SERIES 8796 SELF PRIMING PROCESS PUMPS

Performer® Series

ENGINEERING DATA

Self Priming Centrifugal Pumps
How They Work

No pump will successfully move liquid unless it is adequately primed. A pump is considered primed when the casing and suction line are completely filled with liquid. Pumps that are located below the source of supply are primed by opening the suction and discharge valves to allow the liquid to enter the pump casing. The pump casing should also be vented. Pumps that are located above the source of supply must be primed by some other means such as a vacuum pump or an ejector. The corrosive nature of many process liquids makes these unsatisfactory methods. Another method sometimes used to prime pumps is the installation of a foot valve in the suction piping. This allows the pump and piping to be filled from an outside source but usually requires the use of an elevated tank to store the liquid. Each of these methods requires that someone be present to operate the equipment and be available to re-prime the pump if it becomes air bound during operation. A self priming pump offers a solution to these problems. It primes itself and will re-prime if it becomes air bound during operation, thus eliminating the need for an attendant.

A properly designed self priming pump must be capable of evacuating the air from the suction piping. As air is removed a vacuum is created thus allowing atmospheric pressure to push the liquid up the suction pipe, and into the pump casing to complete the prime. The pump must also be capable of forming a seal above the impeller so that atmospheric pressure can not work back through the discharge line to break the vacuum. A self priming pump must also serve as an efficient centrifugal after it has been primed. Thus the self priming feature must not compromise the pumping ability of the unit.

Though there are several types of self priming designs, they all function in a similar way. An amount of liquid is retained when the pumps shut down or loose prime. This is essential as it allows the pump to re-prime itself on restart. Self priming pumps also recirculate the priming liquid in a way that allows entrained air on the suction side to be released to the discharge side. Once the air is completely evacuated from the suction pipe and casing the pump will operate in a normal manner until the source of supply is interrupted.

Although self priming pumps will expel air, it should be remembered that they are primarily designed to move liquids, and care should be exercised in the amount of air the pump must evacuate. Vertical lifts should always be as short as possible, and the suction line diameter should be equal to the pump suction. Avoid smaller or larger suction pipe sizes. In addition all piping connections must be air tight.

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ENGINEERING DATA

Self Priming Centrifugal Pumps
How They Work

(continued from page 1)

It is very important that the stuffing box be adequately sealed against the entrance of air. Packing or mechanical seals can be used. As the pump operates during the priming cycle the stuffing box pressure is less than atmospheric. If the box is not sealed, outside air will enter which will cause the priming time to be extended, or will prohibit the pump from achieving a full prime. A flush line from an external source is recommended to prevent leakage of air into the stuffing box. The flush line should never originate from the pump casing.

When large amounts of air must be evacuated from the suction piping, the priming time may be so extended that the recirculated liquid in the pump casing becomes hot enough to vaporize. When this occurs the priming cycle will stop and the casing must be refilled.

The maximum lift that can be obtained is a function of both the vapor pressure of the liquid and its specific gravity. Both of these factors must be taken into consideration when determining the available NPSH. This should be done on every self priming application to assure that the correct pump is selected.

ENGINEERING DATA

Proper Suction Piping

Proper suction piping is essential for the successful operation of a centrifugal pump. It is even more crucial on a self priming pump and if not properly selected and designed it can cause prolonged priming time or even prohibit priming action.

