INSTALLATION, OPERATION AND MAINTENANCE MANUAL VM PUMPS

Taco Comfort Solutions
A Taco Group Company

APPLICATION

PLANT ID 001-988

1. WORKING PRESSURE:
360 PSI :VM01B-VM06B, VM1004B-VM1008B
175 PSI :VM1002-VM1003, VM2002B-VM2005B
275 PSI VM2006B

2. WORKING TEMPERATURE
250 Degree Fahrenheit

General

Centrifugal pumps, when properly installed and when given reasonable care and maintenance, should operate satisfactorily for a long period of time. The following paragraphs discuss the general principles that must be considered to insure trouble free pump operation.

Applications for vertical multistage pumps include any application requiring relatively high head at low to medium flow rates and high efficiencies such as boiler feed, condensate return, constant pressure booster service, jockey pumps for fire protection.

MAINTENANCE

A. ROUTINE INSPECTIONS

Routine inspections should be made on a regular basis. Inspections made while the pump is running should reveal potential failures. Preventive maintenance which include vibration profiles with base line readings will minimize down time and improve pump life.

1. Inspect motor bearings for any sign of temperature rise. Temperature rise may indicate the early stages of bearing problems.

2. Listen for any unusual noise:
   A. Air trapped in the pump
   B. Hydraulic noise.

3. Check the suction gauge reading and confirm that it is normal.

4. Check the discharge gauge reading and confirm that it is normal. If any of the readings vary from base line readings, find out why. Take the appropriate corrective action.

MAJOR ELEMENTS

1. VM PUMP BEARINGS

The pump shaft is coupled to the motor by a rigid coupling. The motor bearing carries the axial thrust created by the pump. There are water lubricated radial bearing spaced evenly through the pump stack. These bearings are usually replaced during a complete pump

2. VM MOTORS

The motor must be lubricated in accordance with the manufacturers recommendations. **Avoid over greasing the motor as it can cause premature motor failure.**

3. VM MECHANICAL SEAL

The mechanical seal consists of a carbon rotating element and either a tungsten carbide (VM01-VM06) or a silicon carbide (VM10-VM20) stationary element. It is important to keep the seal area free of air and dirt. As working temperatures and pressures permit, vent the pump periodically when air and dirt are known to be in the working fluid.

INSTALLATION

1) LOCATION

1. Install the pump vertically with the motor up.

2. The pump should be accessible for inspection and repair work, head room must be provided for the use of a hoist or tackle as necessary. Allow at least 15 to 18 inches free clearance above the pump motor for its removal .

3.Lift the pump by slinging through motor eye bolts and the pump adapter piece. **Caution: Do not lift the pump and motor using only the motor eye bolts.**

4. In no case should any part of the motor be covered with insulation.

PIPING

Correct piping is of prime importance for the proper operation and long life of the pump. Stresses induced by the piping will cause excessive wear of seals, bearings, and couplings that could ultimately destroy theses elements.

Both suction and discharge piping should be supported close to the pump connections, so that no pipe weight rests on the pump. Pipe flanges and pump flanges should align perfectly before connections are made. Piping should never be drawn by force into place.

Thermal expansion of piping requires special attention on heating installations. If no room is provided for pipe expansion, stresses are induced in the piping that will exert a load on the pump. Forces created by pipe stresses can far exceed the load exerted through pipe and water weight. Stress forces can distort the pump suction and discharge chamber, bend shafts, wear out mechanical shaft seals and impeller wear rings, and ultimately burn out motor bearings or cause motor overload. To protect the pump from thermal pipe stresses, provide spring hangers and flexible connectors that are suitable to compensate of pipe expansion.

Install isolation valves on both suction and discharge sides of the pump to allow servicing without draining the system.

On open pumping systems drawing water from a level below the pump (suction lift) install a foot valve with strainer. Also consider including a low level switch in the control panel to protect the pump. The piping should rise from the suction source to the suction flange to prevent air pockets in the suction line.

On open systems where the pump is located below the suction water level (suction head) install a check valve in the discharge line close to the pump.

