Taco Comfort Solutions®
A Taco Family Company

VT Series
Vertical Turbine Pumps

302-053

Installation and Operation Instructions

EFFECTIVE: August 9, 2019 SUPERSEDES: May 25, 2016

A: INSTALLATION

SAFETY REQUIREMENTS

It is important that you read and understand all the installation instructions prior to beginning the installation of the unit.

A1: RECEIVING, UNCRATING, AND INSPECTING

1. Using the packing list as a guide, make certain that all equipment arrived in the shipment and inspect for obvious damage incurred during shipment.
2. Immediately report any damage to carrier.
3. Uncrate and lay out all the equipment in the order of installation on clean boards or floor.

A2: INSTALLATION EQUIPMENT AND TOOLS

The following is a checklist of tools and equipment needed for the installation. Assemble prior to starting the installation.

( ) 1. A portable or permanent derrick of sufficient strength to safely lift the total weight of the pump. A conservative weight for the pump will be listed on the freight bill. The minimum travel of the derrick should be at least 6' greater than the longest piece of pump equipment. Hoist must have swivel hook.
( ) 2. One or two cable slings of sufficient strength to lift the entire pump and long enough to clear greatest shaft projection.
( ) 3. One erector sling for lifting the driver.
( ) 4. Dial indicator calibrated in .001" divisions with a stand.
( ) 5. Wire brush, paint brush, three-cornered file, flat file, and emery cloth.
( ) 6. Set of mechanic's tools including an assortment of socket wrenches.
( ) 7. Bucket of solvent, coal oil or naphtha, etc.
( ) 8. Machinist's level
( ) 9. Steel tape measure.
( ) 10. Two pipe wrenches of sufficient size to handle shaft and couplings. (Always required for hollow shaft drive).
( ) 11. One set of steel clamps to fit the pump bowl.
( ) 12. Two sets of steel clamps to fit the column pipe. NOTE: One set is required if only one section of column is furnished with the pump assembly.
( ) 13. Two 4 x 4 timbers or "H" beams (if the unit is extra large and heavy). Long enough to span the installation opening.
( ) 14. Two "V" blocks for checking shaft straightness.
( ) 15. Two chain tongs of sufficient size to handle column pipe.
( ) 16. Thread compound and gasket compound with thinner.
( ) 17. Sufficient quantity of wedges to level discharge head or foundation plate (if applicable).
( ) 18. Sufficient quantity of top quality non-shrink grout.
( ) 19. Teflon Paste compound for stainless threads, anti-seize compound for the other threads.
( ) 20. Bundle of cleaning rags.
( ) 21. Putty knife.

A3: SPECIAL PRECAUTIONS

1. Make certain that no rags, wood scraps, etc., are lodged in any exposed openings. Check pit depth and anchor bolt spacing with pump dimensions. Lift and handle unit carefully to prevent bending strain damage caused by the hanging weight of the unit. Do not lift any item by the shaft. Take extra precautions when handling a mechanical seal or packing gland assembly since this is a delicate and precision component.
2. **ALWAYS USE THREAD COMPOUND ON SHAFT AND COLUMN JOINTS.** Do not allow pipe compound, solvent, or any petroleum products to get on the rubber bearings.
3. Shaft threads are usually left hand; column threads are right hand. **If unit is shipped assembled, and has threaded column pipe; pipe joints may have loosened during shipment. Before installation check threaded connections for tightness. A chain tong pipe wrench should be used to verify tightness of pipe connections.**

A4: PREPARATION AND CLEANING

1. Clean all threads and flange faces with a wire brush or paint brush and solvent. If required, clean threads with a three-cornered file. The protective coating on the threads and flanges is a rust preventive coating and not a thread compound or gasket material.
2. Clean all shafts and couplings with a rag soaked in solvent. Make certain that all bearings are clean.
3. If applicable, remove protective caps from ends of oil tubing and clean all tubing threads and shaft bearings thoroughly with solvent. Make certain tubing faces are free of nicks, dents, and burrs.
4. Remove gland assembly from discharge head. Remember to be very careful with this item.
5. Make a physical check of the discharge head or foundation plate for proper fit to foundation.
6. Check pipe ends and couplings to be sure there are no dents, nicks, or burrs.
7. Check shaft end for nicks, burrs, etc. The shaft alignment is dependent on the point of the shaft ends.
8. Check all boxed shafting for straightness using "V" blocks and dial indicator as follows:

   8.a Start with "V" blocks as close to the threads as possible. Check two or more places between "V" blocks and straighten shaft to within .003" to .005" of the Total Indicated Run-Out. Straightening may be performed by mechanical or high pressure on the high point.
   8.b Move one "V" block about 20% of shaft length inward from the end. Check between the "V" blocks and the overhanging ends; straighten as in step 1 above.
   8.c If straightening was required in Step 2 repeat Step 1. Repeat the above steps until shaft checks within tolerance in both positions. Wipe the shaft clean after checking.

9. Check run-out on bowl shaft extensions by placing dial indicator toward the end of the shaft and turning slowly making certain the shaft stays to one side of the upper most bowl bearing. Total Indicating Run-Out should not exceed .005".
10. Check and record the total bowl lateral or end play. If a solid shaft motor is used, this information will be required for flanged coupling assembly.

