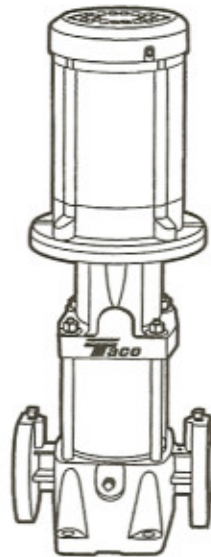




INSTALLATION AND OPERATING INSTRUCTIONS

VERTICAL MULTISTAGE PUMPS

Single and Three Phase 60 Cycle



Record the following information from the motor and pump nameplates for future reference:

Pump Model No. _____

Bill of Material No. _____

Motor Model No. _____

Motor Serial No. _____

H.P. _____ Volts/Hz/Ph _____

Rated Amp Draw _____

Taco, Inc.
1160 Cranston Ave., Cranston, RI 02920

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Carefully read and follow all safety instructions in this manual or on pump.

⚠ This is the safety-alert. When you see this symbol on your pump or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

⚠ DANGER warns about hazards that **will** cause serious personal injury, death or major property damage if ignored.

⚠ WARNING warns about hazards that **can** cause serious personal injury, death or major property damage if ignored.

⚠ CAUTION warns about hazards that **will** or **can** cause minor personal injury or property damage if ignored.

The word **NOTICE** indicates special instructions which are important but not related to hazards.

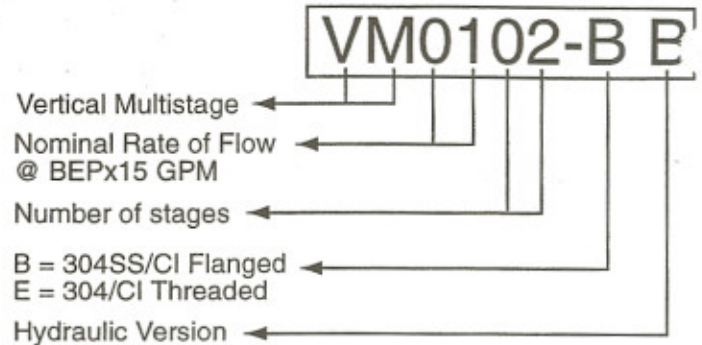
To avoid serious or fatal personal injury and possible property damage, carefully read and follow the safety instructions.

1. Install pump according to all code requirements.
2. Compare pump nameplate data with desired operating range.
3. Pump only liquids compatible with pump component materials (that is, liquids that will not attack the pump).
4. Make sure plumbing is adequate to handle system pressure.
5. Periodically perform maintenance inspection on pump and system components.
6. Wear safety glasses at all times when working on pumps.

INSPECT THE SHIPMENT

The vertical multistage centrifugal inline pump has been carefully inspected and packaged to assure safe delivery. Inspect the pump and fittings and report to the carrier any items which are damaged or missing.

CONFIRM YOU HAVE THE RIGHT PUMP



| | | | |
|---|---------------|----------|--|
| MODEL # | SO# | | |
| Q(GPM) | H(FEET) | N(RPM) | |
| BHP(HP) | PR. Max (PSI) | TEMP (F) | |
| PART # | MFG DATE | | |
| TACO INC., GRAND ISLAND, NEBRASKA 68801 | | | |

FIGURE 1 - Model Plate Information

APPLICATIONS AND OPERATING RANGES

Multistage in-line centrifugal pumps are designed for liquid transfer, circulation, and pressure boosting of hot or cold clean water or other thin, non-explosive liquids, not containing solid particles or fibers, which will not chemically attack the pump materials.

Typical applications include:

- Municipal water supply and pressure boosting
- Boiler feed and condensate systems
- Cooling water systems
- Irrigation
- Fire fighting

Maximum Ambient Temperature.....104° F(40° C)

Liquid Temperature Range5° F to 250° F
(-15° C to +121° C)

Maximum Permissible Operating Pressure Curves.....See Figure 4

Maximum Inlet Pressure: Table II shows the maximum permissible inlet pressure. However, the actual inlet pressure plus the pressure when the pump is running against a closed valve must always be lower than the "Maximum Permissible Operating Pressure".

Electrical Data:See Motor Nameplate

Dimensions and Port to

Port Lengths :.....See Figures 2 and 3, Page 3

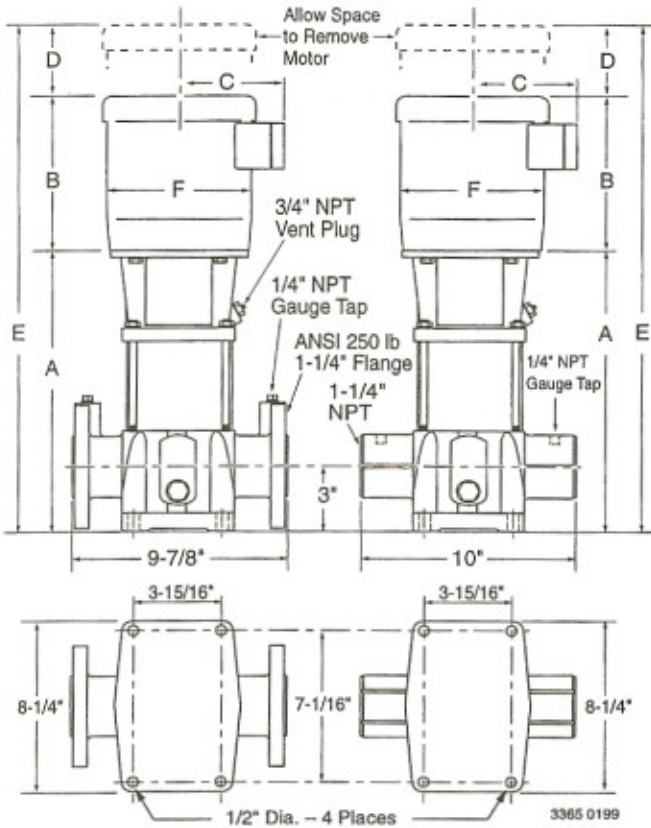


FIGURE 2 - Height, width and baseplate dimensions for VM01 and VM02 Series pumps

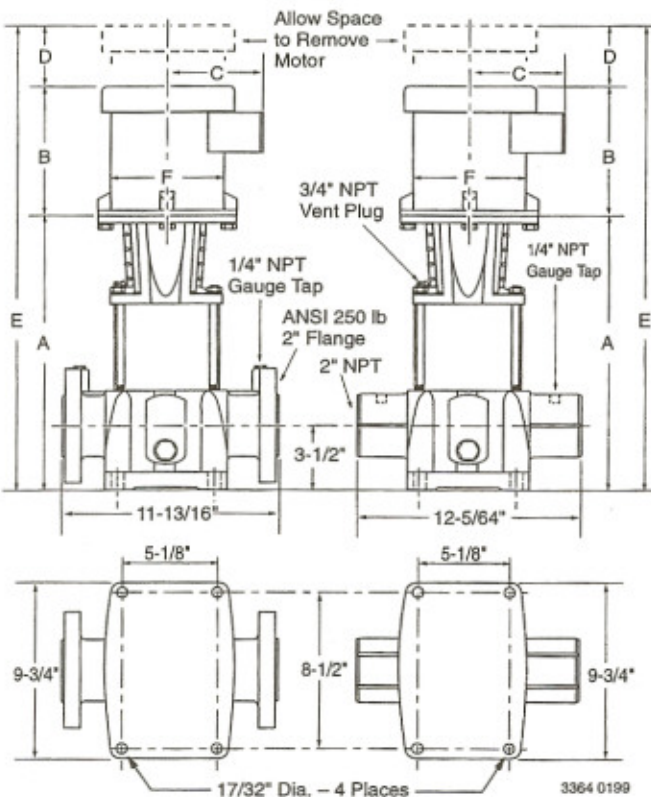


FIGURE 3 - Height, width, and baseplate dimensions for VM04 and VM06 Series pumps