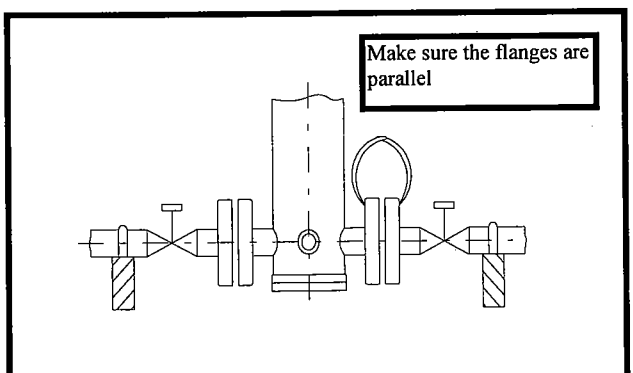


Fig 1 Example of piping suitable for compensation of thermal pipe expansion.

CONNECTING PIPING

Piping may now be connected to the pump. Make sure that the pump and pipe flanges are strictly parallel and properly spaced for the gasket that will be used. Also check that the pipes are supported properly and do not rest on the pump flanges. Never draw pipes by force to pump flanges. Recheck alignment after piping connections are made. If misalignment was caused by piping, it is a sign that pipe stresses distorted the pump. Correct piping to relieve stresses.

PRIMING THE PUMP

The pump must not be run unless it is completely filled with liquid, as there is a danger of damaging some of the parts of the pump which depend upon liquid for lubrication. One can expect damage to the pump wear o-rings and mechanical seal if the pump is run without liquid for any period of time. The pump may be primed by any of the following methods, as may be best suited to the conditions of installation.

Utilize an ejector, exhauster or a vacuum pump to vent the pump.

For suction lift applications, utilize the funnel provided with each pump to fill the pump through the vent hole located at the top of the outer pump sleeve .Be sure that the entire pump and suction line is full of water at the time the pump is started. (See Fig 2.)

For systems with pressurized suction lines removing the vent plug and slowly opening the suction side isolation valve will vent the pump.

Regardless of how the pump is vented, it is imperative to bump the motor to check motor rotation and then vent the pump again. Use extreme **caution when removing the vent plug since the pump may have residual pressure built up internally. Utilize the isolation valves to reduce the pressure and avoid serious injury.**

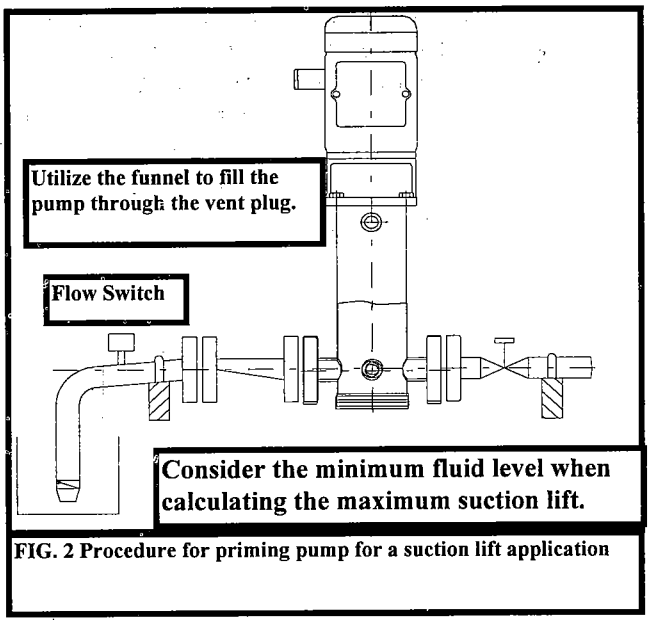


FIG. 2 Procedure for priming pump for a suction lift application

OPERATION

BEFORE OPERATING FOR THE FIRST TIME CHECK THE FOLLOWING:

1. Is the motor correctly wired for voltage available?
2. Has the pump been primed?
The pump should never be run dry.
3. Do all rotating parts turn freely?
4. Is the pump operating with the correct rotation?

STARTING THE PUMP

1. Start the pump with the discharge valve closed.

2. Verify that the pump is rotating in the correct direction.

3. When the correct pressure has been reached, open the discharge valve slowly.

4. To avoid overheating and damaging the pump, do not operate the pump for prolonged periods with the discharge valve closed.