A5: INSTALLATION INSTRUCTIONS

A5.1: BASE PLATE OR FOUNDATION PLATE (IF SUPPLIED)

1. Place foundation plate over anchor bolts and allow to rest on foundation. Check to make sure foundation plate is level, use wedges or shim stock if necessary. Full contact with foundation is important for vibration free operation.
2. If the final elevation of the plate is critical, this should be checked at this time.
3. Attach hex nuts to anchor bolts and turn until snug against foundation plate.

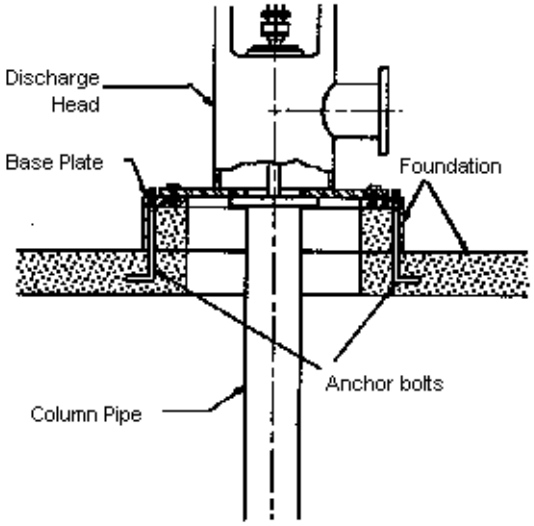

Figure A5.1

4. The foundation plate serves as a good surface for the discharge head. See Figure A5.1.

A5.2: PUMP BOWL

1. Place the two beams on the foundation plate or foundation opening.
2. Secure the proper clamp to the upper end of the bowl beneath a convenient shoulder. If only one sling is used, attach the sling to the clamps far enough out on the ears to allow for easy removal after setting the unit down on the beams.
3. Hoist the bowl to a vertical position using the derrick. If the bowl is equipped with a strainer, do not drag the strainer across the floor.
4. If there is any auxiliary piping to the bowl bearing or the thermo-wells, make certain the bowl portion of the piping is attached to the bowl at this time.
5. Center the bowl over installation opening then carefully lower until the clamp ears are resting squarely on the beams. Then remove the sling.
6. Clean the following items: shaft threads, discharge threads, flange face (if applicable), threads and face of oil tubing (if applicable). Lightly oil the shaft threads and screw the coupling on half way. Place a rag over the coupling to prevent entrance of foreign matter during the next step in assembly.

A5.3: COLUMN OPEN LINESHAFT

Refer to the installation plan or the overall dimension sheet of the submittal to determine correct sequence for installation of column lengths.

1. Secure pipe clamp immediately beneath column coupling.

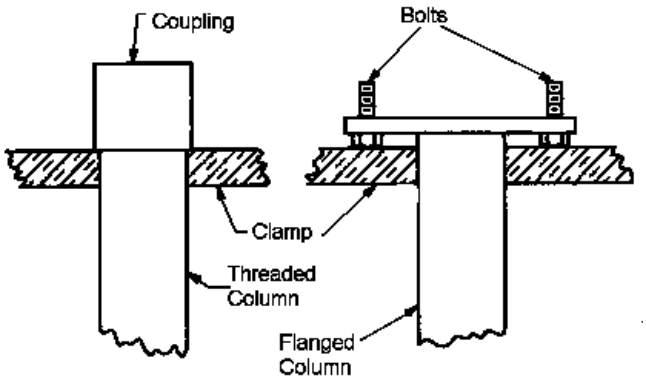

Figure A5.3.1

If column is flanged, insert bolts and secure clamp below bottom of flange. Clamp should keep bolts in position. See Figure A5.3.1.

2. Slide the lineshaft into bottom of column pipe and allow it to extend approximately 15" below the bottom end of the pipe. Make certain the sleeve area of the lineshaft (if applicable) is toward the top of the pipe. Tie a series of half hitches to the column pipe and lineshaft with ¾" rope. (Tie the rope to a chain pipe vise on the lineshaft, if needed.) Attach the sling to the clamp ears as described under Section A5.2, Step 2.
3. Hoist column and lineshaft to a vertical position with the derrick. Do not drag shaft across the floor. Before centering column over bowl, tap the side of column to remove any loose matter.
4. Position the column and lineshaft over the bowl. Align the lineshaft and remove the rag from the bowlshaft coupling. Lightly oil the threads. Lower until the lineshaft contacts coupling. Remove the rope. Hold coupling and turn the lineshaft (left hand threads) until the shaft ends butt up. Place one pipe wrench on the coupling and one on the lineshaft. Tighten securely. Remove the wrench marks form the shaft and coupling with a flat file and emery cloth.

5.a **If bowl to column connection is threaded,** apply thread compound to the pipe threads. Attach chain tongs to bowl and to column for support. Lower the column pipe, and at the same time, turn the pipe until it seats against the mating shoulder on the bowl. Tighten pipe into bowl securely.

