SUBMERSIBLE PUMPS

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1. GENERAL

1.01 This section provides information about electric and hydraulic submersible pumps and covers, in particular the description and operation of the electric submersible pumps. Low voltage (12 Vdc) pumps are not covered because of their limited application.

1.02 This section is reissued to add general information relating to the characteristics of submersible pumps available on the commercial market. Specific manufacturer's products are covered based upon numbers currently in use. The principles of operation and maintenance for most other makes are similar, but manufacturer's instructions must be followed. Since this is a general revision, change arrows have been omitted.

1.03 The presence of water in a manhole usually requires that the water be removed, or the water level lowered, before any work in the manhole can begin. Therefore, any pump used for dewatering should be capable of removing the water in a reasonable length of time with consideration given to portability, power requirements, etc, of the pump selected for the job.

1.04 Submersible pumps are self-priming, centrifugal pumps designed to operate while completely submerged. The pumps will operate when placed in a vertical or horizontal position; however, the suction is in the base of the pump and with the pump placed in a vertical position on a flat floor, water can be removed to within 2 inches or less from the floor. Water is discharged at the top of the pump through a discharge hose of suitable size and length. The intake strainer must be in place when the pump is operating. Avoid taking air into the pump.

1.05 Submersible pumps most generally used for dewatering manholes operate from electric power sources. Some hydraulically driven pumps are used, but they are less common. The most commonly used electric pumps for manhole dewatering are those that are within the 1/2 HP 60 Hz to 1 HP 60 Hz range because the capacities of these pumps are sufficient for most applications, and suitable power is usually available. Where greater pump capacities are required, it is advantageous to use 230 volt single-phase pumps or 230 volt 3-phase pumps. Typical characteristics are shown in Fig. 1.

1.06 Low voltage (12 Vdc) pumps are used occasionally in areas that have very low water tables because their limited capacity (30-35 gpm) is acceptable. When operating a 12 Vdc pump, care must be taken ***not to discharge the vehicle battery*** as these motors will draw in excess of 20 amps.

ALTERNATING CURRENT

BASIC MODEL	HP	PH	HZ	VOLT	AMPS START	AMPS RUN
9-25012	2	1	60	230	41.0	10.6
9-25032	2 1/2	3	60	230	49.2	6.8
9-25034	2 1/2	3	60	460	24.6	3.4
9-25022	2	1	50	220	35.0	11.9
9-25042	2 1/2	3	50	220	33.5	6.2
9-25044	2 1/2	3	50	415	16.8	3.1

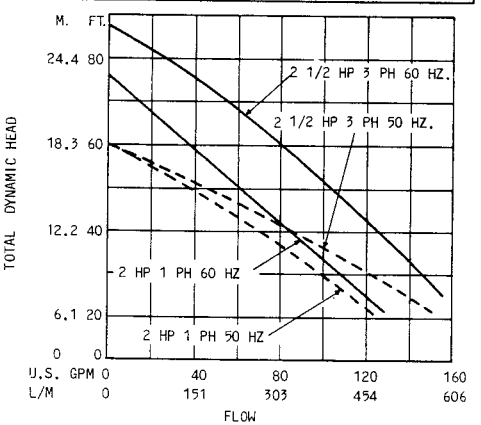


Fig. 1—Typical Characteristics of Prosser 2 and 2-1/2 HP Submersible Pumps

2. ELECTRICALLY DRIVEN SUBMERSIBLE PUMPS—GENERAL

2.01 The proper voltage and frequency must be provided to operate a given pump. Voltage should be within ±10% and frequency within ±2 Hz of the nameplate rating. Submersible pumps of the same capacity may have significantly different starting current requirements depending upon motor design. Be certain that generator capacity is capable of handling the starting current of the pump motor. Table A lists nominal power requirements for various 3/4 and 1 HP Prosser pumps. Table B lists start and run current requirements for the C.H.&E. pump.

