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4. Summary of Practice

4.1 All lift holes and any pipes entering the manhole are to be plugged. A vacuum will be drawn and the vacuum drop over a specified time period is used to determine the acceptability of the manhole.

5. Significance and Use

5.1 This is not a routine test. The values recorded are applicable only to the manhole being tested and at the time of testing.

6. Preparation of the Manhole

6.1 All lift holes shall be plugged.

6.2 All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

7. Procedure

7.1 The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.

7.2 A vacuum of 10 in. of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 in. of mercury.

7.3 The manhole shall pass if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in Table 9.1.

7.4 If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

7.5 Use or failure of this vacuum test shall not preclude acceptance by appropriate water infiltration or exfiltration testing, (see practice C9690, or other means).

8. Precision and Bias

8.2 No justifiable statement can be made either on the precision or bias of this procedure, since the test result merely states whether there is conformance to the criteria for the success specified.

9. Keywords

9.1 Acceptance criteria: Concrete; manhole sections; test method; vacuum test.

TABLE 9-1
Minimum Test Times for Various Manhole Diameters
(seconds)

Depth (feet)	Diameter (Inches) 30	33	36	42	48	54	60	66	72
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	39	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

9.04 LIFT STATION AND FORCE MAIN TESTING

The following section describes the testing that shall be performed on the lift station pumps, piping and force main for acceptance and dedication to the District.

NOTE: The Contractor shall be responsible for providing sufficient notice of all lift station and force main testing to the District, 48 hours minimum, to ensure that the following personnel shall be present at the time of testing: (1) District engineering representative, (2) private inspector, (3) contractor's representative, (4) developer's representative, (5) Fall Creek Regional Waste District Lift Station Maintenance representative.

A. FORCE MAIN TESTING

1. General

Under the observation of the District's Inspector, force mains shall be tested for leakage after installation and prior to final acceptance. The Contractor shall be responsible for providing all equipment and tools necessary to perform an air pressure test or hydrostatic pressure test conducted in accordance with AWWA standards for testing pressure pipe.

*These standards are material specific and generally reference manufacturer's guidelines. The standards apply to method of conducting air pressure tests only. Established pass/fail criteria are contained in the following sub-sections.

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

2. Air Pressure Testing

Force mains shall not be tested using air pressure test methods.

3. Hydrostatic Pressure Testing

Hydrostatic pressure testing of force mains is the only method of force main testing approved by the District.

The Contractor shall be responsible for providing all of the equipment and tools necessary to conduct the hydrostatic test including, but not limited to, the following:

a. Hydrostatic test pump (jockey pump).

b. Four and one half (4 1/2" inch diameter calibrated pressure test gauge of range 0-150 psi graduated in 1 psi increments. The manufacturer's calibration papers and test date information shall be made available at the request of the District.

c. All pipe plugs and/or caps required to perform the hydrostatic test.

d. Calibrated/graduated container to measure quantity of water required to be added during hydrostatic pressure test to maintain specified test pressure.

The hydrostatic pressure test shall be conducted in accordance with the applicable AWWA standard based on force main material and in accordance with ASTM E103 - "Standard Method for Hydrostatic Leak Testing." in conjunction with and in addition to the aforementioned standards, the hydrostatic pressure test shall proceed as follows:

e. The force main shall be completely backfilled prior to testing.

f. The influent line and effluent discharge shall be appropriately plugged/bulkheaded. The plugs/bulkheads shall be equipped with a minimum of two (2) openings for filling/draining the pipeline and for bleeding air from the line. Thrust blocking restraints are required at each bulkhead and shall be furnished in accordance with the bulkhead manufacturer's requirements.

g. The test line shall be filled with water at a slow rate to prevent air entrapment. In the case where concrete force main materials are being tested, the line shall be left at low pressure for 24 hours prior to pressure testing in order to minimize the apparent leakage due to water absorption by the pipe walls.

h. Trapped air shall be expelled through high point bleed off valves as the line is being filled.

i. The test line shall be pressurized to 1.5 times the pump shut-off head as determined from the pump manufacturer's performance curves or to 100 psi whichever is greater.

j. Water shall be added to the test segment to maintain the test pressure for a period of no less than 2 hours and no more than 8 hours. The District's inspector must be present for at least the first 2 hours of testing.

k. If the force main or any portion thereof fails the hydrostatic pressure test, the Contractor shall remove and replace or otherwise repair the force main to the satisfaction of the District and the force main shall be retested.