TABLE I – Maximum Height and Width Dimensions*

| Model Number | Dimension in Inches | | | | | |
|--------------|---------------------|--------|-------|-------|--------|--------|
| | A | B | C | D | E | F |
| VM0102 | 11-3/8 | 9-1/4 | 4-7/8 | 2 | 22-5/8 | 6 |
| VM0103 | 11-3/8 | 9-7/8 | 4-7/8 | 2 | 23-1/4 | 6 |
| VM0104 | 12 | 11-1/8 | 5-1/4 | 2 | 25-1/4 | 7-1/8 |
| VM0105 | 12-3/4 | 11-1/8 | 5-3/4 | 2-1/8 | 26 | 7-1/4 |
| VM0106 | 13-1/2 | 11-1/8 | 5-3/4 | 2-1/8 | 26-5/8 | 7-1/4 |
| VM0107 | 14-1/8 | 12-1/8 | 5-3/4 | 2-1/8 | 28-1/4 | 7-1/4 |
| VM0108 | 14-7/8 | 12-1/8 | 5-3/4 | 2-1/8 | 29 | 7-1/4 |
| VM0110 | 16-5/8 | 13-5/8 | 2-7/8 | 2-7/8 | 33-1/4 | 8-1/2 |
| VM0112 | 18-1/8 | 13-5/8 | 6-7/8 | 2-7/8 | 34-5/8 | 8-1/2 |
| VM0115 | 20-1/4 | 15-1/4 | 8 | 3-3/8 | 38-7/8 | 10-5/8 |
| VM0118 | 22-3/8 | 15-1/4 | 8 | 3-3/8 | 41 | 10-5/8 |
| VM0201 | 11-3/8 | 9-1/4 | 4-7/8 | 2 | 22-5/8 | 6 |
| VM0202 | 11-3/8 | 9-7/8 | 4-7/8 | 2 | 23-1/4 | 6 |
| VM0203 | 12-3/8 | 11-1/8 | 5-1/4 | 2 | 25-5/8 | 7-1/8 |
| VM0204 | 13-1/2 | 11-1/8 | 5-3/4 | 2-1/8 | 26-5/8 | 7-1/4 |
| VM0205 | 14-1/2 | 12 | 5-3/4 | 2-1/8 | 28-5/8 | 7-1/4 |
| VM0206 | 16 | 13-5/8 | 6-7/8 | 2-7/8 | 32-1/2 | 8-1/2 |
| VM0207 | 18-1/8 | 13-5/8 | 6-7/8 | 2-7/8 | 34-5/8 | 8-1/2 |
| VM0208 | 18-1/8 | 13-5/8 | 6-7/8 | 2-7/8 | 34-5/8 | 8-1/2 |
| VM0210 | 20-1/4 | 15-1/4 | 8 | 3-3/8 | 38-7/8 | 10-5/8 |
| VM0212 | 22-3/8 | 15-1/4 | 8 | 3-3/8 | 41 | 10-5/8 |
| VM0214 | 24-1/2 | 15-1/4 | 8 | 3-3/8 | 43-1/8 | 10-5/8 |
| VM0216 | 26-5/8 | 15-1/4 | 8 | 3-3/8 | 45-1/4 | 10-5/8 |
| VM0401 | 15 | 9-7/8 | 4-7/8 | 2 | 27 | 6 |
| VM0402 | 15 | 11-1/8 | 5-3/4 | 2-1/8 | 28-1/4 | 7-1/4 |
| VM0403 | 17-3/4 | 13-5/8 | 6-7/8 | 2-7/8 | 34-1/4 | 8-1/2 |
| VM0404 | 18-7/8 | 13-5/8 | 6-7/8 | 2-7/8 | 35-1/2 | 8-1/2 |
| VM0405 | 20-1/8 | 15-1/4 | 8 | 3-3/8 | 38-3/4 | 10-5/8 |
| VM0406 | 21-1/4 | 15-1/4 | 8 | 3-3/8 | 40 | 10-5/8 |
| VM0408 | 23-5/8 | 15-1/4 | 8 | 3-3/8 | 42-1/4 | 10-5/8 |
| VM0410 | 26 | 15-1/4 | 8 | 3-3/8 | 44-5/8 | 10-5/8 |
| VM0412 | 28-3/8 | 16-1/2 | 8-3/4 | 3-3/8 | 48-1/4 | 10-5/8 |
| VM0414 | 30-3/4 | 16-3/8 | 8-3/4 | 3-3/8 | 50-1/2 | 10-5/8 |
| VM0416 | 33-5/8 | 19-5/8 | 9-1/2 | 4-1/4 | 57-1/2 | 13 |
| VM0602 | 19-1/2 | 15-1/4 | 8 | 3-3/8 | 38-1/4 | 10-5/8 |
| VM0603 | 19-1/2 | 15-1/4 | 8 | 3-3/8 | 38-1/4 | 10-5/8 |
| VM0604 | 21-3/8 | 15-1/4 | 8 | 3-3/8 | 40 | 10-5/8 |
| VM0605 | 23-1/8 | 16-3/8 | 8-3/4 | 3-3/8 | 42-7/8 | 10-5/8 |
| VM0606 | 25-3/8 | 19-5/8 | 9-1/2 | 4-1/4 | 49-1/4 | 13 |
| VM0607 | 27-1/8 | 19-5/8 | 9-1/2 | 4-1/4 | 51 | 13 |
| VM0608 | 28-7/8 | 19-5/8 | 9-1/2 | 4-1/4 | 52-7/8 | 13 |
| VM0610 | 32 | 21-3/4 | 9-1/8 | 4 | 57-3/4 | 11-1/2 |
| VM0612 | 35-3/8 | 21-3/4 | 9-1/2 | 3-1/4 | 60-3/8 | 13 |

* Measurements represent the largest number possible for each Model.

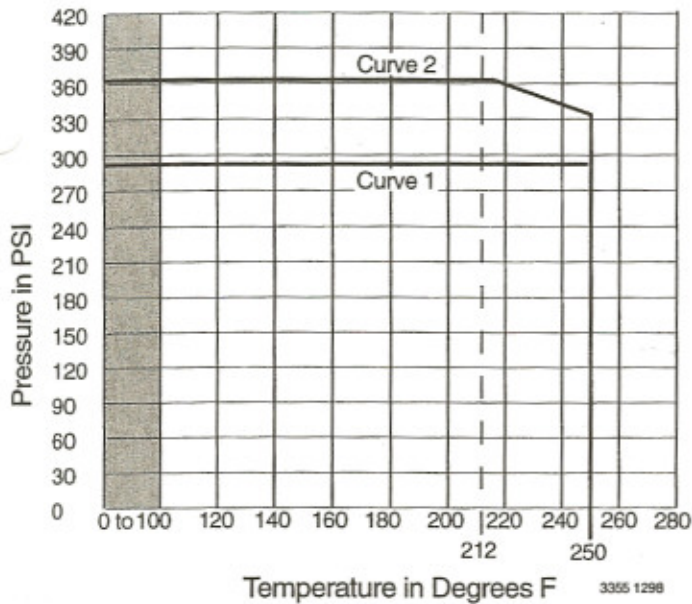


FIGURE 4 - Maximum Inlet Pressure and Maximum Permissible Operating Pressure Curves

TABLE II – Permissible Operating Pressure Curves

| Curve 1 | Curve 2 |
|------------------|------------------|
| VM0102 to VM0112 | VM0115 to VM0118 |
| VM0201 to VM0212 | VM0214 to VM0216 |
| VM0401 to VM0412 | VM0414 to VM0416 |
| VM0602 to VM0608 | VM0610 to VM0612 |

| Model Number | | Maximum Inlet Pressure (PSI) |
|--------------|---------|------------------------------|
| VM01 | 02 - 06 | 145 |
| | 07 - 18 | 220 |
| VM02 | 01 - 02 | 90 |
| | 03 - 07 | 145 |
| | 08 - 16 | 220 |
| VM04 | 01 - 04 | 90 |
| | 05 - 16 | 145 |
| VM06 | 02 - 03 | 90 |
| | 04 - 12 | 145 |

INSTALLATION

⚠ WARNING Hazardous voltage. Voltage can shock, burn, or cause death. Ground pump motor correctly before connecting to power supply, per article 250-80 of the National Electrical Code (NEC) in the U.S., or the Canadian Electrical Code (CEC), as applicable.

Location

Locate pump in a dry, well ventilated area, not subject to freezing or extreme variations in temperature.

Mount pump a minimum of 6" from any obstruction or hot surface. Install the pump with the motor shaft vertical. Make sure that an adequate supply of cool air reaches the motor cooling fan. Maximum ambient air temperature is 104° F (40° C).

For open systems requiring suction lift, locate the pump as close to the water source as possible.