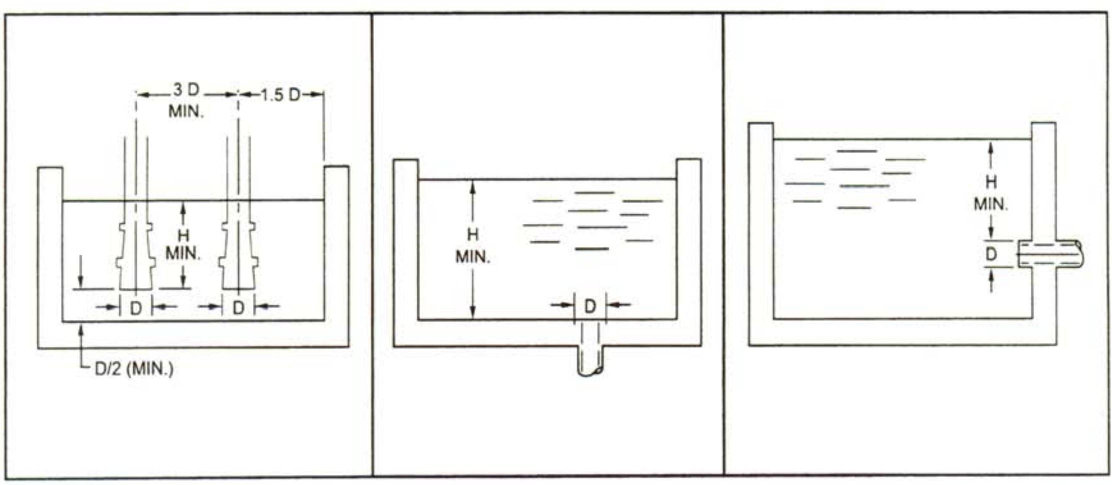
For proper suction piping, the suction pipe should always be the same size as the pump suction. A self priming pump must evacuate the total volume of air in the suction line before it can reach a full or complete prime. The larger the pipe, the greater the amount of air to be removed. Suction pipe velocities should ideally be between 5 and 8 feet per second (see graph for velocity equation). Suction pipe should always be as short and straight as possible. Piping should gradually slope up to the pump suction to eliminate the possibilty of air pockets in the suction line.

It is also very important to hold horizontal runs of suction piping to a minimum. Due to the inherent characteristics of self priming pumps, it is more difficult to evacuate the air from a horizontal run of pipe than from a vertical run. The reason for this is because when a horizontal line partially fills with liquid, the pump attempts to handle the liquid which flows to the impeller and at the same time evacuate the residual air. This causes the amount of air that the pump is trying to evacuate to be reduced, thus prolonging priming time.

Once the pump has achieved a complete prime it will act like any other centrifugal pump. Therefore it is extremely important that turbulence and entrained air that enters the pump be kept to a minimum. Air in the system can lower the capacity and efficiency of a pump, accelerate corrosion, cause loss of prime, and cause severe vibration and mechanical damage. The two major causes of entrained air are:

1. Free falling liquid to supply tank at or near the pump suction inlet. This can be prevented by either submerging the line, adding a baffle, or both.

2. Vortex formation at suction inlet due to improper suction line submergence and high inlet velocities. Baffles can be used to help prevent vortexing. Also, refer to the Minimum Submergence vs. Velocity chart and the three tank drawings to determine the proper minimum suction submergence.