5.b **If bowl to column connection is flanged,** spread a thin, even film of gasket compound on the bowl discharge flange. Lower pipe and align studs in the bowl with the holes in the flange. Seat the column flange against bowl flange. Install and tighten hex nuts evenly.

6. Hoist assembly enough to remove the clamp on the bowl assembly.
7. If there is any auxiliary piping to bowl bearing or thermo-well being used, that portion that attaches to the column section should now be installed. Also, if the bowl and column are coated with any special coating, any required patch work should be done before lowering unit.
8. Slide beams in close to column. Lower the assembly and rest the clamp ears on the beams. Remove the sling.

9.a If there is more than one section of threaded column, a centering spider may be used. Slip the spider over the lineshaft with lock ring on top. Screw the centering spider into the column coupling until it butts against the column pipe. See Figure A5.3.9 (THREADED).
Note: Some spiders may not have lock rings.

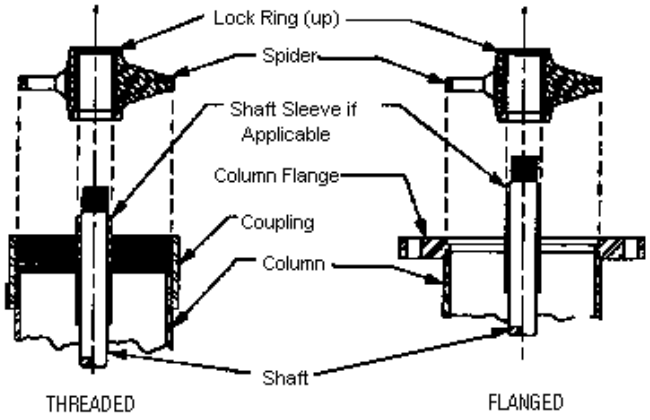

Figure A5.3.9

9.b If column is flanged, clean flange and the O.D. of the spider. Slip the spider over the lineshaft with lock ring on top and seat into spider recess. See Figure A5.3.9 (FLANGED).

10. Clean all lineshaft threads and faces thoroughly. Screw the coupling on half of its length. Cover the coupling with a rag to prevent foreign matter from dropping into the entrance.

11. If there is more than one section of column, repeat Section A5.3, steps 1 through 10, for each additional section until all of the column is assembled. Clean the thread/flange face of the column pipe and the lineshaft projection thoroughly. Do not attach the shaft coupling to the top piece of shaft.

A5.4: PUMP HEAD

1. Wipe a thin layer of joint compound on the top column threads, or, if connection is flanged, on the top flange face. Remove the packing gland assembly from the discharge head or motor stand. Clean all machined faces of the discharge head/motor stand thoroughly. Attach a sling to the discharge head/motor stand, hoist and center over the column. Lower the discharge head/motor stand being careful not to damage the top section of shafting, known as the head shaft, or the stretch tube (if applicable).

2.a Set the discharge head on the top section of threaded column pipe. Screw the discharge head onto the column pipe.

2.b Align the holes of the discharge head/motor stand with the holes of the column pipe flange, then lower until head is resting squarely on flange. Install bolts and tighten.

3. If there is an underground outlet, place the head as close as possible to the final position in relation to the outlet.

4.a If an adjustable top flange or threaded head is used, the head can be readily turned to place it in alignment to the underground outlet. In addition, the head should be turned as needed to attain the proper shaft projection and the correct distance from the outlet center line to the bottom of the head. Back the packing ring off to allow ample working room, fill the chamfer on the lower end of the flange with lampwick packing that has been precoated with joint compound. Use a generous amount of the packing and wind the packing around in such a manner that it is screwed into place. Screw the packing ring against the flange or bottom of the head and tighten.

4.b If the adjustable flange is being used in conjunction with oil tubing, the top of the tubing should be approximately $1^{1}/_{4}$ inches below the tension box mounting face of the head after the flange is adjusted.

5. Hoist head slightly. Remove the clamp from the top piece of column. Remove setting beams and clean surface of the foundation itself. If there is an auxiliary line to the bowl bearing or thermo-well, that portion immediately below and attaching to the head should now be installed. Properly place discharge outlet and align mounting holes with anchor bolts and lower until head is resting squarely on the foundation.

6.a If head is resting on foundation plate, align mounting holes of the head with tapped holes in the foundation plate. Install and tighten cap screws.

6.b Mix a sufficient quantity of rather dry non-shrink grout. Force as much grout under the foundation plate as possible. If grout holes are provided, grout can be pressure-fed through the grout holes until all cavities are filled.

6.c As the head is resting on the foundation, drive wedges under head until proper elevation is within .005 inches of the Total Indicated Run-out with respect to head shaft. Install and tighten hex nuts to anchor bolts. Grout under the outer perimeter of the head and cover the wedges with the grout.

6.d If a motor stand is used, as in an underground discharge application, it should first be determined that the outlet in the column aligns with the discharge piping so that no strain will be placed on the pump. **Do not make this correction at this time, however.** After checking the pipe alignment follow Step 4a for leveling and grouting.