B. WET WELL LEAKAGE TESTING

Leakage tests shall be made and observed by the District's Inspector in the wet well. The test shall be the exfiltration test made as described below:

After the wet well has been assembled in place, all lifting holes shall be filled with an approved non-shrinking mortar. The test shall be made prior to placing any fill material. If the ground water table has been allowed to rise above the bottom of the wet well, it shall be lowered for the duration of the test. All pipes and other openings into the wet well shall be suitably plugged and the plugs braced to prevent blow out.

The wet well shall then be filled with water to the top. If the excavation has not been backfilled, and observation indicates no visible leakage after 1 hour; the wet well may be considered to be satisfactorily water-tight. If the test described above is unsatisfactory or if the wet well excavation has been backfilled, the test shall be continued for a period of 24 hours to allow for absorption. At the end of this period, the wet well shall be refilled to the top, if necessary; and the measuring time of at least 8 hours begun. At the end of the test period, the wet well shall be refilled to the top, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth. The leakage for each wet well shall not exceed 1 gallon per vertical foot for a 24-hour period. If the test fails this requirement, but the leakage does not exceed 2 gallons per vertical foot per day, repairs by approved methods may be made as directed by the District to bring the leakage within the allowable rate of 1 gallon per foot per day. Leakage due to a defective section or joint or exceeding the 2 gallon per vertical foot per day maximum shall be cause for the rejection of the wet well. It shall be the Contractor's responsibility to uncover the wet well as necessary and to disassemble, reconstruct, or replace it as directed by the District. The wet well shall then be retested.

No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc.; i.e., it will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the District's Inspector that the water table is below the bottom of the wet well throughout the test.

C. LIFT STATION PUMP TESTING

Lift Station pump test will be performed by the Contractor during the lift station's final inspection. The Contractor shall be responsible for providing the clean water to run the pumps and perform the test(s).

1. Manufacturer's Start-up

Prior to the District's final inspection of the lift station equipment, the Contractor shall be responsible for coordinating start-up activities with the pump manufacturer's representative in accordance with the manufacturer's requirements. The District's Inspector must be present at the time of manufacturer's start-up.

The manufacturer's representative shall complete the appropriate one of the two lift station check lists attached at the end of this Section. The checklist shall be witnessed to in writing by the District's Inspector. Any deficiencies in equipment and/or workmanship noted during the manufacturer's start-up shall be remedied by the Contractor prior to final inspection.

Upon successful completion of the manufacturer's start-up, the manufacturer shall deliver to the Contractor:

a. Three (3) copies of the completed, witnessed checklist with cover letter certifying that all pumping and electrical equipment has been installed and is operating in accordance with manufacturer's requirements;

b. Five (5) sets of Operation and Maintenance Manuals as specified in Section 10 of these Standards; and

c. One (1) complete set of Spare Parts as specified in Section 10 of these Standards.

2. Final Inspection

Contractor shall deliver two (2) copies of the manufacturer's start-up checklist at the time of final inspection. In addition, the Contractor shall provide the following pump test equipment and materials:

a. Water to conduct test,

b. Amp/volt meter,

c. Stop watch,

d. Tape level rod to measure settings,

e. Calibrated test gauge to measure operating head. The gauge shall be calibrated in feet of water from 0 to 100 feet in one foot increments, and

f. Manufacturer's pump performance curves.