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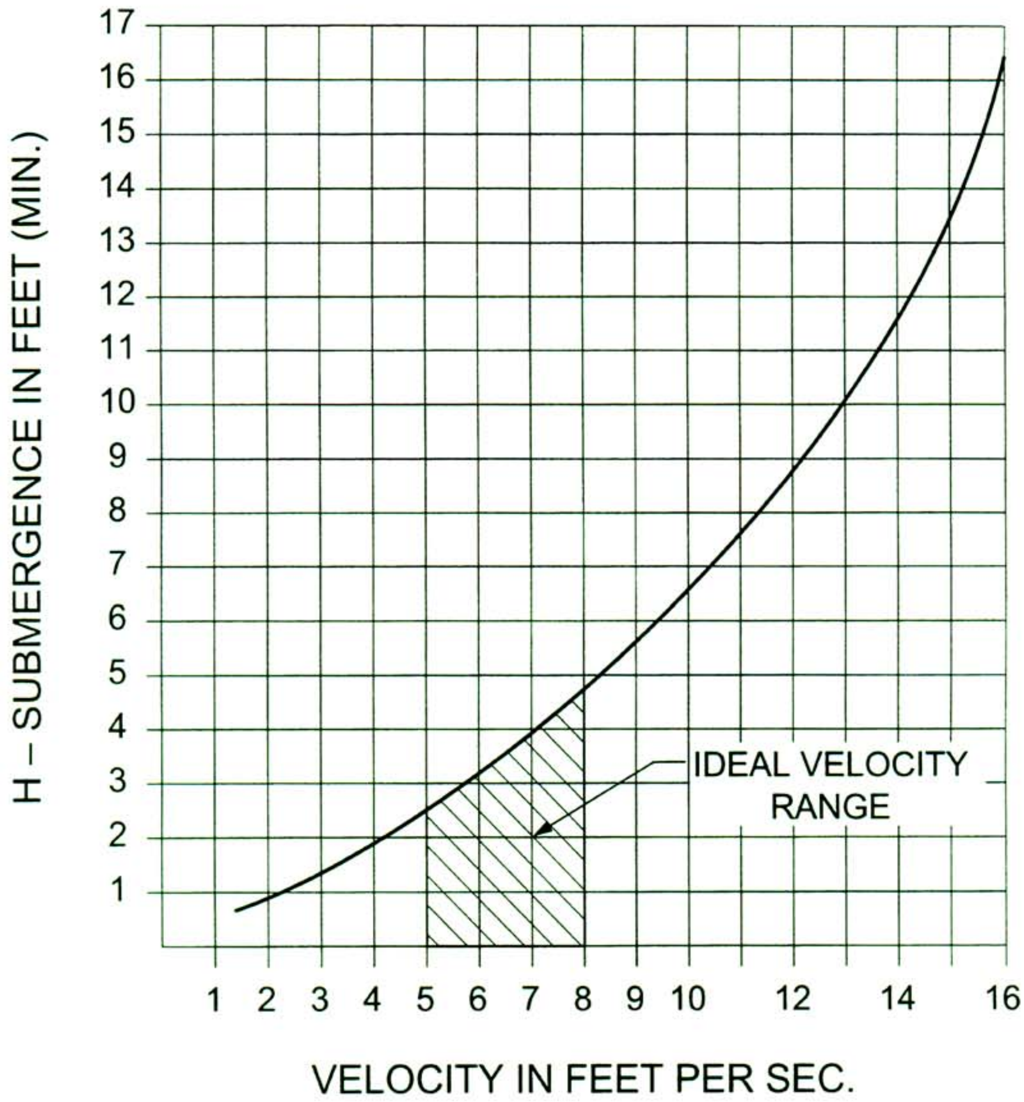
ENGINEERING DATA

CHART OF RECOMMENDED MINIMUM SUBMERGENCE VS. VELOCITY



$$\text{VELOCITY (FEET PER SEC.)} = \frac{\text{QUAN. (G. P. M.)} \times .321}{\text{AREA}}$$

OR

$$\frac{\text{G. P. M.} \times .4085}{D^2}$$

Model 8796 Priming Time Calculations

To calculate the total priming time of a Model 8796 Pump, it is necessary to use the priming time and effective static lift curves that can be found on the performance curves. These curves are for nominal suction pipe diameter. **Corrections must be made for larger pipe sizes and longer piping than the effective static lift.**

Priming time calculations:

1. Select correct performance curve for pump size and RPM.
2. Calculate NPSH available. The NPSH available must be equal to or greater than the NPSH required as found on the pump performance curve.