6.e Step 6d should be followed if there is a suction connection to the header. It is recommended that a flexible joint of some description be used between the suction flange and header to compensate for any slight misalignment. If no flexible joint is used, the header flange must be perfectly aligned so that no misalignment is transferred to the pump.

A5.5: PACKING GLAND OR MECHANICAL SEAL

1. Packing Gland Open Line Shaft

1.a Remove the packing gland, packing rings and lantern ring from the gland assembly. Clean the packing box thoroughly and apply a neoprene o-ring to the receiving hole in the discharge head.

1.b Slide the packing box over the head shaft. Properly adjust mounting holes so that the grease ports of the packing gland are directed toward the access windows of the discharge head or motor stand. Seat the packing gland against the discharge head/motor stand then install and tighten cap screws. It should not be necessary to exert any side pressure on the shaft in order to seat the packing box properly.

1.c Reseat packing. See Section G4 for details.

1.d Slip rubber slinger over head shaft and position just above the packing gland.

2. Mechanical Seal Open Line Shaft

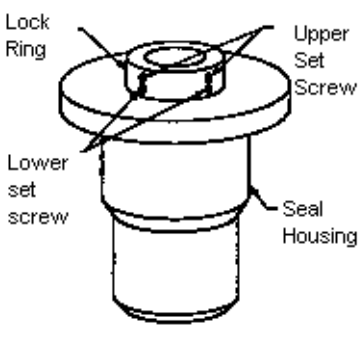

Figure A5.5

2.a Inspect the seal assembly to be sure O-rings are included on the seal housing cover and the shaft sleeve. On the lock ring, be sure the lower set screws are tight and upper set screws are loose. See Figure A5.5.

2.b Prior to installing the shaft sleeve o-ring, lubricate with light grease then slide complete assembly over head shaft. Seat and bolt down the assembly against the seal housing, taking care to be sure that the O-ring of the seal housing cover is in its groove.

2.c To set seal, first set impeller lateral, then tighten top set of set screws of the lock ring. Remove paper spacers and keep for future use.

A5.6: VERTICAL MOTORS

1. Hollow Shaft Motor

1.a Clean threads and face of head shaft projecting above packing gland thoroughly, then oil threads lightly. Thread coupling on shaft for half of its length. Stuff a rag into open end of the shaft coupling.

1.b Remove the top cover from the motor. Unbolt the coupling (clutch or drive block) from the motor and remove the coupling.

1.c Run a fine flat file over the motor mounting surface of the head to remove any nicks or burrs. Thoroughly clean face and register with solvent. Wipe a thin layer of light oil over the surface. This will help prevent rust and will also facilitate slight driver shifting during coupling alignment.

1.d Attach the erector sling to the motor lifting lugs. Hoist motor sufficiently to allow easy access to mounting flange. Remove nicks and burrs on the mounting flange with a fine flat file and thoroughly clean with solvent.

1.e If there is sufficient head room to install the head shaft after placing the motor on the discharge head, prepare the shaft as described in Step 1.g below, then lower the head shaft through the motor with the keyway end up. Install the adjusting nut and thread it on 4 or 5 threads, then allow the shaft to suspend inside the motor.

1.f Hoist motor sufficiently to clear the stand and swing it over until motor is resting on mounting ring. Properly place conduit box, align mounting holes and install, but do not tighten cap screws.

1.g Clean the head shaft thoroughly and dress the threads and keyway with a 3-cornered file, if necessary. Lift the head shaft and carefully lower it through the quill or hollow shaft (end with keyway goes toward the top) and allow shaft to contact head coupling. Remove the rag in the coupling. Screw the head shaft into the motor coupling on the head shaft and tighten.

1.h Make temporary electrical connection to motor, **bump** starter to determine correct rotation (counter clockwise as viewed from above). Install and tighten cap screws to the motor and discharge head/motor stand. **If power is not available, DO NOT make final drive shaft connections (Steps 1.i and 1.j) until power is available and correct rotation is determined.**

1.i Slide clutch over head shaft, seat against drive plate, install and tighten bolts.

1.j **IMPELLER ADJUSTMENTS:** Turn clutch until keyways in shaft and clutch align; install and seat gib key. Thread head adjusting nut onto head shaft until it seats against top of the clutch. Hold the clutch to keep from turning and turn head nut until the impellers clear the bottom allowing the rotor to turn freely. Continue to tighten head nut until impellers are elevated a sufficient distance (about 1½ turns) to accommodate pump hydraulic thrust and associated shaft stretch. Align holes in head nut with taps in clutch, install and tighten machine screws. Place top cover on driver and secure.

2. Solid Shaft Motor

2.a Slide the pump hub of the adjustable motor coupling onto the head shaft and insert the key. Screw the adjuster nut onto the head shaft.

2.b Attach the erector sling to the motor lifting lugs. Hoist motor sufficiently to allow easy access to mounting flange. Remove nicks and burrs on the mounting flange with a fine flat file and thoroughly clean with solvent.

2.c While the motor is suspended from the erector sling, slide the motor hub of the adjustable motor coupling onto the motor shaft. Insert the key into the keyway of the motor hub far enough up the motor shaft to expose the keeper key seat on the shaft. Seat the keeper key onto the motor shaft. Pull the motor hub down over the keeper key.