The District's representative attending the final inspection shall review the manufacturer's checklist and re-check any deficiencies. The District's representatives shall then complete a cursory final inspection checklist and perform pump draw down tests which shall include the following:

a. Manual check of all on-off operations, alarm and run lights;

b. Determination of inflow rate (if any);

c. Determination of pump capacity for each pump individually and both/all pumps simultaneously;

d. Determination of pump capacity with force main full. Verification of full force main shall be determined by pressure gauge provided by Contractor. Force main shall be considered full when the line pressure stabilizes; and

e. Plot performance of each pump or pump curves provided by Contractor.

Contractor shall provide all water necessary to conduct the pumping tests, and shall provide a connection for the test gauge on the blind flanged tee in the valve vault. The stem connection shall be equipped with a plug valve to close the connection after testing is complete. The connection shall be left in place and shall be suitable for use as an air bleed off.

The pumping test results must meet or exceed the design pumping criteria approved by the District to successfully pass the final inspection. Any deficiencies noted during the final inspection shall be repaired/replaced by the Contractor to the satisfaction of the District and reinspected/retested prior to final acceptance.

9.05 CLOSED CIRCUIT TELEVISION INSPECTION

When Mandrel Test shows areas of deflection failure along the pipe or when air testing fails, the Contractor shall be required to perform a closed circuit television inspection of the sanitary sewer between manholes as follows:

A. A camera equipped with a rotating lens and remote control devices to adjust the light intensity and one thousand (1,000) lineal feet of sewer cable shall be provided. The camera should be able to transmit a continuous image to the television monitor as it is being pulled through the pipe. The image shall be clear enough to enable the District representative and others viewing the monitor to easily evaluate the interior condition of the pipe. The camera shall have a digital display for lineal footage and project number and an audio voice-over shall be made during the inspection identifying any problems.

B. The pipe shall be thoroughly cleaned before the camera is installed and televising is commenced.

C. The VHS tape of the entire sewer line and reproduction map indicating the pipe segment numbers of all the pipe that has been televised shall be submitted to the District for their records.

If any pipe and/or joint is found to be leaking, the Contractor shall be required to repair that portion of the pipe to the satisfaction and approval of the District.

D. FCRWD will perform a closed circuit television inspection of all new sanitary sewer lines prior to final acceptance by the District. Any deficiencies noted must be repaired and re-televised by the Contractor before final acceptance by the District.

Table 9-2
(9-Arm Mandrel)
Dimensions for ASTM D3034 SDR 35 PVC Pipe

Nominal Diameter	Length	Deflection 3%	5%
8	8	7.71	7.56
10	10	9.63	9.45
12	12	11.46	11.26
15	12	14.03	13.78

(10-Arm Mandrel)
Dimensions for ASTM D3034 SDR 35 PVC Pipe

Nominal Diameter	Length	Deflection 3%	5%
8	8	7.72	7.58
10	10	9.65	9.48
12	12	11.48	11.29
15	12	14.06	13.82

EXAMPLE LOW PRESSURE AIR TESTS

A. GENERAL

The purpose of this Section is to illustrate the proper application of this recommended practice with regard to appropriate test time selection. The examples that follow include a variety of conditions which may be encountered in the field.

1. EXAMPLE A

A manhole to manhole reach of nominal 12-inch pipe is 350 feet long. No lateral connections exist in the reach. What is the required test time for a 0.5 psig pressure drop?

Solution: The required test time can be read directly from Table 9.1B. For 350 feet of 12-inch pipe, the required test time is 9:58 (9 minutes and 58 Seconds).

2. EXAMPLE B

A 350 foot section of nominal 12-inch pipe is ready for testing. A total of 128 feet of 4-inch lateral sewer pipe is connected to the 350 foot section and will be included in the test. What will be the required test time for a 0.5 psig pressure drop?

Solution: Lateral sewers may be disregarded when selecting test times. Therefore, the required test time will be the same as for Example A, i.e. 9 minutes and 58 seconds.

Note: If lateral sewers had not been disregarded, the required test time would be 10 minutes and 22 seconds, i.e. only 24 seconds longer.

3. EXAMPLE C

What should the required test time be for a 1.0 psig pressure drop in 327 feet of nominal 8-inch diameter pipe between two manholes?