Warning Against Operating with Suction and/or Discharge Valves Closed

Brief shut-off operation of most centrifugal pumps is often necessary. The necessity may arise from system start-up or shut-down requirements and is usually met by closure of the discharge valve for minimum possible time.

Prolonged operation of the pump under this condition may prove harmful to the structural integrity of the pump, mainly because of:

1.Increased vibration level affecting the bearings, stuffing boxes, or mechanical seals.

2. Increased radial thrust and resultant stresses on the shafts and bearings of centrifugal volute type pumps.

3. Heat build-up resulting in a dangerous temperature rise of the liquid being handled and pump elements in contact with it.

4. Excessive cavitation and accompanying damage resulting from internal recirculation

5.Pump should be stopped if any of the following occur:

A. No discharge flow or pressure.
B. Insufficient discharge flow rate.
C. Insufficient suction/discharge pressure
D. Loss of suction.
E. Excessive Power Consumption.
F. Vibration.

DIS-ASSEMBLY AND RE-ASSEMBLY

GENERAL

If the pump has been maintained and serviced properly, breakdowns which necessitate the pump being dis-assembled should not occur often. Applications requiring the pump to run continuously should have 100% back up in the event of a failure.

The following steps should be followed to dissassemble and service the pump:

1. If a problem occurs, the cause should be determined, if possible, before disassembling the pump. (See "Problem Analysis")

2. If the pump is being dis-assembled, all parts must be carefully handled. Avoid heavy blows and shocks. **Stainless steel components can be extremely sharp. Wear the appropriate protective clothing.**

3. All parts must be carefully cleaned and inspected for wear. Recondition or replace parts where necessary. It is important to have a clean area where the pump components can be laid out in the order in which removal occurs to facilitate re-assembly.

4. Close the suction and discharge isolation valve. Drain liquid from the casing by removing the drain plug at the base of the pump. To facilitate drainage remove the vent plug from the top of the pump. **Be careful when removing the vent and drain plugs as the pump may still be under pressure.**

MOTOR REMOVAL

WARNING: Due to motor weight, it is recommended that a lifting device of some type be used to lift the motor off the motor adapter. Fasten the motor to the lifting device and apply tension before proceeding to the next step.

1. Remove the stainless shaft guards by inserting a punch in one of the side holes and pressing toward the center of the guard. Once the compressed guard clears the bevelled edge of the motor adapter, the guard may be pulled out. Do the same for the guard on the other side, and put the guards aside for later reassembly.

2. Remove the four bolts which hold the two sides of the motor shaft clamp together. Remove the bolts and shaft clamp and put them aside for later reassembly. Remove the pin located in the top of the pump shaft and set it aside with the shaft clamp.

3. Remove the bolts which hold the motor to the motor adapter and set them aside.

4. Use the lifting device to remove the motor from the adapter.

MOTOR REPLACEMENT

1. Use a lifting device to hoist the new or repaired motor over the pump and motor adapter.

2. Lower the motor until the motor shaft extends down into the adapter and the motor frame is aligned with the mounting holes in the motor adapter.

3. Attach the motor to the adapter with the mounting bolts.

4. Replace the pin in the pump shaft, and replace the two halves of the drive adapter. Snug the bottom two adapter bolts, but leave the top two bolts loose. Make sure the coupling halves have even spacing on both sides.

5. Place the blue plastic spacer (supplied with the pump) between the bottom of the drive adapter and the base plate of the motor adapter casting. You will probably need to lift up on the pump shaft slightly to do this. (See Figure 3)

WARNING: A failure to use the spacer to properly align the pump stack may result in abnormal wear, parts breakage and overall poor performance. Be sure the distance between the drive adapter and motor adapter is properly set at 3/16" before proceeding to the next step.

6. Once the drive adapter has been positioned, tighten the top two bolts to connect the adapter firmly to the motor shaft. Remove the blue plastic spacer. Table 1 has the torque values listed for the motor stool, coupling bolts, and adapter plates.

7. Replace the two stainless shaft guards by squeezing the edges gently together and positioning them along the edges of the adapter openings.