2.d Bolt the spacer to the motor hub, if applicable.

2.e Hoist motor sufficiently to clear the stand and lower it until the motor is resting on the discharge head. Properly place the conduit box, align mounting holes and install cap screws.

2.f **IMPELLER ADJUSTMENT:** Adjust the adjuster nut until the clearance between the spacer/adjuster nut and the motor hub is equal to the impeller adjustment as stated in Section A5.6, 1.j. Add additional clearance to the above adjustments to accommodate pump hydraulic thrust and the associated shaft stretch.

2.g Make temporary electrical connections to motor, **bump** starter to determine correct rotation (counter clockwise when viewed from above). **If power is not available, DO NOT make final drive shaft connections (Step 2.h) until power is available and correct rotation is determined.**

2.h Align holes and taps of the motor hub, pump hub, adjuster nut, and spacer (if applicable). Install and tighten cap screws.

A5.7: MISCELLANEOUS ASSEMBLIES

1. Discharge Piping

1.a Above and below floor piping should be installed in such a manner as to eliminate the possibility of the discharge head being strained. Gate valves, check valves, and other piping items must not depend upon the pump head for support.

1.b If a flexible joint, such as a dresser coupling, is to be used, the tie bolts and lugs used to span the flexible joint should be of sufficient strength to resist the force created by the discharge pressure at the pump head. None of this force should be imposed on the head or the foundation bolts. The tension should be taken carefully on these tie bolts so that any amount of forward movement induced to the head will be counteracted during operation so that alignment is maintained **throughout the operation.**

2. Air Release Valve

Install the air release valve on the pump head or just beyond on the discharge piping. It is suggested that if a throttling valve is not furnished, a throttling device be used to restrict the discharge of air to insure that a cushion of air is available in the discharge head. Placement of the throttling device should be such that the air release valve is between the discharge head and throttling valve. **Note: Exhausting the air from a head too quickly often causes breakage.**

3. Gauges and Miscellaneous Pipe Connections

PRESSURE	"L" PORT	"U" PORT
0-100 PSI	Grease	Grease
100-300 PSI	Grease	Grease
300-450 PSI	Bypass	Grease

3.a Connect the pressure gauge to the tap in the discharge and, if required, in the suction flange. Position dial face to facilitate reading.
3.b Make drain pipe connections. Route piping so that it will not interfere with normal maintenance procedures.
3.c If packing gland bypass line is to be installed use the following chart to determine correct configuration.

4. Electrical Connections

4.a All connections to the motor such as main leads, space heater leads, winding protection leads, etc., should be made in accordance with prevailing specifications.
4.b Motor wiring can be identified by the following designations:
H – Space Heaters
P – Thermostats
T – Main leads (connect per nameplate and voltage required) on motor.

B: STORAGE

B1: CONSIDERATIONS

When a pump is made for use in a sump or a can, it is usually a short coupled or close coupled pump assembly. Short coupled pump assemblies are usually shipped assembled but with the driver separate. Storage for such a pump is an easy matter. See Section B3 below.

Pumps used for deep sump or well applications on the other hand, tend to be deep setting pumps. These are shipped unassembled. The unassembled pieces are generally the driver, the discharge or motor stand, column pipe, tube and shaft assemblies, and the bowl assembly. The following is a general list of storage suggestions.

B2: GENERAL HINTS

As stated in Section A1 INSTALLATION of this manual, it is a very good idea to make sure all of the necessary items ordered are received without damage.

1 After uncrating/unpackaging and checking that all items were received in good order, recrate and package all items in the same manner that they were received. Clearly label each package as to the contents and use in the assembly.
2. If more than one size and/or model of pump is ordered, take special care not to confuse like items, such as valves, gauge, bolts and hardware, or spare parts, for the two or more pumps.
3. Group parts according to their stage of assembly. Example: bowls first, column and shafting second, discharge third, and so on. This will save searching for the proper parts and hardware at any given point during assembly.

B3: SHORT COUPLED PUMPS

1. Cover suction and discharge ports to prevent entrance of any foreign materials.

WARNING: If unit is equipped with VFD (Variable Frequency Drive), consult the factory for minimum and critical pump speeds before start-up.

2. Cover all other miscellaneous holes, i.e. pressure relief, prelube and pressure gauge holes, etc.
3. Avoid exposure to weather and elements: either store indoors or cover with a tarp.
4. Use a support framework so that no side pressure is exerted on the pump when placed in storage.

C: ELECTRICAL

D: OPERATION

D1: PRIOR TO START-UP

1. Perform initial servicing on the driver as recommended by the driver manufacturer. Also perform initial servicing on all auxiliary assemblies if required.
2. Recheck all fasteners and fittings for tightness.
3. If the air release is manual or if air vent is automatic but equipped with a valve, make certain the valve is opened **partially** but not all of the way.
4. If there is a control valve on the discharge side of the pump, make certain it is partially open so that the pump will not be damaged if normal back pressure is not available until the line is filled.
9. **Bump** starter to insure that the unit has correct rotation.