Foundation

Foundation should be concrete or a similarly rigid foundation to provide a secure, stable mounting base for the pump.

Secure pump to foundation using all bolt holes. Refer to Figures 2 and 3 for bolt plate dimensions. Be sure that all four pads on the base are properly supported.

Shim pump base to make sure that pump is level.

Piping

⚠ WARNING Explosion and burn hazard. Do not run pump with discharge valve closed; the water in the pump may boil, with risk of explosion and steam burns to anyone near. If there is any danger of the pump running against a closed discharge valve, install a pressure relief or by-pass valve in the discharge pipe to allow for minimum liquid flow through the pump. Minimum liquid flow through the pump is needed for cooling and lubrication of the pump (See Table III). Run the bypass/relief valve and discharge pipe to a floor drain or a tank for collection.

Suction pipe should be adequately sized (See Table IV) and run as straight and as short as possible to keep friction losses to a minimum. Pipes, valves, and fittings must have a pressure rating equal to or greater than the maximum system pressure.

TABLE III – Minimum Pumping Rates

| Type | Liquid Temperature +5° F to +250° F |
|------|-------------------------------------|
| VM01 | 1 GPM |
| VM02 | 2 GPM |
| VM04 | 4 GPM |
| VM06 | 8 GPM |

TABLE IV – Minimum Suction Pipe Sizes

| Type | Pipe Size |
|------|---|
| VM01 | 1-1/4" Nominal Diameter, Schedule 40 Pipe |
| VM02 | 1-1/4" Nominal Diameter, Schedule 40 Pipe |
| VM04 | 2" Nominal Diameter, Schedule 40 Pipe |
| VM06 | 2" Nominal Diameter, Schedule 40 Pipe |

Pressure check the discharge piping as required by codes or local regulations.

"Inlet" and "Outlet" are cast into the pump base to show the direction of the liquid flow through the pump.

Install anti-vibration mountings on either side of the pump if a minimum noise level is desired.

Install isolation valves in both inlet and outlet pipes near the pump. This allows for removal of pump for service without draining the system and isolation of the pump in case of a flooded suction condition.

If the system pressure is greater than the pumps maximum inlet pressure the limits of the pump can be exceeded if the discharge pressure backs up to the inlet side of the pump. Installation of a check valve in the discharge pipe is recommended to prevent this condition.

Make sure, especially on the inlet side of the pump, that there are no airlocks in the system. See Figure 5 for correct pipe work to avoid airlocks. The suction pipe should be level or slightly rising.

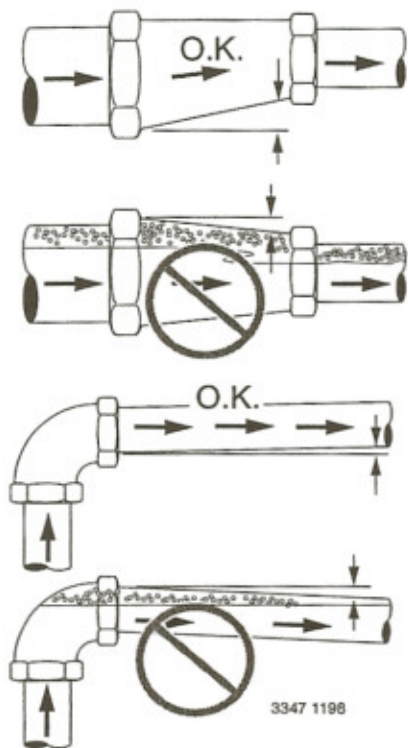


FIGURE 5 - Install Pipe Correctly to Prevent Air Locks

Support all piping independently of the pump so the weight of the piping system does not strain the pump case. Make sure that the expansion and contraction of the piping system from temperature variations cannot put a strain on the pump.

If the system or pump must be drained periodically (especially if the discharge pipe is horizontal or slopes downward away from the pump), install a loop and vacuum valve as shown in Figure 6 to protect the pump against running dry. The highest point of the loop should be at least as high as the lowest point of the motor. This loop/valve combination will allow the pump and the system to be drained independently of one another.

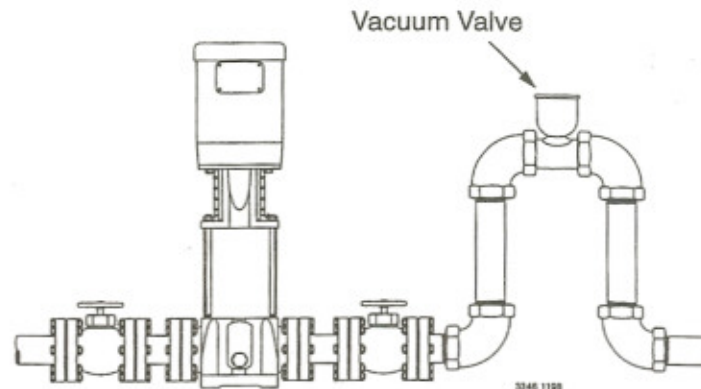


FIGURE 6 - Loop and Vacuum Valve Installation

ELECTRICAL

⚠ WARNING Hazardous voltage. Can shock, burn or cause death. All electrical work should be performed by a qualified electrician in accordance with the National Electrical Code and all local codes and regulations. Make sure that the motor voltage, phase, and frequency match the incoming electrical supply. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run up to $\pm 10\%$ of the nameplate-rated voltage. The wiring connection diagram can be found on either a plate attached to the motor or on a diagram inside the terminal box cover.

- If voltage variations are greater than $\pm 10\%$ do not operate the pump.
- Incorrect voltage can cause fire or serious damage to the motor and voids warranty.
- Ground the pump motor correctly before connecting it to the power supply.
- Follow the wiring instructions when connecting the motor to the power lines.

Position of Terminal Box

To turn the motor so that the terminal box faces the right direction, proceed as follows:

1. Disconnect the power to the pump motor.
2. Remove the coupling guards (use a screwdriver).
3. Remove the couplings.
4. Remove the bolts that fasten the motor to the pump.
5. Turn the motor to the required position (in quarter-turn increments).
6. Follow steps 10 - 20 under "Motor Replacement", on Page 8.

Field Wiring

All wiring connections and wiring sizes must meet National Electrical Code and local requirements.

Motor Protection

See the motor nameplate for electrical connection/wiring diagram.

Taco pumps must be used with the proper size and type of motor starter to ensure protection against damage from low voltage, phase failure, current imbalances, and overloads. The overload should be sized to trip at the full-load current rating of the motor.

OPERATION

Priming

⚠ WARNING **Hazardous pressure.** Do not run the pump with the discharge valve closed; the water in the pump may boil, causing risk of explosion and steam burns to anyone nearby.

⚠ WARNING **Hazardous voltage.** Disconnect all power to the pump before servicing or working on the pump. Make sure that the power is locked out and that the pump cannot be accidentally started.

NOTICE: Under no circumstances should the pump be operated without flow through the pump. **Never** operate the pump dry.

Operation of closed systems or open systems with the liquid level above the pump priming plug:

1. Close the discharge isolating valve and loosen the needle valve in the vented priming plug in the pump head (Figure 7). Do not remove the needle valve.

⚠ WARNING **Risk of water damage and injury.** Watch the direction of the priming plug and make sure that the liquid escaping from it does not injure persons nearby or damage the motor or other components. In hot water installations, pay particular attention to the risk of injury from scalding hot water.

2. Slowly open the isolation valve in the suction pipe until a steady stream of liquid runs out the vent in the priming port.
3. Tighten the needle valve to 25 inch-pounds torque. Completely open isolation valves.

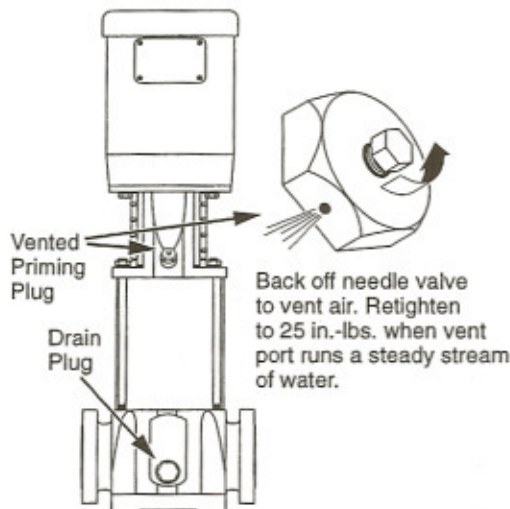


FIGURE 7 - Priming and Drain Plugs

NOTICE: Please turn to "Starting", Page 7, before proceeding any further.