   $NPSH_A = P - (L_S + V_P + h_f)$

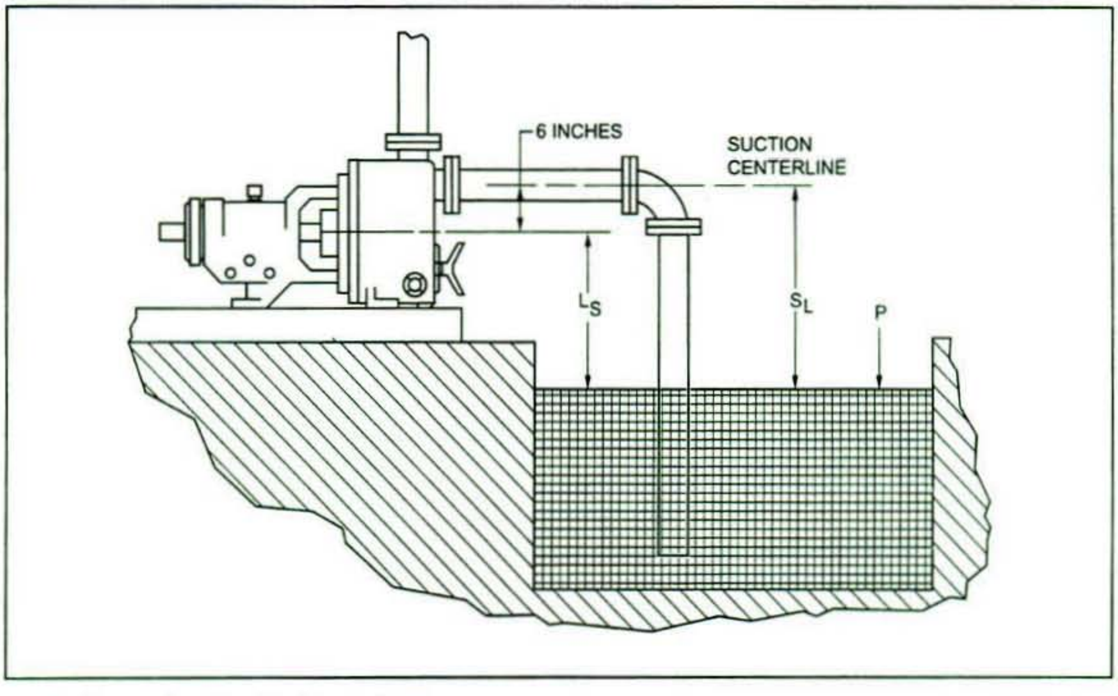
   Where:

   P = Pressure on surface of liquid in feet absolute.

   L_S = Maximum static lift in feet from the surface of the liquid to the centerline of the impeller.

   V_P = Vapor pressure of the liquid at maximum temperature in feet absolute.

   h_f = Suction pipe friction loss in feet.



3. Determine the effective static lift.

   $L_{ES} = S_L \times SpGr$

   L_{ES} = Effective static lift in feet.

Model 8796 Priming Time Calculations (continued)

S_L = Maximum static lift in feet from surface of liquid to the centerline of the pump suction.

SpGr = Specific Gravity of the liquid.

Note: For effective static lift greater than 20 feet, consult factory.

4. Enter the priming time curve at the effective static lift calculated in Step 3. Proceed across to the selected impeller diameter, then downward to determine the priming time (PT_{Les}).

5. Calculate the total system priming time (PT_T)

$$PT_T = PT_{Les} \times (SPL/L_{ES}) \times (D_p/D_s)^2$$

Where:

PT_T = Total system priming time (seconds).

PT_{Les} = Priming time for the effective static lift (from Step 4).