8. Refer to the PUMP START-UP PROCEDURES section to put the pump back on-line.

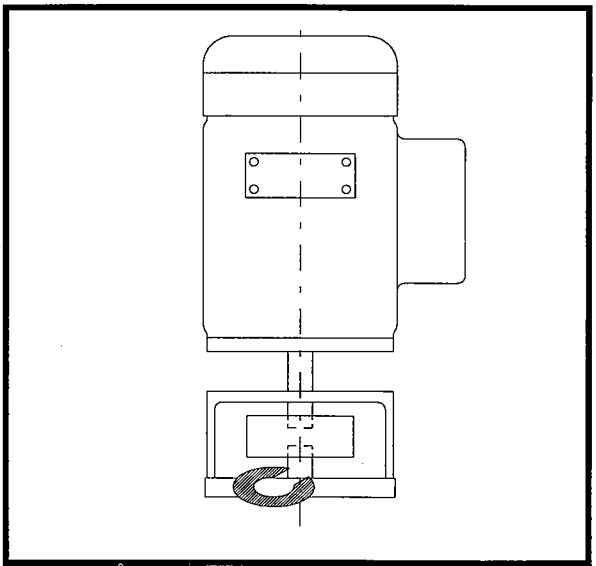


Fig 3 Procedure for setting the pump stack height. Be sure that the coupling halves have an even spacing from side to side and top to bottom

MOTOR FRAME SIZE	MOTOR BOLT TORQUE LBS. FT.	ADAPTER FLG. TORQUE LBS. FT.	COUPLING BOLT TORQUE
56C	20		15
184TCH	20		15
213TC	45	30	30
215TC	45	30	30
254TC	45	48	48
256TC	45	48	48
284TC	45	48	48
286TC	45	48	48

Table 1: Torque values pertaining to replacement of the motor for the VM pump.

MECHANICAL SEAL REMOVAL AND REPLACEMENT

1. Follow all of the steps for MOTOR REMOVAL listed earlier in this section.

2. Remove the four nuts and washers which hold the top of the tie rods to the motor adapter. Put them aside for later use.

3. Remove the motor adapter and put it aside. **CAUTION: On larger models, the removal of the motor adapter may require the use of a lifting device.**

4. In order to replace the mechanical seal, you will need to remove the top of the pump casing. This piece also houses the upper half (stationary) of the mechanical seal. The top is held in place by an o-ring located under the rim.

5. Place the edge of a small block of wood against the underside of the rim on the casing top. Tap the end of the underside of the block with a mallet. Move around the pump and continue to tap on the block until the casing top has been loosened. Remove the casing top and set it aside. **Caution : The stainless steel components have sharp edges.**

6. Below the casing top, will be the bottom (rotary) seal face mounted to a spring. Remove the top (vented) top diffuser and set it aside. Grasp the shaft below the seal and move it sharply back and forth to free the fit of the first stage in the suction/discharge head. Pull the entire stack assembly out of the pump casing.

7. Lift the old seal segment from the shaft and discard.

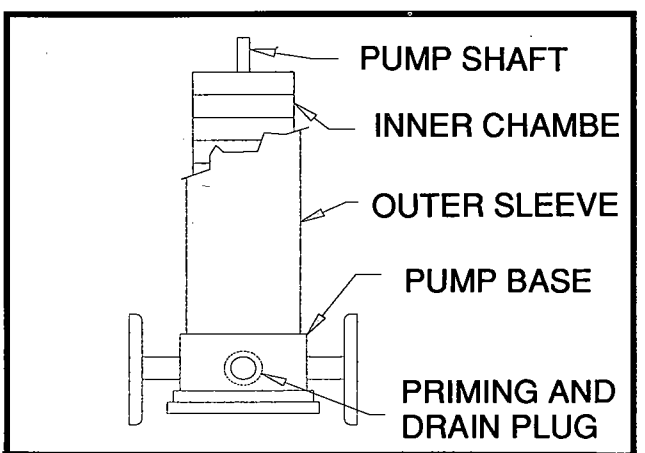


Fig. 4 Removal of the pump stack from the casing. The shaft seal and top diffuser have been removed. The stack can be lifted out whole.