TABLE A

POWER REQUIREMENTS FOR PROSSER UTILITY PUMPS, 3/4 AND 1 HP

BASIC MODELS	PH	HZ	VOLTS	AMPS START	AMPS RUN
3/4 HP					
9-911	1	60	115	35.0	10.4
9-912	1	60	230	17.5	5.1
9-932	3	60	230	14.5	2.6
9-934	3	60	460	7.3	1.4
9-935	3	60	575	6.4	1.12
1 HP					
9-1211	1	60	115	45.0	13.5
9-1212	1	60	230	22.5	7.1
9-1232	3	60	230	17.0	3.4
9-1234	3	60	460	8.5	1.7
9-1235	3	60	576	6.4	1.2

TABLE B

C. H. & E. PUMP MODEL ES-005 (FORMERLY B SUBMERSIBLE PUMP) ELECTRICAL CHARACTERISTICS AND FLOW RATE

HEAD (FEET)	AMPS START	AMPS RUN	FLOW RATE (GPM)
5	14.5	7	87
10	14.5	6.5	63
15	14.5	6.5	51
20	15.5	6	33

2.02 Most generator systems on vehicles have ground fault interrupters (GFI). The GFI serves two purposes; it protects the circuit from overload such as attempting to start an oversize pump, and it opens the circuit at a predetermined current leakage to ground (about 5 milliamps). If it is known that the pump is not overloading the circuit and the GFI trips repeatedly, the pump and cord must be examined for integrity of insulation and conductor faults.

2.03 If a generator does not provide sufficient power to operate a pump properly, pump capacity will be decreased, starting may be difficult, and other problems can occur. It is often the reaction of the operator to increase the speed of the generator in an attempt to increase pump efficiency. Increased speed causes an increase in voltage and frequency. As frequency increases, the speed of the driven motor will increase and the pump head, output, and horsepower will increase. However, this can produce amperage values above the rating of the pump motor and cause the protector to trip or cause pump motor damage.

2.04 The power cable to the pump must be of the proper size to prevent voltage drop under full load conditions. The cable must be examined periodically for abrasions, wear, or breaks and repaired or replaced as required. Never lift the pump by the power cable. Use the lifting handle or discharge hose when raising or lowering the pump.

2.05 Before operating a submersible pump, be sure a suitable ground connection has been provided at the power source. Check direction of impeller rotation on 3-phase pumps. If rotation is incorrect, reverse any two leads at the power source.

2.06 Perform all lubrication and maintenance in accordance with the pump manufacturer's recommendations. Pay particular attention to the condition of the impeller. A worn impeller can not only cause a loss of pump efficiency but also cause a severe increase in the wear on mating parts.

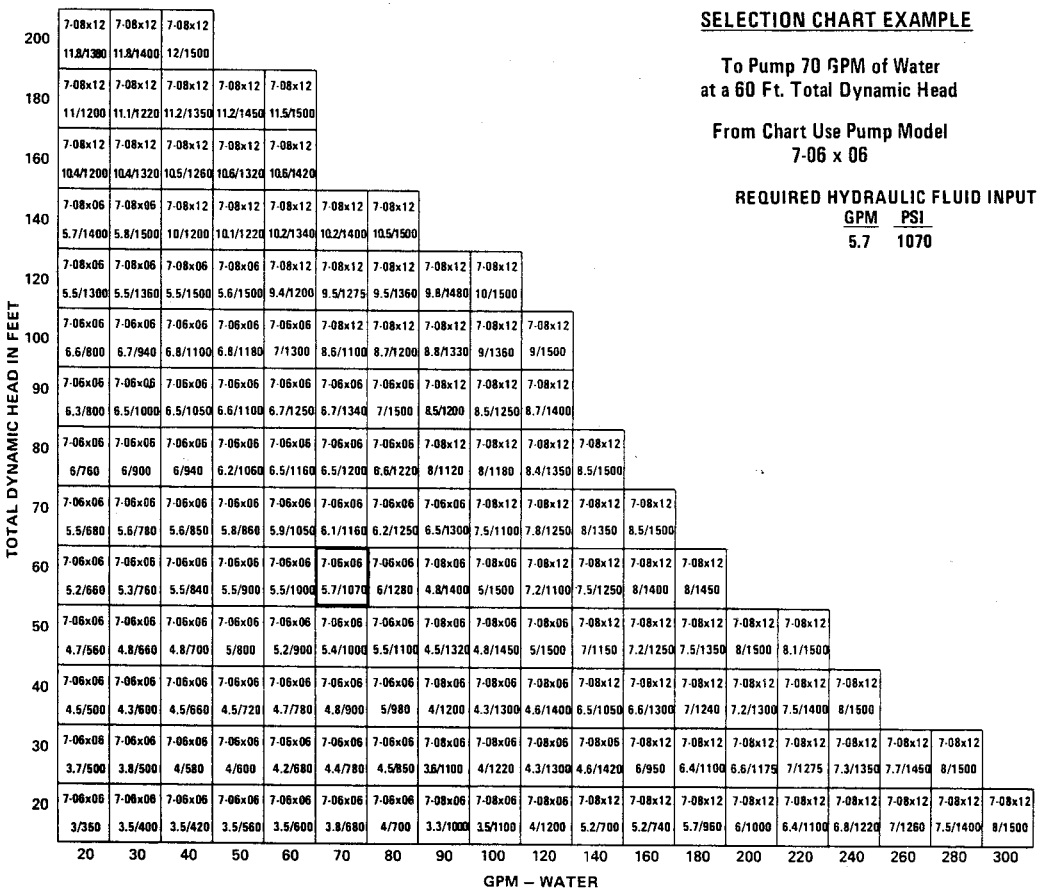
2.07 Most manhole pumps that are in use for manhole dewatering are not approved for use in explosive environments. Do not use a submersible pump in an environment known to contain a concentration which exceeds 10 percent of the LEL.

