Engineer approved equal.

B. Piping: Piping shall be designed so that the friction losses will be minimized. The piping shall not be subject to contamination and have watertight joints. The piping shall be designed to protect against surge or water hammer and provided with suitable restraints where necessary.

Flanged header pipe shall be cement-lined ductile complying with ANSI/AWWA A21.51/C115 and class 53 thickness. Flanges shall be cast iron class 125 and Comply with ANSI B16.1. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe. Bolt holes shall be in angular alignment within ½ degree between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

C. Supports And Thrust Blocks: The contractor must insure all pipes connected to the pup station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

D. Gauges and Meters: Two gauges shall be installed on each pump with Petcocks for shut-off and piping so that each gauge is clearly visible. Suction pressure must be monitored by a spring suspended movement type compound gauge, and discharge pressure by a spring suspended movement type pressure gauge. Gauges to be at least 3 inches in diameter graduated in inches of mercury and pounds per square inch. Compound gauge shall be graduated -30" Hg to 100 p.s.i. Pressure gauge to be graduated 0 to 200 p.s.i.

E. Standby Power: To ensure continuous service when the primary power has been interrupted, a power supply shall be provided from at least two independent sources or a standby or an auxiliary source shall be provided. If standby power is provided by onsite generators or engines, the fuel storage and fuel line must be designed to protect the water supply from contamination.

2.07 INSPECTION

The contractor shall off-load equipment at the installation site using equipment of sufficient size and design to prevent injury or damage. The station manufacturer shall provide written instructions for proper handling. Immediately after off-loading, the contractor shall inspect the complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with the shipper.

2.08 INSTALLATION

A. Install, level, align and lubricate the pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

2.09 FIELD QUALITY CONTROL

A. Operational Test:

1. Prior to acceptance by owner, an operational test of all pumps, drives and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition, and conforms to the specified operating characteristics.

2. The contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gauge readings, ampere draw, pump controls, and pressure controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

B. Manufacturers Start-Up Services: Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust the instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

2.10 CLEANING

Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

2.11 PROTECTION

The pump station should be placed into service immediately. If operation is delayed, drain liquid from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

2.12 QUALITY ASSURANCE

The manufacturer of the pressure booster station shall have a quality management system in place and shall be ISO 9001 Certified. Upon request from the engineer, the pressure booster pump station manufacturer shall prove financial stability and ability to produce the station

within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

Each pump shall undergo a certified hydrostatic test at 150% of the pressure developed at shut-off head. Certified performance tests shall be performed on each unit utilizing its specified drive. If variable frequency drives are specified, one drive of each rating shall be used to drive the appropriate pump in the system. All tests shall be performed in accordance with the Hydraulic Institute Test Standards for Centrifugal Pumps - 1.6 (1988). Six evenly spaced test points shall be taken and shall include conditions at shut-off (zero flow) and the operating points specified herein. Preliminary test data must be submitted to the owner seven days prior to the actual test date. Liquid to be used for all tests shall be water.

The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment.

2.13 RECORD DRAWINGS

A. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and pressure control circuits to the extent necessary to validate function and integration of circuits to form a complete working system.

B. A minimum of three (3) operational and maintenance (O&M) manuals shall be provided along with one copy on CD-ROM in either Work format or Adobe Acrobat format. The Owner shall have time prior to project completion to review the O&M manuals and have any comments or requests incorporated into the final three copies and CD-ROM version of the O&M manuals.

1. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provide by those supplying the equipment. Instructions shall include the following as a minimum:

    a. Functional description of each major component, complete with operating instructions.

    b. Instructions for operating pumps and pump controls in all modes of operation.

    c. Calibration and adjustment of equipment for initial start-up, replacement of pressure control components, or as required for routine maintenance.

d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 79. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pressure booster pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

2.14 WARRANTY

A minimum two-year warranty from date of final acceptance shall be provided on all equipment.

2.15 EMERGENCY STANDBY POWER

New water pumping stations shall be equipped with emergency standby power either generator or bypass pumps as determined by Daphne Utilities for each site. Supervisory Control and Data Acquisition (SCADA) systems in accordance with the SCADA systems currently in use by Daphne Utilities sewer system for monitoring operating conditions of the pump station from remote sites shall be installed at new water pumping station.

2.16 SHOP DRAWINGS AND RECORD DRAWINGS

The Contractor shall submit to the Engineer for review and approval prior to ordering materials six (6) sets of shop drawings for valves, fittings, special connection fittings, and piping at connections to existing pipes. No separate compensation will be allowed the Contractor for Shop Drawings. Review and approval of Shop Drawings by the Engineer shall in no way relieve the Contractor of his responsibilities for materials and workmanship in construction of the project. Upon project completion, two (2) sets of record drawings shall be submitted to the building inspector showing final construction conditions noting installed materials and locations.

Refer to Design Criteria section certification by manufacturers and suppliers for equipment and products.

END OF SECTION