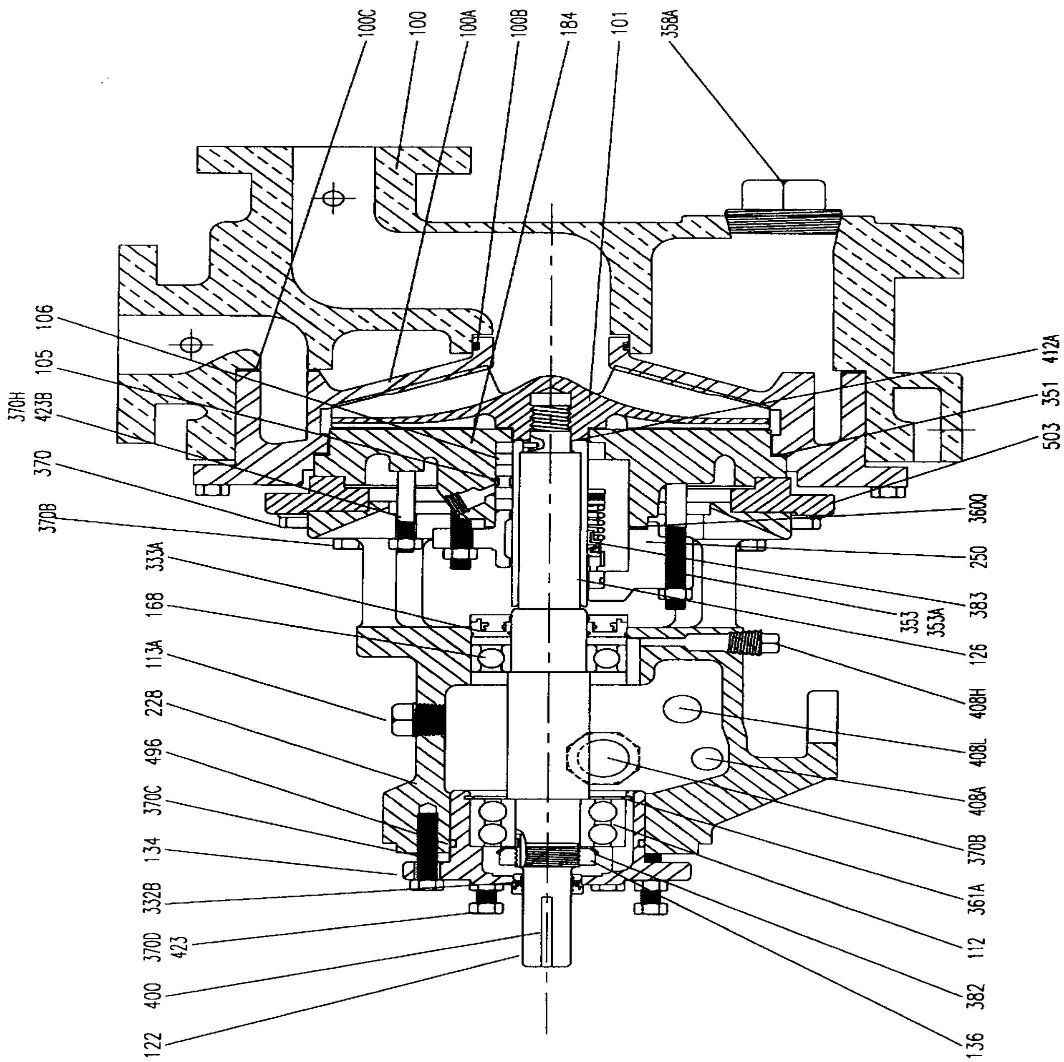
SPL = Total suction pipe length above the surface of the liquid in feet.

L_{ES} = Effective static lift.

D_p = Nominal pipe diameter.

D_S = Nominal pump suction diameter.

Cross Sectional Drawing



Refer to page 7 for parts list and materials of construction

SERIES 8796 SELF PRIMING PROCESS PUMPS

Performer® Series

Engineering Data

Parts List and Materials of Construction –Peerless Pump Series 8796 Self Priming Process Pumps