Solution: The exact test time is easily calculated by using Table 9.1A. Table 9.1A is used because a 1.0 psig pressure drop is specified. Since 327 feet exceeds the minimum test time for an 8-inch pipeline, the fourth column in Table 9.1A shall be used to quickly calculate the required test time as follows:

T = 1.520 L = 1.52 X 327 = 497 seconds

Therefore, the required test time for a 1.0 psig pressure drop is 497 seconds, or 8 minutes and 17 seconds.

4. EXAMPLE D

A manhole to manhole reach of nominal 24-inch pipe is 82 feet long. What is the required test time for a 0.5 psig pressure drop?

Solution: Table 9.1B must be used because a 0.5 psig pressure drop is specified. Since 82 feet is less than the 99 foot length associated with the minimum test for a 24-inch pipeline, the minimum test time shall apply. Thus, the required test time for a 0.5 psig pressure drop must be 11:20 (11 minutes and 20 seconds).

5. EXAMPLE E

A 412 foot section of nominal 15-inch sewer pipe has been readied for air testing. A total of 375 feet of nominal 6-inch lateral piping and 148 feet of nominal 4-inch lateral piping branch off of the 15-inch sewer line. All laterals have been capped and/or plugged and will be tested together with the 15-inch main line. The specified pressure drop which will be timed is 0.5 psig. What is the appropriate test time for this pipe network?

Solution: All lateral sewer sizes and lengths may be disregarded since their influence is generally not significant enough to warrant computation. Table 9.1B must be used for a

0.5 psig pressure drop. The fourth column in the Table provides the appropriate formula for calculating the required test time because 412 feet is longer than the third column value of 159 feet.

T = 2.671 L = 2.671 X 412 - 1, 100 seconds

The required test time is 1,100 seconds or 18 minutes and 20 seconds.

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

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec) 100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

Table 9.1A

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

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec) 100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:46	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

Table 9.1B

SECTION 10 - LIFT STATIONS

10.01 GENERAL

This Section pertains to the requirements for the design and construction of submersible type lift stations, which are the primary type constructed as part of private development. Wet well/dry pit stations are acceptable, and their design and approval will be handled on a case-by-case basis.

Lift stations meeting or exceeding the requirements set herein will be approved. Any proposed alteration of the lift station dimensions, equipment, controls, etc. from the standards set forth herein will be approved only upon the submittal of plans and specifications of the proposed changes to the District, and upon the District's written approval.

Lift Stations, in general, shall be submersible type including a minimum of two (2) pumps and motors of minimum pumping capacity of 100 gpm under site operating conditions, wet basin, separate valve pit, valves, piping, hatches, guide rails, pump removal components, control center, float switches, remote monitor package, interconnecting electrical wiring, incoming power and radio supply, and all other features regularly and normally required as a part of a complete and functional facility. All work shall be in accordance with site requirements, details in the Plans, these Standards and the manufacturer's recommendations.

All Lift Stations shall be designed for and operate on three (3) phase power. No deviation from this requirement shall be permitted without the express prior written approval of the District.

10.02 GENERAL REQUIREMENTS

A. All of the mechanical and electrical equipment shall be an integral package supplied by the pump manufacturer with local representation so as to provide undivided responsibility. The package shall be equal in construction and performance to Hydromatic Pump equipment and other specific requirements set forth herein and in the approved plans.

B. The Contractor shall submit to the District for review and approval three (3) sets of shop drawings, detailed specifications, pump warranty and performance characteristics for all of the equipment and fixtures to be furnished and installed.

The Shop Drawings and equipment data shall be submitted with a cover letter or Contractor's stamp of approval, indicating that he has reviewed, checked and approved the data submitted. The District will review the submittal and render a decision in writing as to the acceptability of the equipment. Without prior written District approval, the item of work may not be accepted.

C. Any exceptions to this Standard or associated approved Plans shall be submitted in writing and clearly stated. The exceptions must be approved by the Engineer and the District prior to proceeding with the work.