D2: INITIAL START-UP

1. Energize starter. After pump has come up to the rated speed and all air has been exhausted, regulate control valve to achieve desired pressure.
2. If the air release is manual, close it off after air is exhausted. If air release is automatic, determine if the air was exhausted too quickly (which causes the pump to jerk violently when the valve is closed) or too slowly and regulate manual valve or throttling device to correct this.
3. Check all joints for leakage and correct if evident.
4. Make certain the driver is operating satisfactorily as to temperature, bearing temperature, etc., as prescribed by the driver manufacturer.
5. Check for excessive vibration. If this is evident, shut down unit immediately and begin checking for the cause.
6. If pump is equipped with packing, adjust the packing gland (see Sections G4.h and G4.i) to allow some leakage past the packing.

D3: ROUTINE/NORMAL

1. Start the pump in accordance with the starting equipment used.
2. Driver lubricants should be checked following the instructions in the Motor O & M manual attached.
3. The packing gland should be checked for proper leakage.

D4: SHUTDOWN/EMERGENCY

1. Shutdown in accordance with the starting equipment used. Refer to Section H (Trouble Shooting) for further instructions.

E: FIELD TESTS

When a field test of the pump's performance is required, make the following readings: Volume, Total Head and Horsepower Measurements, Rotating Speed and Liquid Temperature. Compare the results of the field test with performance curve for your pump.

All volume, total head and efficiency guarantees are based on a shop test when handling clear, cold, fresh water at a temperature not exceeding 85° F and under certain specified suction conditions.

(1) Volume (Capacity) Measurement – Measure the rate of flow from the pump discharge in gallons per minute. The volume measurement may be made using any one of the following pieces of equipment: A calibrated Venturi meter, a thin-plate calibrated orifice, a calibrated pilot tube, or an accurately measured reservoir.

(2) Total Head Measurement – The total pumping head consists of: distance from the water level in the sump (when pumping) to the center of the discharge pressure gauge, plus the discharge gauge reading, the friction loss through the column and head, and the velocity head at the discharge.

NOTE: Convert pressure gauge reading to feet of liquid by multiplying the reading times 2.31 times the specific gravity of liquid.

(3) Horsepower Measurement – Measure horsepower consumption of the pump by a direct reading of a wattmeter and applying the reading to the following formula:

Horsepower Formula:

$$BHP = (KW\ Input \times Eff)^{0.746}$$

Pump Efficiency Formula:

$$Pump\ Efficiency = (TDH \times GPM \times SG) / (3960 \times BHP)$$

Where:

BHP =	Brake Horsepower Delivered
KW Input =	Real Input Power (KW)
Eff =	Motor Efficiency
SG =	Specific Gravity of Liquid
TDH =	Total Dynamic Head
GPM =	Gallons per Minute

F: ENGINEERING

Customer:

TACO Model:

Lateral:

K Factor:

Impeller Type:

Impeller Adjutment:

Minimum Submergence:

G: MAINTENANCE

G1: GENERAL

1. For normal operation and maintenance of driver, follow the instructions of the driver manufacturer.
2. If the pump is oil lubricated, check the oil level in the lubricator and refill on a regular schedule.
3. If the unit requires pre-lubrication, make certain this process is started with ample time prior to pump start-up to insure that all bearings are properly wetted.
4. Apply grease to the packing box assembly at the rate of ¼ to ½ oz. for each 24 hours of operation. See Section G5 (PREVENTATIVE MAINTENANCE).
5. Bowl bearings are self lubricated by the liquid pumped. Lower suction bowl bearing is packed at the factory with no maintenance required in the field.
6. The packing box should seldom require adjustment but in the event that the leakage becomes excessive, see Section F4 for details. Remember that overtightening wears out the packing rings prematurely and causes scoring and damage to the top shaft. Always adjust the gland with the unit running.

G2: BEARING REPLACEMENT

1. Alloy bearings, such as bronze, can be readily pressed in with an arbor or screw press. If this is not available, they can be driven in very carefully with a block of wood and a hammer. Make certain that bearing projections are maintained.
2. Graphite and composition bearings do not possess great tensile or compressive strength and cannot be driven in as alloy bearings can. They must be pressed in with a slow, continuous and even motion attained with an arbor or screw press with a mandrel to fit the bearing properly. The hub bore and the bearing should be lubricated with water to aid the pressing operation. **DO NOT LUBRICATE WITH OIL OR GREASE.**

G3: WEAR RING (optional) REPLACEMENT

1. Wear rings can be removed by cutting the cross section with a chisel and prying one end inward until it is loose in the bore. To install, make a mandrel to fit the wear rings and press in with an arbor or screw press. In an emergency, the wear rings can be installed by gently and evenly tapping around the top edge with a wood block and a hammer or a rubber mallet.
2. If impeller skirts are equipped with wear rings, cut the wear ring cross section with a chisel and force off. Heat on the ring will assist in the removal and installation. To install, make a mandrel to fit the O.D. of the wear rings and press flush with the bottom of the impeller skirts. If necessary, gently and evenly tap around the top edge with a wood block and a hammer or with a rubber mallet.