3. HYDRAULICALLY DRIVEN SUBMERSIBSLE PUMPS—GENERAL

3.01 Hydraulically driven pumps are similar in appearance to electrically driven pumps but weigh less than comparable electric submersible pumps. Two hydraulic hoses (high pressure and return) are connected to the pump at the top of the pump housing. Generally the source of hydraulic power is from a tool circuit provided on the construction vehicle. Hoses are usually stored on a retractable reel. A pump that is satisfactory for use in manhole dewatering should be capable of passing abrasive solids of from 5/16- to 3/8-inch diameter without damage to the impeller.

3.02 Hydraulically operated submersible pumps are available with a wide range of capacities depending upon the hydraulic flow rate. (See Table C for typical capacities of the Prosser Model 7-0000 series pumps). Any pump selected for a particular application must be compatible with the hydraulic flow rate and pressure relief setting. Different pumps require an input of approximately 3 to 12 GPM at pressures of from about 400 to 2000 psi. When selecting a hydraulic pump, be sure to compare the hydraulic flow rate with the hydraulic system capacity. When hydraulic pumps are operated continuously, a significant amount of heat is generated in the hydraulic fluid. To ensure proper pump performance, the hydraulic system reservoir must be of sufficient capacity to dissipate the heat.

TABLE C
CAPACITIES VS HYDRAULIC INPUT—PROSSER MODEL 7-0000 SERIES HYDRAULICALLY DRIVEN SUBMERSIBLE PUMPS



SELECTION CHART EXAMPLE

To Pump 70 GPM of Water
at a 60 Ft. Total Dynamic Head

From Chart Use Pump Model
7-06 x 06

REQUIRED HYDRAULIC FLUID INPUT

GPM	PSI
5.7	1070

3.03 Hydraulic hoses must be examined periodically for abrasions and wear and should be replaced as required. Never lift the pump by the hydraulic hoses. Use the lifting handle or discharge hose when raising or lowering the pump.

3.04 When connecting hydraulic lines, be sure the fittings are clean. Do not allow dirt or any foreign material to enter the hydraulic system. When lines are disconnected, protect fittings with covers or caps to prevent the entrance of dirt and protect against damage.

3.05 Hydraulic pumps are designed for unidirectional rotation. Connecting hoses improperly may result in leaking pump seals and subsequent replacement. One method of assuring proper connection of hoses is to equip one of the hoses with a male quick disconnect and the other with a female quick disconnect coupling. When the hoses

are disconnected and stored on the reel, the two hose ends can be coupled to exclude contamination.

3.06 Perform all lubrication and maintenance in accordance with the pump manufacturer's recommendations. Pay particular attention to the condition of the pump impeller. A worn impeller can not only cause a loss of pump efficiency but also can cause a severe increase in the wear on mating parts.

4. C.H.&E. PUMP MODEL ES-055 (Formerly B Submersible Pump)

DESCRIPTION

4.01 The C.H.&E. pump model ES-055 (Fig. 2) is a 2-inch, self-priming, centrifugal pump, powered by a 1/2 HP, single-phase motor that operates on a 115 volt ac, 60 Hz power supply. Thermal cutouts on the stator winding protect the motor from electrical overloads.