Item No.	Qty /pump	Part Description	All Ductile Iron	All 316 Stn Steel	All CD4M	Alloy 20 Stn Steel	Hastelloy B or C
59	1	Cover Oval Cleanout	Ductile Iron	316 ss	CD4M	Alloy 20	Haselloy
59A	1	Gasket	ECH-Sponge	ECH-Sponge	ECH-Sponge	ECH-Sponge	ECH-Sponge
59B	1	Wing Nut	Steel	Steel	Steel	Steel	Steel
59C	1	Hand Hole Brace	Steel	Steel	Steel	Steel	Steel
100A	1	Casing	Ductile Iron	316 ss	CD4M	Alloy 20 ss	Hastelloy
100B	1	Inner Volute	Ductile Iron	316 ss	CD4M	Alloy 20 ss	Hastelloy
101	1	Impeller	Ductile Iron	316 ss	CD4M	Alloy 20 ss	Hastelloy
105	1	Lantern Ring	TFE	TFE	TFE	TFE	TFE
106	1 Set	Stuffing Box Packing	PTFE-aramid	PTFE-aramid	PTFE-aramid	PTFE-aramid	PTFE-aramid
107	1	Packing Gland	316 ss	316 ss	Alloy 20 ss	Alloy 20 ss	Hastelloy
108	1	Frame Adapter	Cast Iron	Cast Iron	Cast Iron	Cast Iron	Cast Iron
112A	1	Ball Bearing-Outboard	Steel	Steel	Steel	Steel	Steel
113A	1	Bearing Frame Breather	Steel	Steel	Steel	Steel	Steel
122	1	Pump Shaft for Sleeve	SAE 4140	SAE 4140	SAE 4140	SAE 4140	316 ss
123	1	Deflector Used with Lip Seal Construction	Nylon - Glass Ref.	Nylon - Glass Ref.	Nylon - Glass Ref.	Nylon - Glass Ref.	Nylon - Glass Ref.
126	1	Shaft Sleeve	316 ss	316 ss	CD4M	Alloy 20 ss	Hastelloy
132	1	Eye Bolt (not shown)	Steel	Steel	Steel	Steel	Steel
134A	1	Bearing Housing	Cast Iron	Cast Iron	Cast Iron	Cast Iron	Cast Iron
136	1	Bearing Locknut	Steel	Steel	Steel	Steel	Steel
168A	1	Ball Bearing Inboard	Steel	Steel	Steel	Steel	Steel
184	1	Stuffing Box Cover-Std.	Ductile Iron	316 ss	CD4M	Alloy 20 ss	Hastelloy
228A	1	Bearing Frame	Cast Iron	Cast Iron	Cast Iron	Cast Iron	Cast Iron
241	1	Bearing Frame Foot	Cast Iron	Cast Iron	Cast Iron	Cast Iron	Cast Iron
247	1	Drip Basin	-	316 ss	316 ss	316 ss	316 ss
251	1	Constant Level Oiler (not shown)	Glass/White Metal	Glass/White Metal	Glass/White Metal	Glass/White Metal	Glass/White Metal
332A	1	Oil Seal- Cplg End Labrynth Isolator	Brz/Buna Rubber	Brz/Buna Rubber	Brz/Buna Rubber	Brz/Buna Rubber	Brz/Buna Rubber
333A	1	Oil Seal- Inboard End Labyrnth Isolator	Brz/Buna Rubber	Brz/Buna Rubber	Brz/Buna Rubber	Brz/Buna Rubber	Brz/Buna Rubber
351	1	Gasket-Adapt to Stuff Box	Paper	Paper	Paper	Paper	Paper
351A	1	O ring , Volute to Case	Viton	Viton	Viton	Viton	Viton
353	2	Gland Stud	316 ss	316 ss	316 ss	316 ss	Monel
355	2	Nut , Gland Stud	316 ss	316 ss	316 ss	316 ss	316 ss
360D	1	Gasket-Brg Frm to Adapter	Veg Fiber	Veg Fiber	Veg Fiber	Veg Fiber	Veg Fiber
361A	1	Ret Ring-Brg Housing	Steel	Steel	Steel	Steel	Steel
370	4 to 24	Cap Screw-Frm/Adapt to Casing	Steel	304 ss	304 ss	304 ss	304 ss
370H	2	Stud & Nut, Cover to Adapr	304 ss	304ss	304 ss	304 ss	304 ss
370B	4	Cap Scr-Adp/Adpt Rg to Fr	Steel	Steel	Steel	Steel	Steel
370C	3-to 4	Tap Bolt Brg Housing	Steel	Steel	Steel	Steel	Steel
370D	3 to 4	Tap Bolt w/Jam Nut Imp Adjusting	Steel	Steel	Steel	Steel	Steel
370F	1 to 2	Cap Screw-Frame Foot	Steel	Steel	Steel	Steel	Steel
370H	2	Stud & Nut Cvr to Adpt	304 ss	304 ss	304 ss	304 ss	304 ss
412A	1	"O" Ring - Impeller	TFE	TFE	TFE	TFE	TFE
418	2-3	Tap Bolt - Jacking	Steel	Steel	Steel	Steel	Steel
469B	2	Dowel Pin-Frm to Adpt	Steel	Steel	Steel	Steel	Steel
469D	1	Drive Pin -Shaft Sleeve	420 ss	420 ss	420 ss	420 ss	420 ss
469E	1	Seal Gland	316 ss	316 ss	CD4M	Alloy 20 ss	Hastelloy
496	1	"O" Ring- Brg Housing	Buna Rubr	Buna Rubr	Buna Rubr	Buna Rubr	Buna Rubr
503	1	Adapter Ring (not shown) Model 1.5x1.5 8ST only	Ductile Iron	Ductile Iron	Ductile Iron	Ductile Iron	Ductile Iron