8. Position a new rotary seal face on the shaft so that the tip fits into the hole in the side of the seal driver. **CAUTION: Do not touch the seal face or allow it to come into contact with grease, dirt or other foreign materials.** Seal face damage will cause leakage to occur.

CAUTION: You will need to wear gloves for the next step in order to protect your hands from possible cuts.

9. Locate the casing top and grasp it on the edge so that your thumb can be used to reach the seal face in the center. With the lip facing away from you, press on the back of the seal until it pops out of the casing

10. Position a new stationary seal seat component in the opening of the casing top so that the seal face will point downward when the top is replaced. Press it carefully into position. **CAUTION: Do not touch the seal face.**

11. Examine the o-ring on the outside of the casing. If it appears cracked, dry or damaged, it should be replaced prior to reassembly of the pump.

12. Reinstall the pump stack into the base making sure that the first stage of the pump stack seats firmly into the inner suction chamber of the base.

13. Replace the casing top on the casing and press down evenly. Tap gently with a rubber mallet if necessary to reseat the top of on the o-ring gasket. Be sure that the top is down all the way and is level.

14. Replace the motor adapter on the tie rod bolts using a lifting device if necessary. Replace the washers and nuts on the tie rods and tighten them down completely. Tighten them alternately around the pump to make sure the final torque is evenly distributed. Table 2 lists the appropriate torque values.

15. Continue by following the procedures described in the MOTOR REPLACEMENT section.

Table 2: Torque values pertaining to reassembling the pump end.

Pump Model	Tie Rod Nuts	Vent & Drain Plugs
VM01 & VM02	22 LBS FT.	15 LBS FT.
VMO4 & VM06	37 LBS FT.	15 LBS FT
VM10 & VM20	52 LBS FT.	30 LBS FT.

REPLACEMENT OF IMPELLERS OR OTHER INTERNAL COMPONENTS

1. Follow the procedures in the MOTOR REMOVAL section.

2. Follow steps 1 through 7 of the MECHANICAL SEAL REMOVAL AND REPLACEMENT section to remove the motor adapter, casing top and stack assembly.

3. In order to aid in part identification during reassembly, it is a good idea to label the stages with a grease pencil or crayon before proceding. Label the bottom stage "1" and so on until they are all numbered. Use the grease pencil to draw a line down the stack to establish the radial orientation of the stack to determine if eccentric stack wear ocurred.

4. On the bottom of the stack, below the first stage, is an assembly bolt. In order to remove it, it will be neccessary to hold the shaft. Place the coupling back on the top of the shaft and use two of the bolts to hold it temporarily in place. Place a small screwdriver blade through one of the open bolt holes and brace it against a hard flat surface. Loosen the assembly bolt on the bottom of the stack with a wrench by turning it counterclockwise. Remove it from the shaft and put it aside. The stages can now be removed from the shaft.

5. In order to remove a stage, place the edge of a screwdriver in the seam between the stages and tap the back with a mallet to loosen the fit.

7. Work your way around the seam with the screwdriver to completely free one stage from another.

8. After the stage has been freed, remove it from the shaft. Inside the stage casing you will find two shaft sleeves, one impeller and a diffuser. Remove each and place them with the corresponding stage casing.

9. Some stages will have a different sized shaft sleeve and a bearing in them. Others toward the top of the stack may hve no diffuser or impeller since they are only used to match a particular casing size.

10. Once the stack has been disassembled, examine, clean or replace any of the components which exhibit wear or seem to be causing a problem. See the TROUBLESHOOTING section for guidance on identification of problem components.

11. To reassemble, start with the top of the stack and place it on the shaft. Next replace the vented discharge casing and mate it to the top of the stack. The pump will be assembled in the reverse order and upside down.