G4: PACKING REPLACEMENT

1. When the packing has been compressed to the point that the gland is about to contact the upper face of the packing box, remove the gland, add one extra packing ring and re-adjust. If this fails to reduce the leakage, remove all of the packing rings and repack with new rings.
2. These are the step-by-step procedures in repacking a packing box in the pump:

   a. Clean out the old packing. This includes the packing below the lantern ring. Often the old packing below the lantern ring is not replaced when repacking the gland as it should be. Flexible packing hooks are available for removing the packing.
   b. Check the shaft for nicks and score marks; remove any that are present; then clean carefully. Clean up the bore of the box. Check the lantern ring to make sure the channels and holes are not plugged up.
   c. If the replacement packing is in the form of a continuous coil or rope, it must be cut into rings before installing. After cutting on the mark, the first length of packing may be used as a template for cutting all the other rings. Begin by installing the first ring. It is recommended that grease or oil be smeared on at least the outer diameter of the ring.
   d. With the aid of a split bushing, push the packing to the bottom of the box. The O.D. of this split bushing should be approximately .005 inch smaller than the bore of the packing box to prevent the formation of a lip on the packing that is being seated. Seat this bottom ring hard because it must seal on the face of the packing box bearing as well as against the shaft and the bore. See Figure G4.d.
   e. Repeat this operation with each ring making sure to stagger the gaps formed by the ends of the ring at 90 degree intervals. See Figure G4.e.
   f. If a lantern ring is used, be sure it is properly positioned so it is centered with the drilling in the packing box. See Figure G4.f.
   g. Position the packing gland. Tighten it down evenly. The packing gland must not be cocked within the packing box. An unsquare packing gland causes uneven compression of the packing rings and, more importantly, damage to the shaft. Good practice is to allow at least ¼ inch from the top

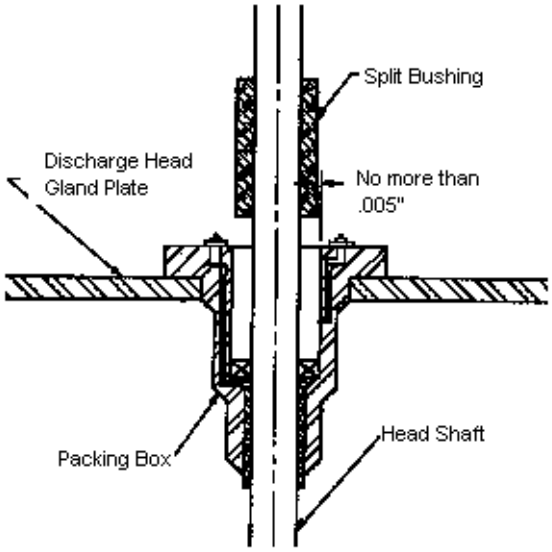

Figure G4.d

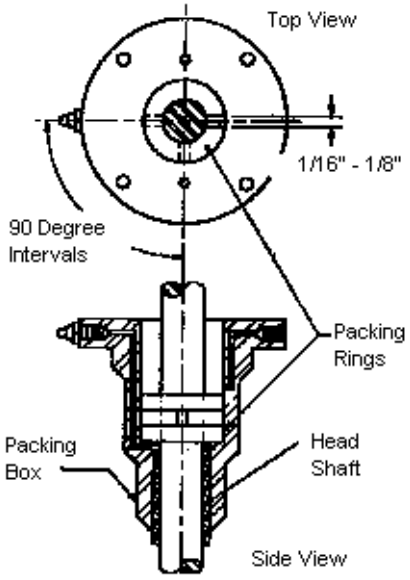

Figure G4.e

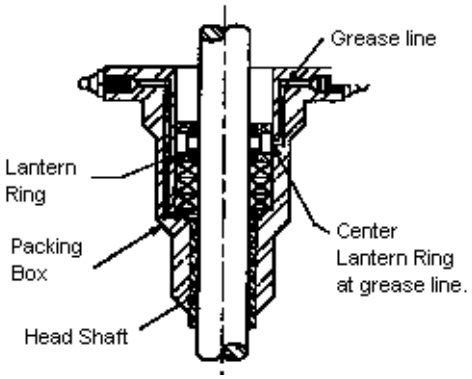

Figure G4.f

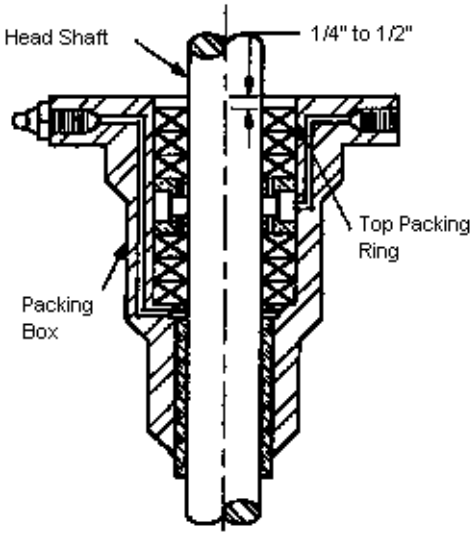

Figure G4.g

of the top packing ring to the top face of the packing box. This helps center the gland and minimizes cocking. See Figure G4.g.