D. All components of the lift station that are exposed to weather shall be constructed of material that is resistant to corrosion and will not require surface protection throughout the expected life of the lift station. In general, these materials are stainless steel, aluminum, Fiberglas reinforced polyester (FRP) and ultraviolet stabilized PVC. All control panels disconnect enclosures, and fittings must be constructed of stainless steel.

E. The lift station wetwell and valve vault structures must include external waterproofing and internal corrosion resistant lining. See section 10.05 for more details.

F. All valves and piping less than 4" diameter, coming in contact with sewage or installed in the pump or valve chambers shall be stainless steel or brass. All valves and piping of 4' diameter or greater coming into contact with sewage or installed in the pump or valve chambers shall be coated with 14 mil coal tar epoxy. Stainless steel or brass fasteners shall be used in all cases.

G. All lift station control panels and antenna must be connected to an adequately sized and installed grounding rod to provide lightening protection. A separate grounding rod is to be used for each component which is to be protected from lightning.

*See Section 9 for information regarding Testing of Lift Stations and 4.04B for economic Analysis of Lift Station.

10.03 OPERATING CONDITIONS

The characteristics and operating conditions of the lift station and pumps shall be provided in detail as part of the ENGINEER'S design and submitted for approval to the District.

Prior to installation the Contractor shall submit the following information for each pump to the District for review and approval:

A. Pump capacity in gallons per minute;

B. Total dynamic head (TDH) and operating RPM;

C. Motor horsepower;

D. Motor rpm;

E. Motor voltage, phase and cycle;

F. Make and model number; and

G. Pump curves for the pumps to be provided.

10.04 PUMPING EQUIPMENT

A. Pumps shall be of the submersible type for handling raw unscreened sewage. Pump volute, motor and seal housing are to be high quality gray cast iron. Impeller shall be either cast iron or cast bronze of a non-clog design capable of handling minimum three (3) inch sphere solids, fibrous material, heavy sludge, and other matter found in normal sewage applications. Impeller shall have pump out vanes on the back shroud of the impeller to keep pumped material away from the seal area and increase operating life. Impeller shall be either slip fit or taper fit with key to securely lock the impeller to the driving shaft. The pump volute shall be fit with a replaceable bronze wear ring to minimize wear on the impeller and help achieve longer balanced operating life. All fasteners shall be of stainless steel.

B. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber o-rings. Sealing shall be accomplished when metal-to-metal contact is made, resulting in controlled compression of the rubber o-rings without requirements of a specific torque limit.

C. The pump shall be provided with a mechanical rotating shaft seal system running in an oil reservoir having separate, constantly lubricated lapped seal faces. The lower seal unit between the pump and oil chamber shall consist of one (1) stationary seat and one (1) rotating ring held in place by its own spring. The lower seal shall be removable without disassembling the seal chamber. The upper seal between the motor and the seal chamber shall be of the same design with its own separate spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable.

Shaft seals with conventional double seal utilizing a single spring between the two (2) seals and requiring a pressure differential to offset external pressure shall not be considered acceptable nor equal to the dual independent seal system specified. The shaft sealing system shall be capable of operating submerged to pressures equivalent to two hundred (200) feet. No seal damage shall result from operating the pump unit out of its liquid environment. The seal system shall not rely upon the pumped media for lubrication.

The seal chamber shall also be equipped with a seal failure sensor probe which will sense water intrusion through the lower seal. This sensor is to be connected to an alarm in the control panel to indicate lower seal failure.

D. The stator winding, rotor and bearings are to be mounted in a sealed submersible type housing. Insulation utilized in the stator windings shall be Class F with maximum temperature capability of 155° C. Motor housing shall be filled with a high dielectric oil to give superior heat transfer and allow the bearing to run in a clean, well lubricated environment; or the housing shall be air filled with grease lubricated bearings.

The pump and motor are to be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped. The pump should not require cooling water jackets. Stator shall be securely held in place with a removable end ring and threaded fasteners so that it may be easily removed in the field without use of heat or press.

Shaft shall be of stainless steel and supported by ball bearings. Motor shall be provided with heat sensing units attached to the motor windings which shall be connected to the control panel to shut down pump if overheating occurs.