Operation of open systems with the liquid level below the top of the pump:

NOTICE: The suction pipe requires a check valve or isolation valve.

1. Close the discharge isolation valve.
2. Remove the vented priming plug.
3. Pour liquid through the priming port until the suction pipe and the pump are completely filled with liquid.
4. Replace the vented priming plug and tighten it securely.
5. Repeat steps 1-4 until the pump is primed.

NOTICE: Please turn to "Starting", Page 7, before proceeding any further.

No-Flow Operation

This pump must not operate at no flow. To prevent no-flow operation, install a bypass orifice, sized to allow the minimum rate of flow to pass the pump at all times (see Table III). Taco recommends a 3-inch long nipple-style orifice, which will compensate for erosion and ensure the correct minimum flow for extended time periods. Inspect the orifice and bypass loop periodically to make sure that it is not obstructed, eroded, or leaking and that the correct minimum flow is maintained. See Table V to select the correct orifice size for your installation.

TABLE V - Bypass Orifice Chart

| Number of Stages | Pump Model | | | |
|------------------|------------|------|-------|-------|
| | VM01 | VM02 | VM04 | VM06 |
| 2 through 6 | 1/8" | 1/8" | 3/16" | 1/4" |
| 7-8 | 1/8" | 1/8" | 3/16" | 3/16" |
| 9 through 16 | 1/8" | 1/8" | 1/8" | 3/16" |
| 17-18 | 1/8" | - | - | - |

Checking Direction of Rotation

NOTICE: Do not disconnect the motor from the shaft to check the direction of rotation. If you remove the coupling, then you must adjust the shaft position when you reinstall it. This must be done before starting the pump.

Arrows on the pump head show the correct direction of rotation. When seen from the motor fan, the pump should rotate *counterclockwise* (↺). For pump motors without a fan remove one of the coupling guards and look at the coupling to determine the direction of rotation. Turn off the pump and replace coupling guard.

NOTICE: Do not check the direction of rotation until the pump has been filled with liquid. See "Priming", at left and above.

1. Switch power off.
2. Remove the coupling guard and rotate the pump shaft to be certain it can turn freely. Replace the coupling guard.
3. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
4. If the fan is visible, turn on and off to verify rotation.

- To reverse the direction of rotation, first switch OFF the power supply.
- On three-phase motors, switch 2 of the 3 power leads on the load side of the starter. On single-phase motors, see the connection diagram on the motor nameplate. Change the wiring as indicated.

⚠ WARNING Hazardous voltage. Voltage can shock, burn or cause death. Ground the pump motor correctly before connecting to power supply per article 250-80 of National Electrical Code (NEC) in the U.S., or the Canadian Electrical Code (CEC), as applicable.

- Switch on the power supply and recheck the direction of motor rotation.

Starting

- If a suction line isolation valve has been installed, check to be sure that it is completely opened.
- For initial starting, the isolation valve in the discharge pipe should be almost closed.
- Start the pump.
- When the piping system has been filled with liquid, slowly open the discharge isolation valve until it is completely open. Opening the valve too fast may result in water hammer in the discharge pipe. If the pump or system start to rattle, the pump is cavitating; to avoid damage to the pump, reduce the flow through the discharge isolation valve until the rattling stops. If this does not give adequate flow for your installation, call your installer or system designer.
- Record the voltage and amperage of the motor. Adjust the motor overloads if required.
- If pressure gauges have been installed, check and record operating pressures.
- Check all controls for proper operation.

Motor Bearings

For the greasing schedule and greasing procedure of the motor bearings follow the motor manufacturers recommendations.

Calculating Minimum Inlet Pressure:

Minimum inlet pressure is required to avoid cavitation in the pump and is calculated as follows:

$$H = P_b - \text{NPSHR} - H_f - H_v - H_s$$

H = Minimum Inlet Pressure in Feet of Head

P_b = Barometric Pressure in Feet

1 Bar = 29.92 inches of Mercury (Hg)

1 PSI = 2.31 Ft of Head

1 Bar = 33.5 Ft. of Head

NPSHR = Net Positive suction head required. To be read from the NPSHR curve, Figure 8, at the highest flow the pump will be delivering.

H_f = Friction Loss in suction pipe in ft of head

H_v = Vapor pressure in feet of head (See Table VI).

H_s = A safety margin of 1.64 ft of head

Example for VM04:

- If: Flow = 60 GPM
 P_b = 1 Bar = 29.92 Inches of Mercury*
 (Convert from Bar to Feet of Head)
 Inches of mercury = 1.33' inches of mercury
 T = 100° F
 NPSHR = 10' (See Figure 7)
 H_f = 10' of 2" Steel Pipe @ 11.9' of loss per 100' of Pipe (H_f = 11.9'/10' = 1.19')
 H_v = 2.195' (from Table VI)
 H_s = 1.64' (safety factor from above)

- Then: H = 33.5' - NPSHR** - H_f - H_v - H_s
 H = 33.5' - 10' - 1.19' - 2.195' - 1.64 = 18.475'
 H = 18.475' = Minimum Inlet Pressure

* 1 Bar = 14.5 PSI x 2.31 Ft of Head = 33.5'

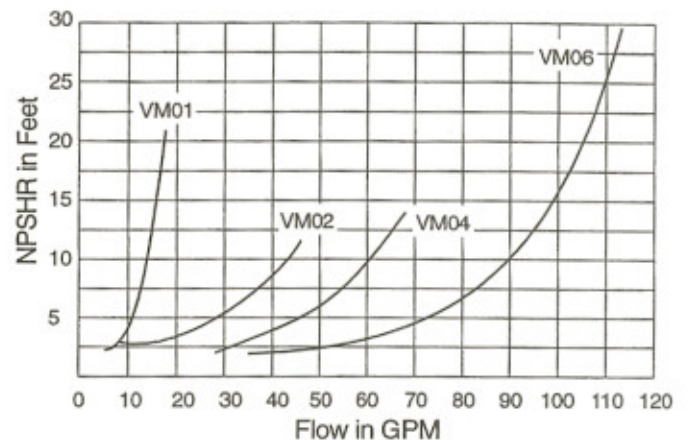


FIGURE 8 - VM01 through VM06 Net Positive Suction Head Requirement (NPSHR)

TABLE VI - Vapor Pressure of Water

| Temperature in °F (°C) | Vapor Pressure in PSIA (kPa) | Absolute Pressure in Feet (M) of Water |
|------------------------|------------------------------|--|
| 32 (0) | 0.089 (.61) | 0.205 (.062) |
| 40 (4.4) | 0.122 (.84) | 0.281 (.086) |
| 60 (15.6) | 0.256 (1.77) | 0.592 (.180) |
| 80 (26.7) | 0.507 (3.50) | 1.172 (.358) |
| 100 (37.8) | 0.95 (6.55) | 2.195 (.669) |
| 120 (48.9) | 1.695 (11.69) | 3.914 (1.193) |
| 140 (60.0) | 2.892 (19.94) | 6.681 (2.036) |
| 160 (71.1) | 4.745 (32.72) | 10.961 (3.341) |
| 180 (82.2) | 7.515 (51.84) | 17.36 (5.291) |
| 200 (93.3) | 11.529 (79.49) | 26.632 (8.117) |
| 210 (98.9) | 14.125 (97.39) | 32.629 (9.945) |
| 212 (100) | 14.698 (101.34) | 33.952 (10.349) |
| 220 (104.4) | 17.188 (118.51) | 39.704 (12.102) |
| 230 (110.0) | 20.78 (143.28) | 48.002 (14.631) |
| 240 (115.6) | 24.97 (172.17) | 57.681 (17.581) |
| 248 (120.0) | 28.79 (188.51) | 66.505 (20.271) |

MAINTENANCE

Motor Replacement

For Key Numbers, refer to the Exploded View, Figure 14, for VM01 and VM02 Series Models and to Figure 15 for VM04 and VM06 Series Models.

▲ WARNING Hazardous voltage. Disconnect all power to the pump before servicing or working on pump. Make sure that power is locked out and that pump cannot be accidentally started.