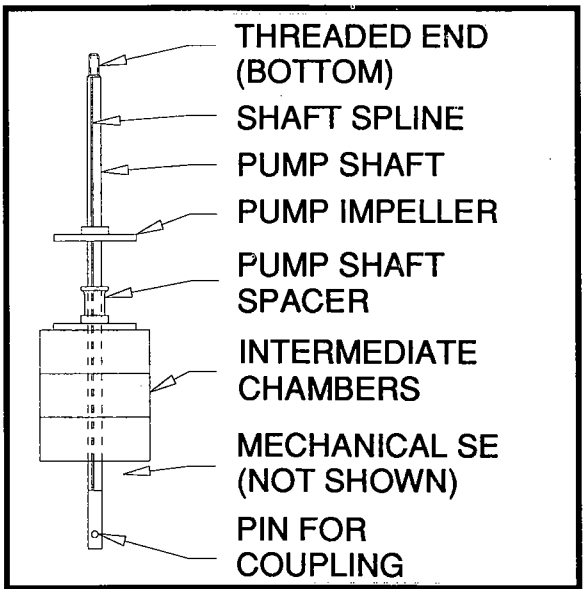


Fig. 5 Reassembling of the pump stack is upside down from the top to the bottom. The mechanical seal is put on last.

12. To reassemble the stages, start with the stage components with the highest number. Place the diffuser on the shaft with the guide vanes facing away from the spring and seal at the top of the shaft.

13. Place on the shaft sleeves on the shaft with the wider end facing away from the diffuser. Push it into the diffuser opening.

14. Place the impeller on the shaft suction eye up and move it into contact with the wide end of the shaft sleeve. For VM10 and VM20 pumps over 4 stages, portions of the pump stack impellers are opposed to one another to balance the axial thrust. In such cases, the first stages to be reassembled will require the impellers to be installed eye up.

15. Place the other shaft sleeve on the shaft with the wide end closest to the impeller. After the crossover chamber has been installed, the proper impeller placement will be with the impeller eye down.

16. Place the stage casing on the shaft and slide it up so that it contacts the diffuser. Press these components together so that they fit snugly.

17. Repeat steps 10 through 14 until all stages are reassembled on the shaft. On stages with a bearing, match the bearing with the smaller shaft sleeve and position these two pieces in the same way that you have positioned the regular shaft leave. If unsure of the component position in the stack, refer to the parts list for the model and stage configuration you are working on.

18. Replace the assembly bolt on the bottom of the stack and tighten it.

19. Grasp the top of the shaft, and lower the stack into the casing. Push down on the stack until it seats firmly into the suction/discharge head. **CAUTION: Be careful not to touch the face of the mechanical seal.**

20. Continue reassembling by following steps 10 through 13 of the MECHANICAL SEAL REMOVAL AND REPLACEMENT procedure and the MOTOR REPLACEMENT section.

21. Make sure that there are no extra parts left over and that the shaft height of the pump is set with the spacer when the pump is being attached to the motor shaft.

22. Verify free rotation after attaching the motor by turning the coupling by hand. Any metal -on - metal contact means that there is a problem and that the pump should not be started.

PROBLEM ANALYSIS

A. NO DISCHARGE

1. Pump not primed.
2. Motor speed too low.
3. System head too high.
4. Suction lift exceeds pump design.
5. Impeller completely clogged.
6. Incorrect direction of rotation.
7. Air leak in the suction line.

B. INSUFFICIENT DISCHARGE

1. Air leak in the suction line.
2. Speed too low.
3. System head higher than anticipated.
4. Insufficient NPSH: Suction lift too high. Check gauges, also check for clogged suction line or screen.
5. Impeller partially plugged.
6. Mechanical defects:
   A. Worn seal O-rings.
   B. Impeller damaged.
   C. Incorrect direction of rotation.

C. INSUFFICIENT PRESSURE

1. Motor speed too low
2. System head less than anticipated
3. Air in the system
4. Mechanical defects.
   A. Worn wear O-rings.
   B. Impeller damaged.
   C. Incorrect direction of rotation
   D. Impeller stack adjusted too high
   E. First impeller partially clogged

D. LOSS OF SUCTION

1. Leak in suction line
2. Suction lift too high
3. Insufficient NPSH available
4. Air in the system.
5. Casing gasket defective.

E. EXCESSIVE POWER CONSUMPTION

1. System head is lower than the pump rating.
2. Specific gravity of the liquid is too high.
3. Incorrect motor rotation.