Subject to change without notice

Engineering Data
Size Comparison Chart

MODEL 8796		MODEL 8196	
1-1/2x1-1/2x8	ST	1X1-1/2X8	ST
2X2X10	MT	1X2X10	MT
3X3X10	MT	2X3X10	MT
4X4X10	MT	3X4X10	MT
3X3X13	MT	2X3X13	MT
4X4X13	MT	3X4X13	MT

TROUBLE SHOOTING
Problem Possible Causes & Corrections

A	No liquid delivered not enough liquid Delivered, or not enough pressure	1, 2, 3, 4, 5, 10, 11, 12, 13, 14, 18, 19, 20
B.	Pump works a while and then quits	4, 5, 7, 8, 9, 11, 12, 20
C.	Pump takes too much power	6, 13, 14, 15, 16, 21, 22, 23, 24, 31
D	Pump is noisy or vibrates	15, 16, 17, 28, 31
E.	Pump leaks excessively at stuffing box	8, 24, 25, 26, 27
F.	High bearing temperature	15, 16, 17, 29, 30, 31
G	Stuffing box overheating	8, 24, 25, 26, 27
H.	Pump does not prime	7, 8, 32, 33, 34

Engineering Data

Trouble Shooting
Causes & Corrective Measures

1. Pump not primed or properly vented-check and see if casing and suction pipe are completely filled with liquid
2. Speed too low-check whether motor wiring is correct and receives full voltage or turbine receives full steam pressure.
3. System discharge head too high-check system head (particularly friction losses).
4. Suction lift too high-check NPSH available (suction piping too small or long may cause excessive friction losses). Check with vacuum or compound gauge.
5. Impeller or piping obstructed-check for obstructions.
6. Wrong direction of rotation-check rotation.
7. Air pocket or leak in suction line-check suction piping for air pockets and/or air leaks.
8. Stuffing box packing or seal worn allowing leakage of air into pump casing-check packing or seal and replace as required. Check for proper lubrication.
9. Not enough suction head for hot or volatile liquids-increase suction head, consult factory.
10. Foot valve too small-install correct size foot valve.
11. Foot valve or suction pipe not immersed deep enough-consult factory for proper depth. Use baffle to eliminate vortices.
12. Entrained air or gases in liquid-consult factory.
13. impeller clearance too great - check for proper clearance.
14. Impeller damaged-inspect and replace as required.
15. Rotating parts bind-check internal wearing parts for proper clearances.
16. Shaft bent-straighten or replace as required.
17. Coupling or pump and driver misaligned-check alignment and realign if required.
18. Impeller diameter too small-consult factory for proper impeller diameter.
19. Improper pressure gauge location-check correct position and discharge nozzle or pipe.
20. Casing gasket damaged-check gaskets and replace as required.
21. Speed too high-check motor winding voltage or steam pressure received by turbine.
22. Head lower than rating; pumps too much liquid-consult factory. Install throttle valve, trim impeller.
23. Liquid heavier than anticipated-check specific gravity and viscosity.
24. Stuffing box not properly packed (insufficient packing, not properly inserted or run in, packing too tight)-check packing and repack stuffing box.
25. Incorrect packing or mechanical seal-consult factory.
26. Damaged mechanical seal-inspect and replace as required. Consult factory.
27. Shaft sleeve scored-re-machine or replace as required.
28. Cavitation-increase NPSH available Consult factory.
29. Pump capacity too low-consult factory for minimum continuous flow.
30. Excessive vibration.
31. Improper bearing lubrication or bearings worn out-inspect and replace as required.
32. Check valve in discharge line-install vent line from pump discharge to check valve.
33. Back pressure in discharge line-eliminate any receiver tank "down legs" and "U" shaped loops in discharge piping.
34. No initial casing fill.