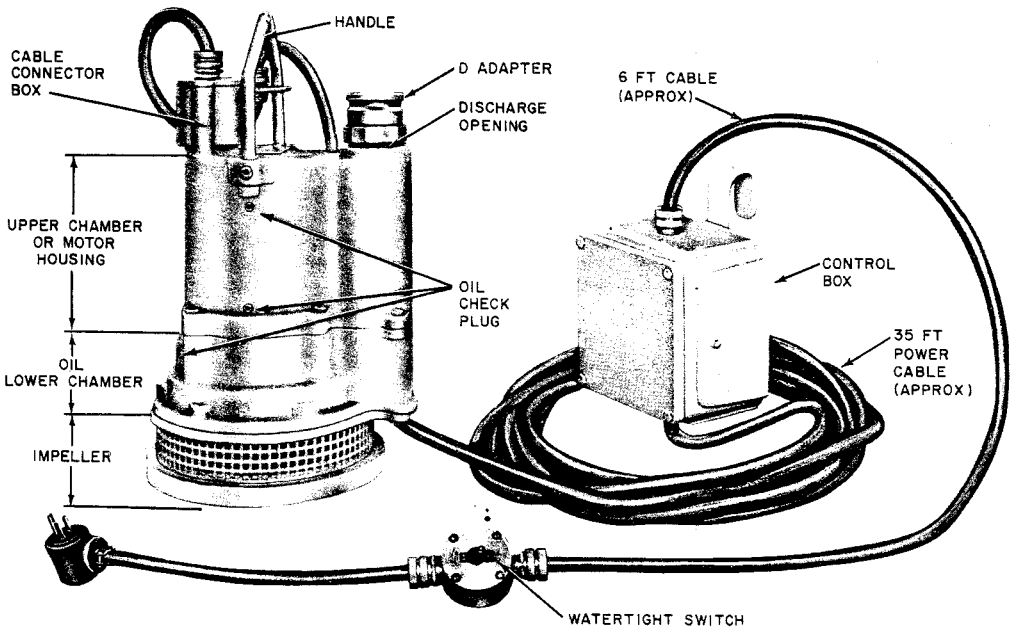


Fig. 2—C.H.&E. Pump Model ES-005 (Formerly the B Submersible Pump)

4.02 The motor is located in the upper chamber of the pump housing. The motor leads are connected to the power cable inside the cable connector box which can be opened without disturbing the motor housing.

4.03 The power cable is equipped with a cable protector at the pump housing. This protector takes the strain off the cable and eliminates the possibility of the cables pulling out of the connector box.

4.04 The 35-foot long power cable connects the pump to the control box with approximately 6 additional feet of cable from the control box to the plug. A water-tight on-off switch is located in the 6-foot section near the plug.

4.05 The water-tight control box contains the start and run capacitors and start relay. A hook on the back makes it convenient for hanging the box on a manhole guard or on a rung of a manhole ladder.

4.06 The lower chamber of the pump housing, which is filled with S.A.E. 10W nondetergent motor oil, contains the lower water seal having carbide surfaces and the upper water seal which has carbon and ceramic surfaces.

4.07 The impeller is connected directly to the motor shaft and is made of abrasion resistant ductile iron.

4.08 The suction screen is designed to permit dewatering to 1-1/2 inches from the bottom of the manhole and has 1/4-inch openings to exclude large solids.

OPERATION

4.09 The discharge port is equipped with a 2-inch D adapter (Fig. 3). Attach a 2-inch discharge hose, of appropriate length and lower the pump into the water with a handline attached to the handle, making sure the hose is not kinked. The power cord is not to be used to raise or lower the pump.

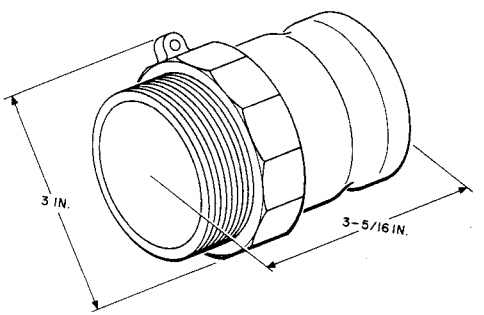


Fig. 3—D Adapter

4.10 With the switch at the OFF position, plug cord into 115-volt single-phase ac-power outlet. The pump will operate from a 1250-watt ac generator.

CAUTION: Do not plug cord into a dc generator.

4.11 Turn the switch to ON. The pump should discharge water immediately.

4.12 The pump can run either completely submerged or with the water level near the bottom of screen. With the water level low, water and air mixture will be pumped without harming the pump. The pump may be run dry for several minutes without damaging the pump.