1. Disconnect the power to the pump motor.
2. Close the nearest suction and discharge valves.
3. Remove the coupling guards (Key No. 4) by prying them loose with a screw driver.
4. Remove the socket head screws (Key No. 3) and the coupling halves (Key No. 2) from the shaft (Key No. 16A). For additional reference, see Figure 12, Page 9.

NOTICE: Socket head screws are metric. See Table VIII on Page 11 for specific metric driver sizes.

5. Remove the shaft pin (Key No. 5).
6. Remove the capscrews (Key No. 12), flatwashers (Key No.10), and lockwashers (Key No.11) that hold the motor (Key No. 1) and the motor bracket (Key No. 7) together.
7. Pull the old motor up and off of the motor bracket.
NOTICE: Note the location of the conduit box on the motor.
8. Thoroughly clean the surfaces of the mounting flanges on the new motor and the pump end.
9. Install the new motor on the pump with the conduit box in the desired position.
10. Lubricate the capscrews (Key No. 12) with oil.
11. Reinstall the lockwashers, flatwashers, and capscrews that hold the motor and the motor bracket together, then tighten evenly and diagonally. See Table VIII, Page 11 for torque specifications.
12. Reinstall the shaft pin (Key No. 5) in the shaft.
13. Reinstall the coupling halves (Key No. 2) on the pump and motor shaft. Make sure to engage the shaft pin (Key No. 5).
NOTICE: Be sure coupling surfaces are thoroughly clean prior to assembly.
14. Snug up the socket head screws (Key No. 3) until the coupling begins to bind and then loosen 1/2 turn the shaft.
15. Draw up the capscrews evenly so the gap between the coupling halves is equal on both sides (See Figure 9).

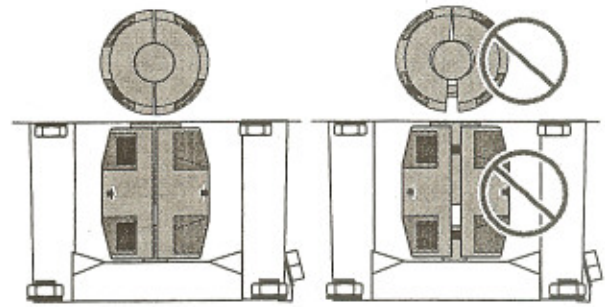


FIGURE 9 - Make Sure that the Coupling Halves are Evenly Tightened

Raise Coupling as far as it will go; then tighten at one-half the height of total axial play.

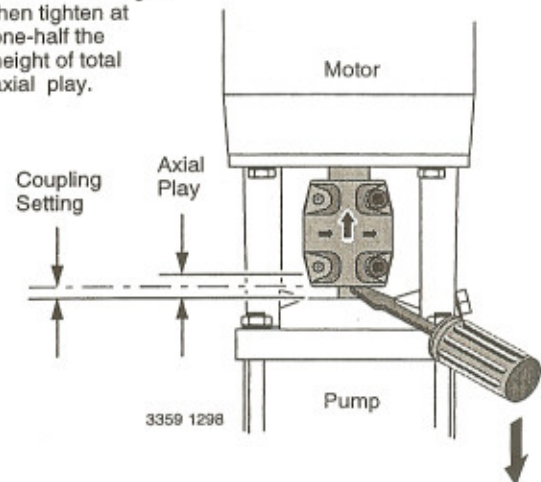


FIGURE 10 - Vertically (axial) Centering the Coupling

16. Insert a screw driver under the coupling (See Figure 10).
17. Raise the pump shaft to its highest point.
18. Lower the shaft halfway back down the distance you just raised it and retighten the capscrews. See Figure 10.

NOTICE: Torque settings are critical to prevent coupling movement. Refer to Table VIII, Page 11 for torque specifications.

19. Rotate the shaft to make sure that there is no interference. If rubbing is noted repeat steps 16, 17, and 18 above and readjust pump shaft height.
20. Reinstall the coupling guards by snapping them into place.
NOTICE: The guards should be in place before the unit is run.
21. Open the suction and discharge valves. Turn the power back on.

Replacing Pump Stack

For Key Numbers, refer to the Exploded View, Figure 14 on Page 12, for the VM01 and VM02 Series Models and Figure 15 on Page 13 for VM04 and VM06 Series Models.

▲WARNING **Hazardous pressure.** Do not run pump with discharge valve closed; the water in the pump may boil, causing risk of explosion and steam burns to anyone nearby.

1. Follow steps 1-8 under "Motor Replacement" section on Page 8; then proceed with step 2 below.

2. Remove the four staybolt nuts, flatwashers, and lockwashers (Key Nos. 8, 9A, and 9B) from the staybolts (Key No. 19).

NOTICE: It is not necessary to remove the staybolts when replacing the stack.

3. Lift the motor bracket (Key No. 7) off of the pump body.

NOTICE: Note the position of the priming plug. The priming plug must be returned to its original position during reassembly.

4. Remove and discard upper sleeve gasket (Key No. 17).

5. Clean gasket seat.

6. Remove and replace round spring ring (VM01 and VM02) or stack spring (VM04 and VM06) (Key No. 13).

7. Pull the old stack (16A through 16L) out of the stainless steel sleeve (Key No. 18) by pulling straight up on the pump shaft (Key No. 16A).

8. Remove the stainless steel sleeve (Key No. 18).

9. Remove and discard the bottom sleeve gasket (Key No. 17).

10. Clean the gasket seat.

11. Remove and discard the O-Ring (Key No. 21A) from the suction/discharge (Key No. 21 VM01 and VM02 only).

12. Clean the O-Ring seat and install a new O-Ring (Key No. 21A).

13. Install a new lower sleeve gasket.

14. Install the new stack without the stainless steel sleeve.

NOTICE: Be sure to align either the small priming hole or the suction interconnector pin hole, located on the bottom stage of the stack properly in the base of the Suction/Discharge (Key No. 21). See Figure 11.

15. Use a rubber mallet to tap the stainless steel sleeve (Key No. 18) into place.

16. Install a new mechanical shaft seal (Key Nos. 14A and 14B, or Key Nos 15A through 15G). Refer to "Mechanical Seal Disassembly and Mechanical Seal Reassembly" sections, Page 10.

17. Install a new upper sleeve gasket (Key No. 17).

18. Install a new round spring ring or stack spring (Key No. 13).

19. Reinstall the motor bracket (Key No. 7) on the pump body. Align the priming plug (Key No. 6) to its original position.

20. Oil the threads on the staybolts (Key No. 19).

21. Replace the lockwashers, flatwashers, and staybolt nuts (Key Nos. 8, 9A and 9B) and cross-torque the staybolts. See Table VIII, Page 11, for torque specifications.

22. Reinstall the motor (Key No. 1) on the motor bracket (Key No. 7) and turn the motor to the desired terminal box position.

23. Follow steps 10 - 21 under "Motor Replacement", Page 8. You have now finished changing out the impeller stack.

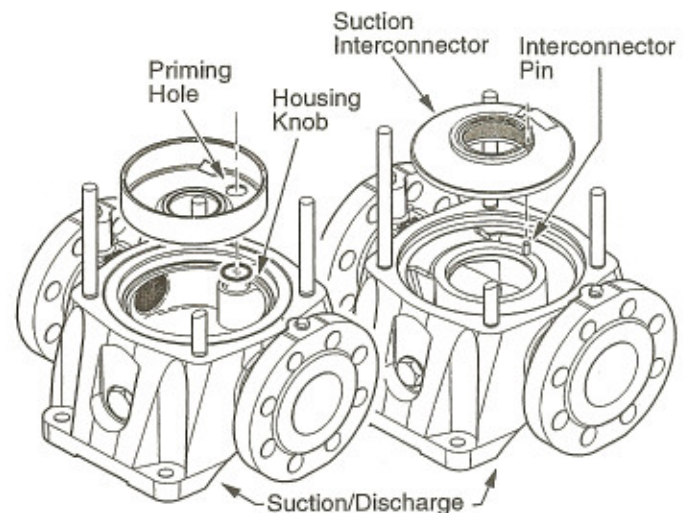


FIGURE 11 - VM01, VM02 – Align Small Priming Port. VM04, VM06 – Align Interconnector Pin

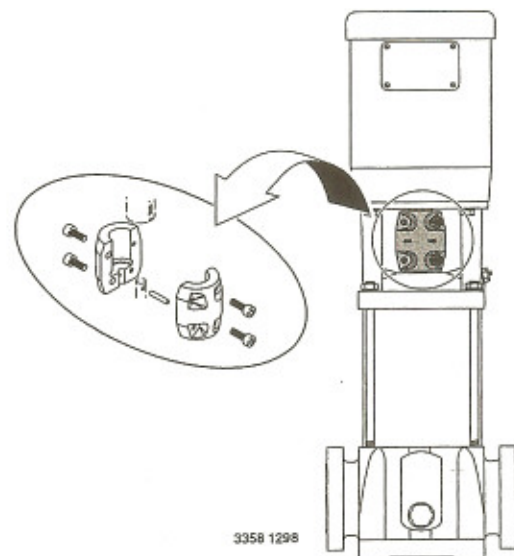


FIGURE 12 - Remove the Socket Head Screws and the Coupling Halves

Two Part Mechanical Seal/Disassembly:

See Table VII to determine which seal your model has.