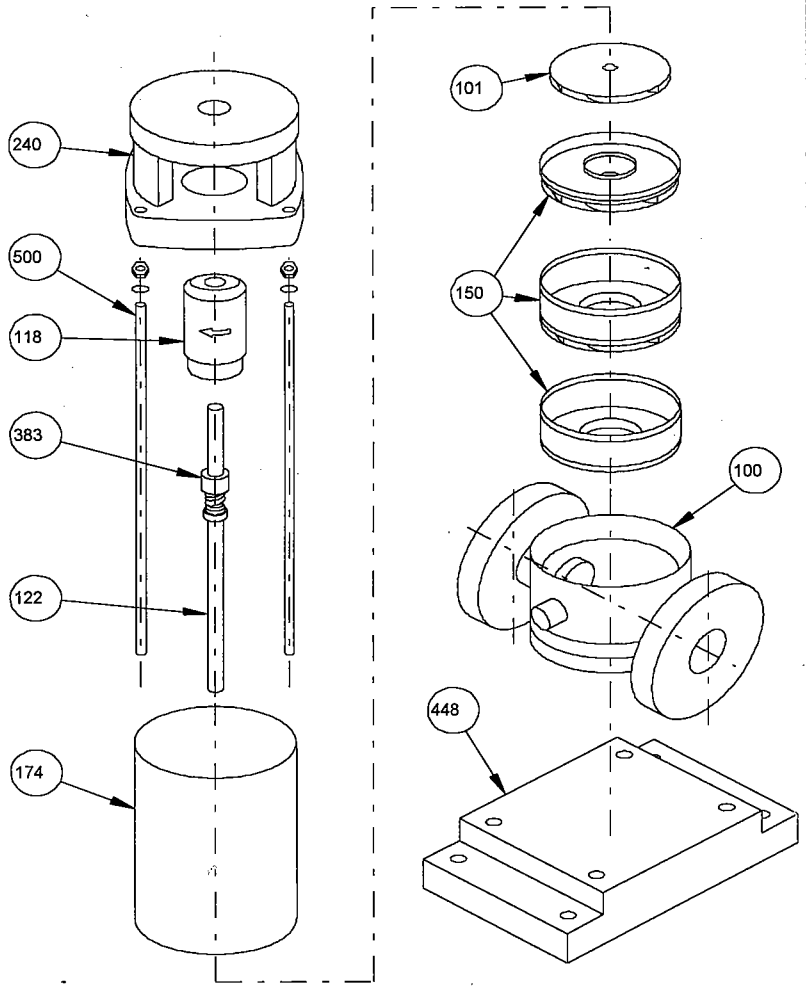
F. VIBRATIONS

1. Air leak in the suction .
2. Air in the system.
3. Foundation not rigid.
4. Impeller partially plugged.
5. Insufficient NPSH available.
6. Mechanical defects:
   A. Damaged impeller.
   B. Worn motor bearings.
   C. Rotor or pump stack out of balance.
   D. Shaft bent.

G. MOTOR RUNS HOT

1. Specific gravity of the liquid too high.
2. Low incoming voltage to motor.
3. Mechanical defects
   A. Shaft bent.
   B. Rotating element binds.
   C. Defective motor.
   D. Motor wired incorrectly.

TACO VERTICAL MULTISTAGE PUMP
TYPICAL EXPLODED VIEW



LIST OF COMPONENTS

100	SUCTION/DISCHARGE CHAMBER
101	IMPELLERS
118	MOTOR COUPLING
122	SPLINED SHAFT
150	DIFFUSERS
174	OUTER SLEEVE
240	MOTOR STOOL
383	MECHANICAL SEAL
448	BASE PLATE
500	TIE ROD

Fig . 6 General layout of vertical multistage pump components. Refer to the drawing to identify individual components.

PUMP NOMENCLATURE

VM 02 11 B A B 0 B943D

- **VM - VERTICAL MULTISTAGE PUMP**
- **02 - NOMINAL FLOWRATE X 15 GPM**
- **11 - NUMBER OF STAGES**
- **B - CONFIGURATION AND METALLURGY**
- **A - PUMP VERSION**
- **B - COMPATIBLE MOTOR FRAME SIZE**
- **0 - MECHANICAL SHAFT SEAL CODE**
- **B943D - MOTOR INDEX CODE**

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