4.13 When storing the pump in a manhole overnight, hang the control box by its hook on the highest rung of manhole ladder, step, or cable rack. Coil the remaining power cable and tie securely close by.

4.14 When the pump is removed from the water, remove and drain the hose. Turn the pump on its side and rock back and forth for complete drainage. To blow out any remaining water, start the motor and run dry for several minutes.

4.15 Be certain to drain pump completely in freezing weather before storing. If the pump has been stored at temperatures below freezing, submerge the lower chamber in water for at least 5 minutes before starting to melt any ice film that may have formed around the impeller or bottom seal. The output of a heater-blower may also be used for this purpose.

CAUTION: Do not use fire or torch for thawing purposes.

MAINTENANCE

4.16 The oil in the upper chamber lubricates the shaft ball bearings and the upper seal. It also dissipates the motor heat to the housing.

4.17 During continuous usage, check the oil level and oil condition in the upper chamber (motor housing) and lower oil chamber every four weeks.

4.18 To check oil level in upper chamber, remove plug in the side near the top of the chamber.

4.19 To check condition of oil, with the plug removed, tip the pump and catch some oil in a clean container. If oil is clear and clean, it is considered to be satisfactory and can be returned to the chamber. If it is cloudy and dirty, the water has leaked in through the shaft seals and the pump should be returned for repair in accordance with local instructions.

4.20 To add or replace the oil in the upper chamber, place the pump on its side and fill through the top side hole. ***Use a good transformer oil. Then place the pump in a vertical position. This will allow excess oil to flow out the hole until the oil level is even with the plug opening. This is the proper oil level for the upper chamber. The air space created between the top of the oil and the upper housing is necessary to allow for oil expansion.***

CAUTION: Do not use ordinary lubricating or automotive oils in upper chamber (motor housing).

4.21 To drain oil from the upper chamber, remove both plugs on the side of the housing and tip the pump on its side. When replacing the plugs, use a pipe joint compound and torque tightly.

4.22 The oil in the lower chamber lubricates the lower and upper seals and aids in isolating the motor from the impeller section. The oil is filled and drained through the plug in the side of the chamber.

4.23 To check the oil in the lower chamber, place the pump in a horizontal position with the plug hole up. Remove the oil plug and check oil in the same manner as in paragraph 4.19. If oil is cloudy and dirty, the water has leaked through the lower seal and the seal must be replaced.

4.24 To refill, place the pump in the horizontal position with the plug hole up. Fill the chamber to 1/2 inch from the bottom of the hole and replace the plug using a pipe joint compound and torque tightly.

4.25 When adding or replacing oil, use a S.A.E. 10W nondetergent engine oil.

CAUTION: Do not use transformer oil in lower oil chamber.

5. PROSSER PUMPS—MODEL SERIES 9-900 AND 9-1200

DESCRIPTION

5.01 The Prosser submersible pumps, model series 9-900 and 9-1200, (Fig. 4) are self-priming, 1-1/2 inch, centrifugal pumps, powered by 3/4 and 1 HP motors. The motor power requirements are given in Part 2 of this section. The pump capacities are given in Fig. 5. The two models most widely used in the Bell System are the 9-911-31 and the 9-1211-31.

5.02 The power cable is secured on the pump with a cable support bracket to protect against pullout from the cable gland. The pump control box is watertight and is located near the plug end of the power cable.

5.03 The motor bearings are prelubricated, double shielded ball bearings. Double shaft seals protect against the leakage of oil and the entrance of water into the oil chamber. The stainless steel impeller is connected directly to the stainless steel shaft.

5.04 The suction screen (strainer) has 3/32-inch size openings; however, a strainer with 3/16-inch size openings is available.