TABLE VII – Seal Type Identification

| 2 Part Low Pressure Seal | 7 Part High Pressure Seal |
|--|--|
| 1800-B78038 | 1800-B78039 |
| VM0102 through VM0112 VM0201 through VM0212 | VM0115 through VM0118 VM0214 through VM0216 |
| 1800-B78040 | 1800-B78040 |
| VM0401 through VM0412 VM0602 through VM0608 | VM0414 through VM0416 VM0610 through VM0612 |

See Figure 14 for VM01 and VM02 Series Models, and Figure 15 for VM04 and VM06 Series Models, for Key Numbers.

NOTICE: The assembly and disassembly procedure for this seal does not require extraordinary force.

▲WARNING Hazardous voltage. Can Shock, burn or cause death. Disconnect power to pump before disassembly.

1. Follow Steps 1-8 under "Motor Replacement" Page 8, and proceed with step 2 below.
2. Remove the four nuts, lockwashers, and washers (Key Nos. 8, 9A, and 9B) from the staybolts (Key No. 19).
3. The shaft seal consists of a stationary half (Key No. 14A) and a rotating half (Key No. 14B). Turn the motor bracket upside down and remove the stationary part of the seal (Key No. 14B) from the seal seat in the base of the motor bracket.
NOTICE: Use care not to chip or scratch the seal seat during disassembly and assembly.
4. Clean the seal seat with a wet cloth.
5. Remove and discard the rotating parts of the seal by twisting and pulling up on them until they come off of the shaft.

Two Part Mechanical Seal Reassembly:

NOTICE: Before assembly check and clean all sealing and gasket surfaces with a clean wet cloth. Replace all seals, gaskets and O-Rings.

1. Turn the motor bracket upside down.
2. Moisten the seal seat (in the motor bracket) and the O-ring (cup seal) portion of the stationary half of the mechanical seal (Key No. 14A) with a small amount of water.
3. Press the cup-seal onto the stationary half of the shaft seal and then press the shaft seal into the seal seat of the pump head (Cup-seal portion first), using finger pressure only. **NOTICE:** If a tool is used, protect the seal face from tool with a clean cloth.

NOTICE: The cup-seal must be placed evenly on the seal and the seal must be installed evenly in the seal seat to avoid pinching the cup-seal.

4. Moisten the internal parts of the rotating portion of the mechanical seal (14B).
5. Install the rotating half of the seal onto the shaft. Push and twist the seal onto the shaft to the stop ring.
NOTICE: Use care when installing the new seal on the shaft. Do not to scratch or mar seal on the shaft shoulder.
6. Follow Steps 11 - 23 under "Replacing Pump Stack", Page 9.

Seven Part Mechanical Seal/Disassembly:

See Figure 14 for VM01 and VM02 Series Models, and Figure 15 for VM04 and VM06 Series Models, for Key Numbers.

▲WARNING Hazardous voltage. Can Shock, burn or cause death. Disconnect power to pump before disassembly.

1. Follow Steps 1-8 under "Motor Replacement" Page 8, and proceed with step 2 below.
2. Remove the four nuts, lockwashers, and washers (Key Nos. 8, 9A, and 9B) from the staybolts (Key No. 19).
3. The shaft seal consists of an O-Ring (Key No. 15A), the stationary half of the mechanical seal (Key No. 15B), the rotating half of the mechanical seal (Key No. 15C), a second O-Ring (Key No. 15D - inside No. 15C), a flat washer (Key No. 15E), a spring (Key No. 15F), and a mechanical drive ring (Key No. 15G), in that order, see Figure 13, below. Turn the pump head upside down and remove the stationary part of the seal (Key No. 15B) from the seal seat in the base of the motor bracket.

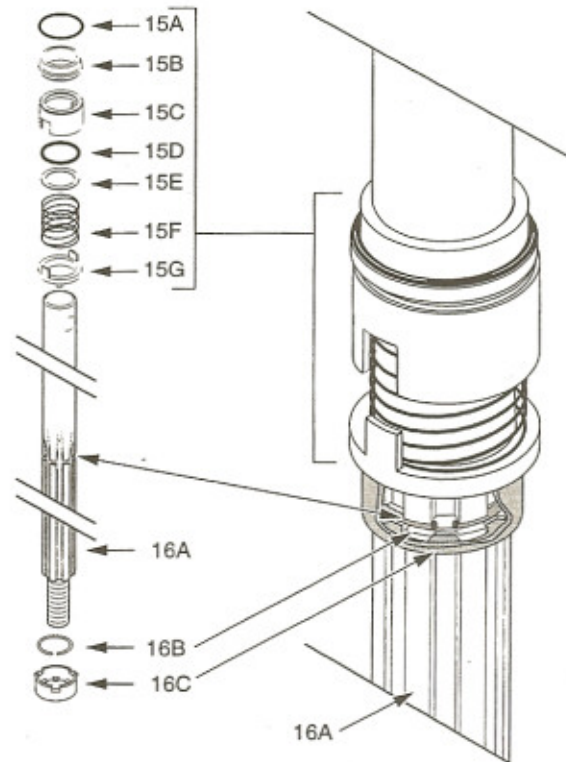


FIGURE 13

NOTICE: Use care not to chip or scratch the seal seat during disassembly and assembly.

- Clean the seal seat with a wet cloth.
- Remove the rotating parts of the seal by twisting and pulling up on them until they come off of the shaft (Key Nos.15C and 15D, 15E, 15F, and 15G). Discard the old seal.

Seven Part Mechanical Seal Reassembly:

NOTICE: Before assembly check and clean all sealing and gasket surfaces with a clean wet cloth. Replace all seals, gaskets, and O-Rings.

- Turn the motor bracket (Key No.7) upside down.
- Moisten the seal seat (in the motor bracket) with a small amount of water.
- Lubricate the larger diameter O-Ring (Key No. 15A) with a small amount of water and install it on the stationary half of mechanical seal (Key No. 15B).
- Press the stationary half of the shaft seal (Key No. 15B) with O-Ring (Key Nos. 15A and 15B) into the seal seat of the motor bracket. Use finger pressure only. If a tool is used, protect the seal face from tools with a clean cloth.

NOTICE: Be sure the seal is installed evenly to avoid pinching the O-Ring.

- Lubricate smaller diameter O-Ring (Key No. 15D) with water and press it into the rotating half of the mechanical seal (Key No.15C).
- Install the mechanical drive ring (Key No. 15G) on the shaft (Key No. 16A). Be sure the drive ring butts up against the mechanical seal spacer (Key No. 16C).
- Install the spring (Key No.15F) up against the drive ring on the shaft .
- Install the flatwasher (Key No.15E) on the shaft, against the spring.
- Install the rotating half of the mechanical seal (Key No.15C) on the shaft. Align the grooves on the rotating half of the mechanical seal with the teeth on the mechanical drive ring (Key No. 15G).
- Follow Steps 11 - 23 under "Replacing Pump Stack", Page 9.

Frequency of Starts and Stops

Check pump cycling frequency and make sure that the pump is not starting more than:

TABLE IX – Maximum Number of Cycles

| Cycles | Motor HP Rating |
|-------------------|-----------------------|
| 20 times per hour | 1/2 - 5 HP motors |
| 15 times per hour | 7- 1/2 - 15 HP motors |
| 10 times per hour | 20 and 25 HP motors |

Frost Protection

- If you do not use your pump during seasons of frost, drain it and add a glycol based antifreeze (50/50 mixture) to avoid damage.