E. Pump motor cable and heat sensor/seal failure sensor cable shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable. Cable of the proper length shall be provided to eliminate need for splices or junction boxes between pump and the "control center." The cable shall enter the motor through a cord cap assembly which is double sealed allowing disassembly and disconnect of the wires and the motor and still not damage the sealed characteristics of the motor housing. Each individual conductor shall be color coded in accordance with generally accepted industry standards. The color coding shall designate the application of the conductor.

F. The pump mounting base shall include adjustable guide rail supports and a discharge connection with a one hundred twenty-five (125) pound standard flange. The base and the discharge piping shall be permanently mounted in place. The anchors with stainless steel studs and nuts as manufactured by HILTI Fasteners, Inc. or equal.

G. A rail system shall be provided for easy removal of the pump and motor assembly for inspection and service. The system shall not require a man to enter the wet well to remove the pump and motor assembly. Two (2) rails of two (2) inch stainless steel pipe or one rail of Fiberglas reinforced plastic (FRP) I-Beam shall be provided for each pump. The guide rails shall be positioned and supported by the pump mounting base. The guide rails shall be aligned vertically and supported at the top by attachment to the access hatch frame. One (1) intermediate guide rail support is required for each fifteen (15) feet of guide rail length for stainless steel pipe and one for each nine (9) feet of guide rail length for FRP I-Beam rail.

H. The pumps shall be equipped with sliding brackets or rail guides. To ensure easy removal of the pumps, the rail guides attached to each pump shall not encircle the rails. A stainless steel lifting chain or manufacturer's pump removal system (similar to the Flygt Lift) of adequate length for the basin depth shall be provided for each pump. Each pump shall be equipped with a permanent, stationary lifting handle with a minimum clearance of 12" between the top of pump and bottom of handle.

I. The rails and the rail guides shall function to allow the complete weight of the pumping unit to be lifted on dead center without binding and stressing the pump housing. The rail system shall function to automatically align the pumping unit to the discharge connection by a simple downward movement of the pump. No twisting or angle approach will be considered acceptable. The actual sealing of the discharge interface may be of the hydraulically sealing diaphragm type assembly with removable Buna-N diaphragm as supplied by Hydromatic Pump.

J. Pump warranty shall be provided by the pump manufacturer and shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. The warranty shall be in printed form and apply to all similar units. A copy of the warranty statement shall be submitted with the approval drawings.

10.05 BASIN, VALVE PIT AND ACCESSORIES

A. The basin and valve pit are to be constructed of precast concrete meeting the requirements of ASTM C-478. Cast-in-place monolithic structures may be substituted with the prior written approval of the District. Minimum valve vault and wet well diameter shall be 6' - 0". The actual arrangement of the structures is to be as shown in the approved Plans. The wet well basin top shall be provided with a four(4) inch PVC vent having a downward pointing inlet and screen over the inlet opening and a 4" PVC by-pass pipe to be within one (1) foot of bottom of wet well and to have an adapter on top of wet well. Adapter to meet District by-pass pump connection.

B. The basin, valve pit, flat tops and base slabs are to be constructed of precast reinforced concrete manhole sections conforming to ASTM C-478. All joints between precast sections shall be made with an approved rubber o-Ring in accordance with ASTM C-443 and a 1/2 inch diameter non-asphalt mastic conforming to AASHTO M-198 and federal Specification SS-521-A. The inside of the wetwell is to be coated with an internal corrosion resistant liner which should consist of either a primer coat of Aquataproxy A-10

REVISIONS		
DATE	DESCRIPTION	BY

HWC ENGINEERING
INDIANAPOLIS - TERRE HAUTE
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SPRINGBROOK
SECTION 1A

SANITARY SPECIFICATIONS

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REGISTERED
No. 10200309
STATE OF INDIANA
PROFESSIONAL ENGINEER

DRAWN BY
SMD
CHECKED BY
SMD
DATE
NOVEMBER 8, 2018
SCALE
N/A
JOB NUMBER
2017-271-A
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SANITARY SPECIFICATIONS