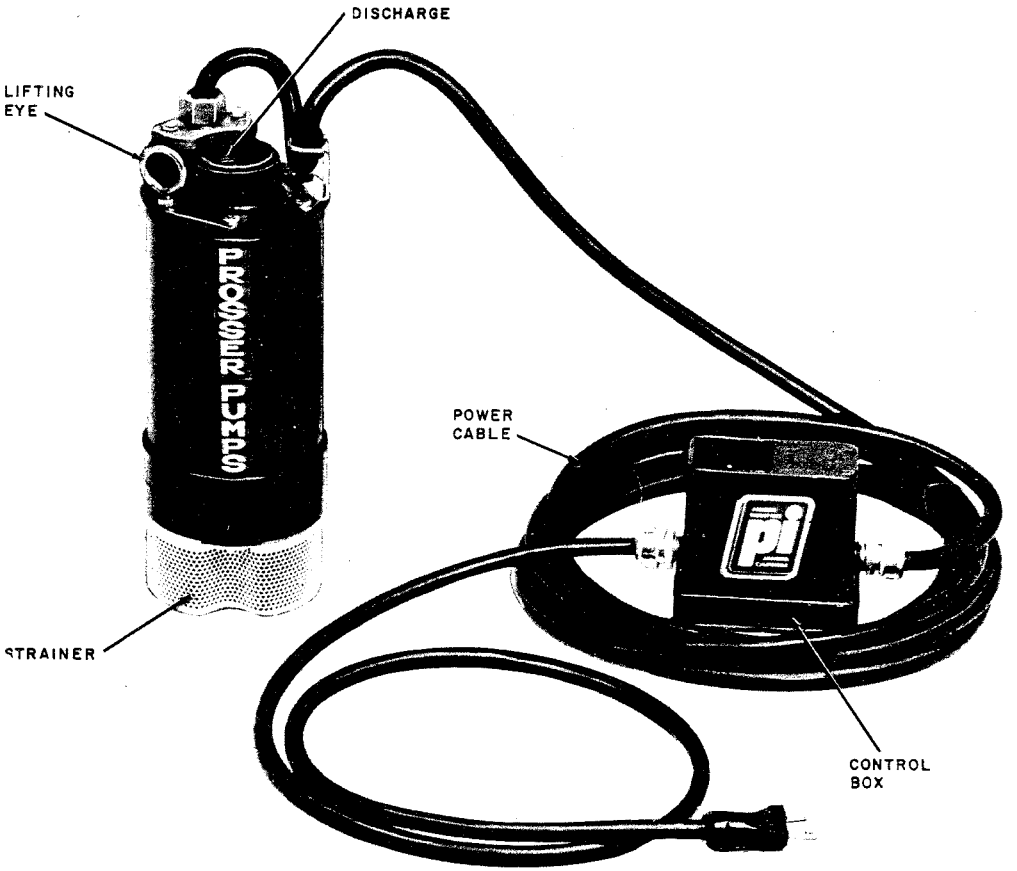


Fig. 4—Electrically Driven Submersible Pump

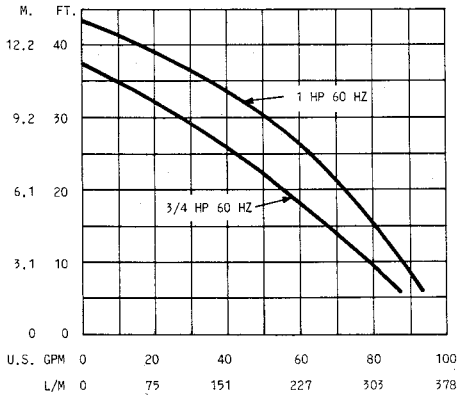


Fig. 5—Capacities of Prosser UTILITY Pumps, 3/4 and 1 HP

OPERATION

5.05 Attach a discharge hose of appropriate size to the discharge port on the pump. Lower the pump into the water with a handline. Be sure the hose is not kinked. Do not use the power cord to lower the pump.

5.06 With the switch in the "off" position, plug the cord into a suitable ac outlet. (See power requirements in Table A.)

CAUTION: Do not plug into a dc generator.

5.07 Turn the switch to the "on" position. The pump should discharge water immediately.

5.08 The pump can run either completely submerged or with the water level near the bottom of the suction screen. With the water level low, water and air mixture will be pumped without harming the pump. The pump may be run dry for several minutes without damaging the pump.

5.09 When storing the pump in a manhole overnight, hang the control box on the highest rung of the manhole ladder, step, or cable rack. Coil the power cable and tie securely close by.

5.10 When the pump is removed from the water, remove the drain hose. Turn the pump on its side and rock back and forth for complete drainage. Start the pump and run dry for a few minutes to blow out remaining water.

5.11 Be certain to drain pump completely in freezing weather before storing. If the pump has been stored at temperatures below freezing, submerge the lower chamber in water for at least 5 minutes before starting. This should melt any ice film that may have formed around the impeller or bottom seal. The output of a heater-blower may be used for this purpose..