CAUTION Risk of water damage and injury. Watch the direction of the priming plug and make sure that liquid escaping from it does not injure persons nearby or damage the motor or other components. In hot water installations, pay particular attention to the risk of injury from scalding hot water.

- Upon restart dispose of spent antifreeze properly.
- Do not replace the drain plug or tighten the priming plug until you put the pump back in service again.

Regular Maintenance Checks

The following checks should be made at regular intervals:

- The pump meets required performance and is operating smoothly and quietly.
- There are no leaks.
- The motor is not overheating.
- Remove and clean all strainers and filters in the system.
- Verify amp draw – check motor amperage.
- Pump wear rings and shaft require no regular maintenance.

TABLE VIII – Torque Specifications (foot-lbs.)

| | Coupling | | | Motor | | Staybolt | | Stack Nut | |
|------------------------------|---------------------------|---------------------------|----------------------------|-------------------------------|-------------------------------|------------------|------------------|-------------|-------------|
| | Socket Head Screw M6 x 20 | Socket Head Screw M8 x 25 | Socket Head Screw M10 x 25 | Capscrew Hex Head 3/8 x 1-1/2 | Capscrew Hex Head 1/2 x 1-1/2 | Hex Nut 1/2 - 13 | Hex Nut 5/8 - 11 | Hex Nut M8 | Hex Nut M12 |
| Hardware Part Numbers | 1800-M11369 | 1800-M11398 | 1800-M11491 | 1800-S23568 | 1800-S23623 | 1800-S26460 | 1800-S26462 | 1800-M11385 | 1800-M11419 |
| Pump Model Number | | | | | | | | | |
| VM01 Series | 20 | 35 | – | 30 | 35 | 45 | – | 10 | – |
| VM02 Series | 20 | 35 | – | 30 | 35 | 45 | – | 10 | – |
| VM04 Series | 20 | 35 | 45 | 30 | 35 | – | 75 | – | 30 |
| VM06 Series | – | 35 | 45 | – | 35 | – | 75 | – | 30 |

VM01
VM02

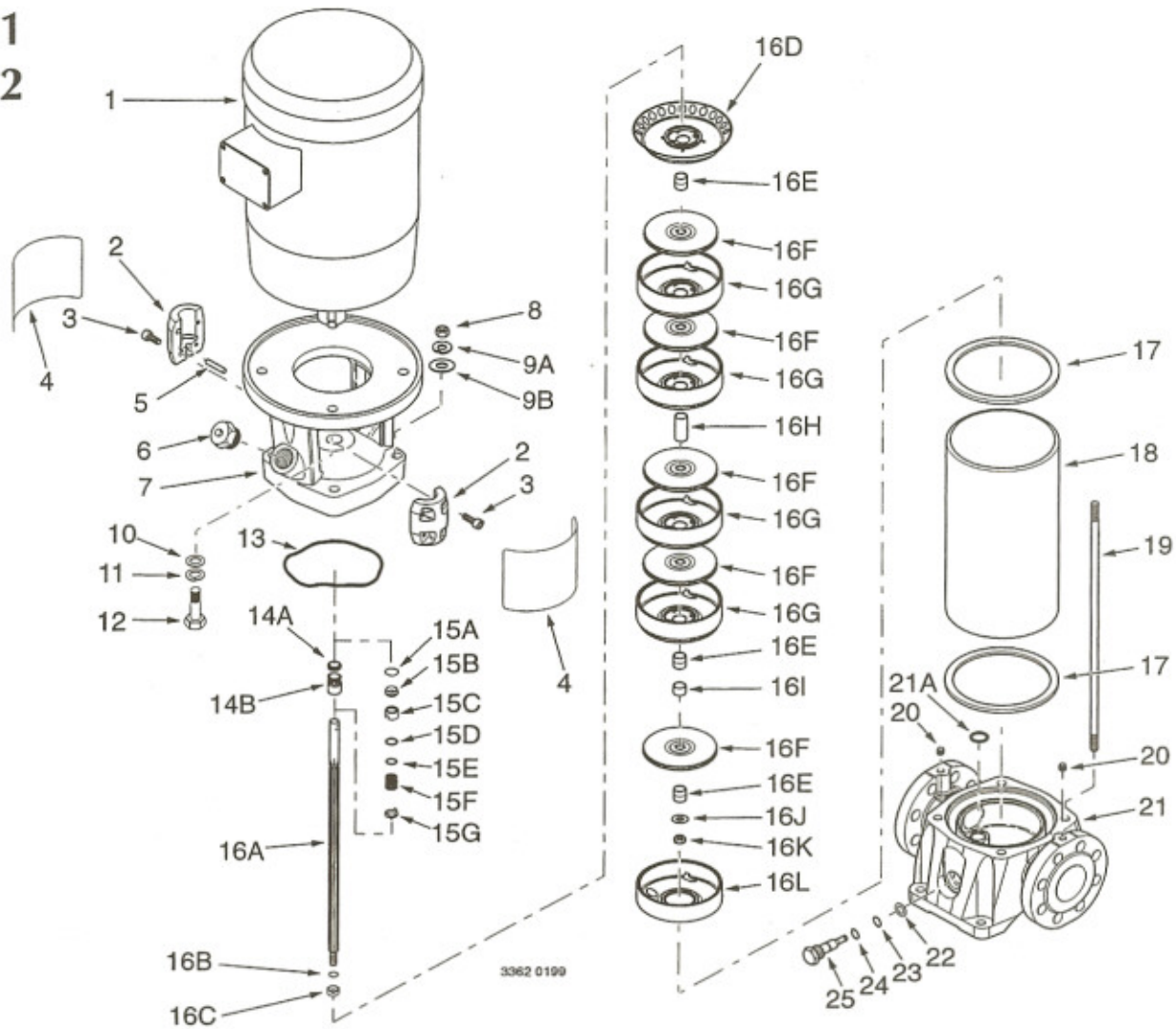


FIGURE 14 - Exploded View VM01 and VM02

REPAIR PARTS LIST FOR VM01 AND VM02 SERIES MODELS

| Key No. | Description | Key No. | Description |
|---------|--|---------|---|
| 1 | Motor | 15G | Mechanical Drive Ring |
| 2 | Coupling Half | 16 | Replacement Stack Kit (Incl. Key Nos. 16A thru 16L) |
| 3 | Socket Head Screw | 16A | Shaft |
| 4 | Coupling Guard | 16B | Stop Ring |
| 5 | Coupling Pin | 16C | Mechanical Seal Spacer |
| 6 | Vented Priming Plug | 16D | Upper Intermediate Chamber |
| 7 | Motor Bracket | 16E | Spacer |
| 8 | Staybolt Nut | 16F | Impeller |
| 9A | Staybolt Lockwasher | 16G | Diffuser |
| 9B | Staybolt Flat Washer | 16H | Spacer |
| 10 | Flatwasher | 16I | Bearing |
| 11 | Lockwasher | 16J | Shaft Washer |
| 12 | Cap screw | 16K | Nut |
| 13 | Spring Ring | 16L | Chamber without Diffuser |
| 14 | Two part Mechanical Seal (Includes 14A and 14B) | 17 | Sleeve Gasket |
| 14A | Stationary Half of Mechanical Seal | 18 | Stainless Steel Sleeve |
| 14B | Rotating Half of Mechanical Seal | 19 | Staybolt |
| 15 | Seven Part Mechanical Seal (Includes 15A thru 15G) | 20 | Pipe Plug |
| 15A | O-Ring, Larger Diameter | 21 | Suction/Discharge |
| 15B | Stationary Half of Mechanical Seal | 21A | O-Ring (Bottom Chamber) |
| 15C | Rotating Half of Mechanical Seal | 22 | Drain Plug Gasket |
| 15D | O-Ring, Smaller Diameter | 23 | O-Ring |
| 15E | Flat Washer | 24 | O-Ring |
| 15F | Spring | 25 | Drain Plug |