MAINTENANCE

5.12 These Prosser pumps are equipped with prelubricated bearings. The two rotary seals are oil lubricated. The seals should be inspected every 400 to 500 hours for wear, more frequently if abrasives have been pumped.

5.13 To check the condition of the seals, remove the oil plug, drain the oil from the seal chamber, and inspect the oil for the presence of water or abrasives. If any are found, replace the seals. If oil is clean and clear, it may be returned to the chamber.

5.14 Before refilling, flush the seal chamber thoroughly to be sure it is clean. With the pump in a horizontal position, refill the oil chamber half full with Texaco Regal Pc (R&O) oil or equal. This is a S.A.E. 20W, nondetergent turbine oil with rust and oxidation inhibitors. After replacing oil, rotate pump (in horizontal position) to place drainhole in the 3 o'clock position. Allow excess oil to drain out. Replace oil plug securely.

CAUTION: Do not use ordinary lubricating or automotive oils in the seal chamber.

6. WESTERN PROGRESS PUMP—MODEL 2285

DESCRIPTION

6.01 The Western Progress model 2285 submersible pump (Fig. 6) is a self-priming, 1-1/2 inch centrifugal pump powered by a 1 HP motor. The pump can be operated from either a 115 Vac or dc power source. The pump draws less than 15 amperes so it can be started and operated with a 1250 watt generator. The power cord plug incorporates a 15 ampere fuse for overload protection.

6.02 The pump has a capacity of 50 gallons per minute against a head of 20 feet. It is 12 inches high, 6 inches in diameter, and weighs 26 pounds, including a 25-foot power cord.

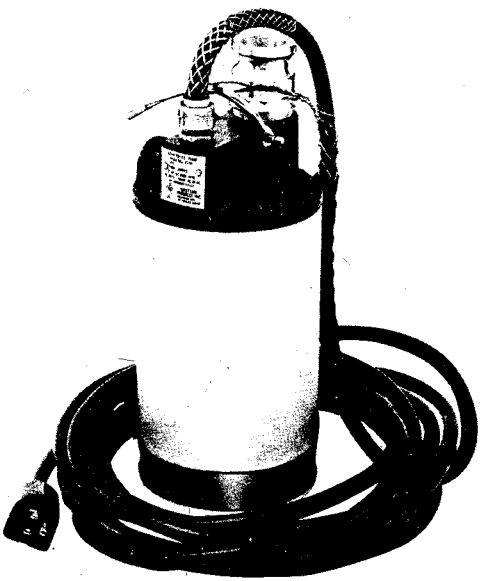


Fig. 6—Western Progress Submersible Pump—Model 2285

OPERATION

6.03 Attach a discharge hose of appropriate size to the discharge port on the pump. Lower the pump into the water with a handline. Be sure the hose is not kinked. Do not use the power cord to lower the pump.

6.04 Plug the cord into a suitable power outlet. The pump will start operating immediately.

6.05 The pump can run either completely submerged or with the water level near the bottom of the suction screen. With the water level low, water and air mixture will be pumped without harming the pump. The pump may be run dry for several minutes without damaging the pump.

6.06 When storing the pump in a manhole overnight, hang the power cord in a coil on the highest rung of the manhole ladder, step, or cable rack. Always store the pump in the upright position.

6.07 When the pump is removed from the water, remove the drain hose. Turn the pump on its side and rock back and forth for complete drainage. Start the pump and run dry for a few minutes to blow out remaining water.

6.08 Be certain to drain pump completely in freezing weather before storing. If the pump has been at temperatures below freezing, submerge the pump in water for at least 5 minutes before starting. This should melt any ice film that may have formed around the impeller or bottom seal. The output of a heater-blower may be used for this purpose.

MAINTENANCE

Note: The manufacture of the Western Progress Model 2285 submersible pump has been temporarily discontinued. However, parts are available for the model 2285 from the manufacturer.

6.09 The model 2285 pump is equipped with permanently lubricated bearings. The seals are oil lubricated. The condition of the seals should be checked by examining the condition of the oil in the oil chamber. If any water or abrasives are found in the oil, the seals should be replaced. Replace seals in accordance with manufacture's instructions. Before refilling the oil chamber, flush thoroughly to be sure the chamber is clean. Only use oil specified by pump manufacturer.

6.10 The motor brushes require periodic inspections. To replace the brushes:

1. Disconnect power cord at power source.
2. Remove two large screws on each side at the top of pump and remove brushes.
3. Insert new brushes, and replace screws.