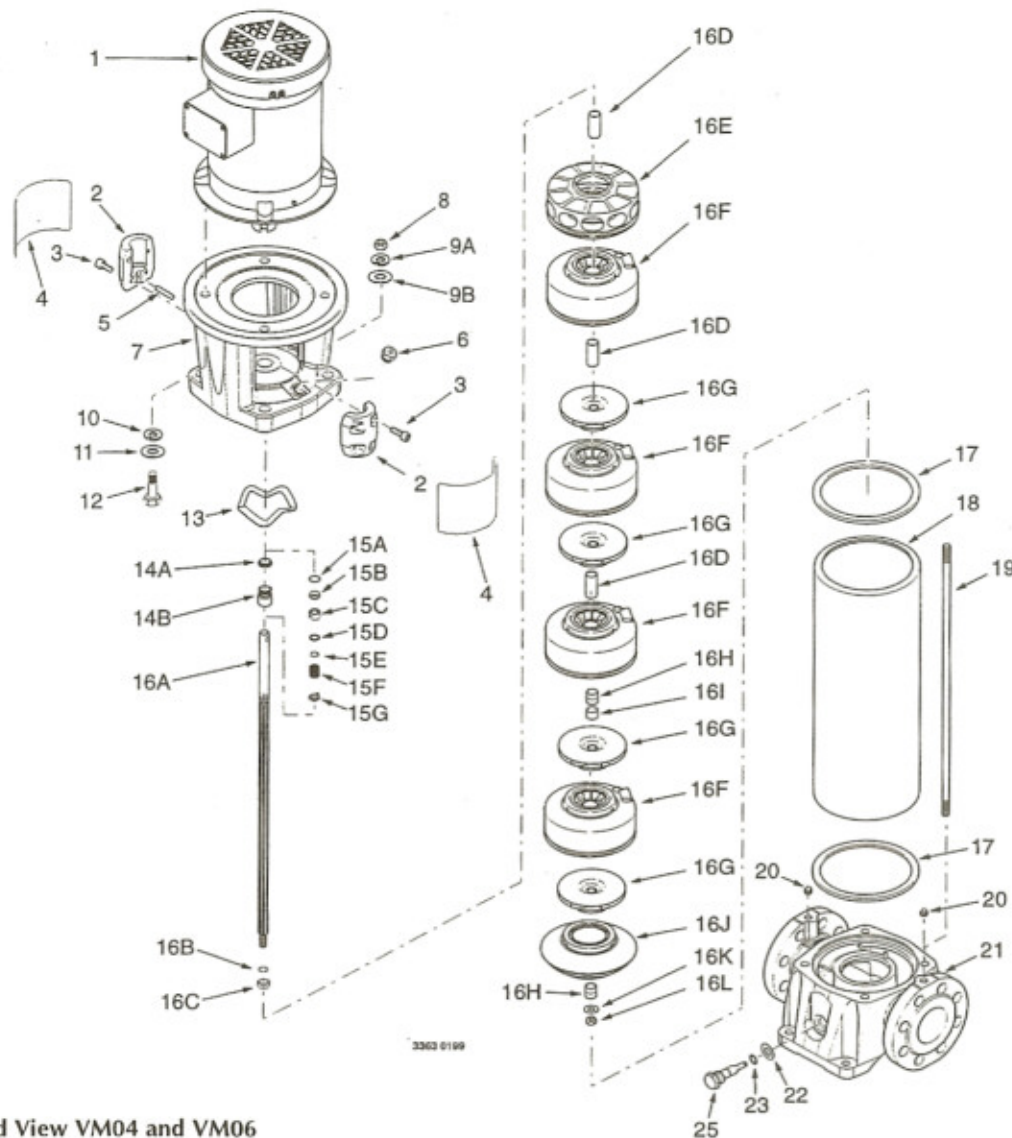


Figure 15 - Exploded View VM04 and VM06

REPAIR PARTS LIST FOR VM04 AND VM06 SERIES MODELS

| Key No. | Description | Key No. | Description |
|---------|--|---------|---|
| 1 | Motor | 15G | Mechanical Drive Ring |
| 2 | Coupling Half | 16 | Replacement Stack Kit (Incl.16A thru 16L) |
| 3 | Socket Head Screw | 16A | Shaft |
| 4 | Coupling Guard | 16B | Stop Ring |
| 5 | Coupling Pin | 16C | Mechanical Seal Spacer |
| 6 | Vented Priming Plug | 16D | Upper Intermediate Chamber |
| 7 | Motor Bracket | 16E | Spacer |
| 8 | Staybolt Nut | 16F | Impeller |
| 9A | Staybolt Lockwasher | 16G | Diffuser |
| 9B | Staybolt Flat Washer | 16H | Spacer |
| 10 | Flat Washer | 16I | Bearing |
| 11 | Lock Washer | 16J | Shaft Washer |
| 12 | Capscrew | 16K | Nut |
| 13 | Spring Ring | 16L | Chamber without Diffuser |
| 14 | Two Part Mechanical Seal (Includes 14A and 14B) | 17 | Sleeve Gasket |
| 14A | Stationary Half of Shaft Seal | 18 | Stainless Steel Sleeve |
| 14B | Rotating Half of Shaft Seal | 19 | Staybolt |
| 15 | Seven Part Mechanical Seal (Includes 15A thru 15G) | 20 | Pipe Plug |
| 15A | O-Ring, Larger Diameter | 21 | Suction/Discharge |
| 15B | Stationary Half of Mechanical Seal | 21A | O-Ring (Bottom Chamber) |
| 15C | Rotating Half of Mechanical Seal | 22 | Drain Plug Gasket |
| 15D | O-Ring, Smaller Diameter | 23 | O-Ring |
| 15E | Flat Washer | 24 | O-Ring |
| 15F | Spring | 25 | Drain Plug |

TROUBLESHOOTING GUIDE

⚠ WARNING Hazardous voltage and risk of sudden starts. Disconnect all power to the pump before servicing or working on pump. Make sure that power is locked out and that pump cannot be accidentally started.

| PROBLEM | CAUSE |
|--|--|
| 1. Motor does not run when started | A. Power failure B. Fuses blown C. Motor starter overload has tripped out D. Main contacts in motor starter are not making contact or the coil is faulty E. Control circuit fuses are defective F. Motor is defective |
| 2. Motor starter overload trips out immediately when power supply is switched on | A. One fuse has blown B. Contacts in motor overload relay are faulty C. Cable connections are loose or faulty D. Motor winding is defective E. Pump mechanically blocked F. Overload setting is too low |
| 3. Motor starter overload trips out occasionally | A. Overload setting is too low B. Low voltage at peak times |
| 4. Motor starter has not tripped out but the motor does not run | A. Check 1 A), B), D,) and E) |
| 5. Pump capacity is not constant | A. Pump inlet pressure is too low B. Suction pipe/pump partly blocked C. Pump is sucking air |
| 6. Pump runs but gives no water | A. Suction pipe/pump blocked B. Foot or non-return valve is blocked in closed position C. Leakage in suction pipe D. Air in suction pipe or pump E. Motor rotates in the wrong direction |
| 7. Pump runs backwards when switched off | A. Leakage in suction pipe B. Foot or non-return valve is defective C. Foot valve is blocked in open or partly open position D. Non return valve leaks or is blocked in open or partly open position E. Discharge valve is defective |
| 8. Leakage from shaft seal | A. Pump shaft position is incorrect B. Shaft seal is defective |
| 9. Noise | A. Cavitation is occurring in the pump B. Pump does not rotate freely (That is, there is increased frictional resistance) because of incorrect shaft position |

COMMERCIAL PUMP WARRANTY TERMS (MODELS VI, VM, FE, CE, TA, S1700)

Taco, Inc. will repair or replace without charge (at the Company's option) any commercial pump product or part which is proven to be defective under normal use within one year from date of start-up or one year and six months from date of shipment (whichever occurs first).

In order to obtain service under warranty, it is the responsibility of the purchaser to promptly notify the Company in writing and promptly deliver the item in question, delivery prepaid to the factory. For complete details on warranty returns, the purchaser should contact a local Taco stocking distributor or the Company. If the product or part in question contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Motors provided on commercial pumps are not covered by this warranty, and are warranted by the motor manufacturer. For complete details on motor warranty returns, the purchaser should contact the motor manufacturer's local service repair center or contact the motor manufacturer directly.

Seals provided on commercial pumps are not covered by this warranty.

Any Taco product or part not installed or operated in conformity with Taco instructions or which has been subjected to misuse, misapplication, the presence of certain chemicals (such as solvents, acids, etc.) or other abuse will not be covered by this warranty. For complete information on chemical and application restrictions, the purchaser should contact the company.

Taco, Inc. reserves the right to make changes in details of design, construction, or arrangement of materials of its products without notification.

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Taco, Inc.

1160 Cranston Street, Cranston, RI 02920 • (401) 942-8000