h. Permit sufficient leakage to keep the packing box running cool. Adequate leakage at this time is a necessity. Check the temperature of the leakage as well as the pump housing. If the pump runs hot and the leakage begins to choke off, stop the pump and let it cool down. Steps d through h must be repeated when the packing is adjusted.
i. Allow the pump to run 15 minutes and if leakage rate is more than desirable, tighten the gland nuts ⅛ of a turn. This packing adjustment is made with the pump running. Before making another adjustment, allow the packing to equalize against the increased pressure and the leakage to gradually decrease to a steady rate. **PUMP PACKING MUST ALWAYS LEAK SLIGHTLY.**

Note:

1. Chances are the packing will run a little warmer for the first few days until the packing rings have burnished in. Often the leakage rate will reduce by itself at this time.
2. Remember that the packing leakage may be warmer than the fluid being pumped It doesn't mean that the packing is being damaged.

G5: PREVENTIVE MAINTENANCE

Proper preventive maintenance consists of maintaining records of operation hours, operating data, gauge readings, and service performed on the pump. Using this information in conjunction with the suggested preventive maintenance schedule below will reduce downtime and prevent costly breakdowns.

PREVENTIVE MAINTENANCE INTERNAL INSPECTION CHART

FREQUENCY OF INSPECTION	COMPONENT	INSPECTION AND MAINTENANCE
Weekly	Driver Motor	Clean oil, dust, water and chemicals from the exterior of motor. Make sure motor air intake and outlets (fan cooled motor) are unobstructed.
Monthly	Driver Motor	Check motor bearing temperature with temperature indicator (not your hand). If bearings are running hot, consult motor manufacturer's instructions.
	Packing Gland	Grease with modest amount of packing lubricant.
Every 3 Months (2000 operating hours)	Packing Gland	Inspect packing and replace if necessary.
	Top Shaft	Check the shaft. Scoring accelerates wear on packing. Repair or replace top shaft if scoring is evident.
Semi-annually (4000 operating hours)	Pump	Check operating vibration of the pump and compare to vibration check taken during initial inspection. If vibration has changed, shut down pump and inspect bowl assembly for damage or clogging.
	Pump Foundation	Check foundation for settling. It may cause misalignment of pump and strain on discharge and suction piping. Correct for any change in foundation.
	Pump Performance	Check discharge and suction pressure readings against initial field test and correct by adjusting impellers if performance has dropped in excess of 10%.
Annually	Packing Gland	Remove by-pass piping from packing gland and check for scaling and deposits that restrict flow. Replace piping.
	Pump Efficiency	Measure total dynamic head and flow. Take power readings. Compare with initial record of pump efficiency. If efficiency has decreased more than 5%, re-adjust impellers. If performance does not improve, replace impeller or wear ring as required.
	Suction Bowl Bearing	Repack suction bell bearing if pump is short coupled or booster can type and supplied with grease line to suction bearing. **Caution:** Use **non-soluble** grease. **DO NOT** overgrease, which can push shafting up and alter impeller setting.

H: TROUBLE SHOOTING

H1: TROUBLE SHOOTING

INSUFFICIENT PRESSURE

1. Speed too slow (check voltage)
2. Impeller trimmed incorrectly
3. Impeller loose
4. Impeller plugged
5. Wear rings worn
6. Entrained air in pump
7. Leaking joints or bowl casings
8. Wrong rotation
9. Incorrect impeller adjustment

NO LIQUID DELIVERED

1. Pump suction broken (water level below inlet)
2. Suction valve closed
3. Impeller plugged
4. Strainer clogged
5. Wrong rotation
6. Shaft broken or unscrewed
7. Impeller loose
8. Barrel or discharge not vented
9. Driver inoperative

VIBRATION

1. Motor imbalance (electrical)
2. Motor bearing is not properly seated or is worn
3. Motor drive coupling out of balance or alignment
4. Misalignment of pump, casing, discharge head, column, and/or bowls
5. Discharge head misaligned by improper mounting or pipe strain
6. Bent shafting
7. Worn pump bearings
8. Clogged impeller or foreign material in pump
9. Improper impeller adjustment
10. Vortex problems in sump
11. Resonance (system frequency at or near pump speed)
12. Cavitation
13. Impeller out of balance

INSUFFICIENT CAPACITY

1. Speed too slow
2. Impeller trimmed incorrectly
3. Impeller loose
4. Impeller or bowl partially plugged
5. Leaking joints
6. Strainer or suction pipe clogged
7. Suction valve throttled
8. Low water level
9. Wrong rotation
10. Insufficient submergence
11. Insufficient N.P.S.H.
12. Incorrect impeller adjustment
13. Worn pump
14. Pressure higher than design

USING TOO MUCH POWER

1. Speed too high
2. Improper impeller adjustment
3. Improper impeller trim
4. Pump out of alignment
5. Coupling out of alignment
6. Pumping foreign material
7. Lubrication oil too heavy
8. Bent shaft
9. Tight bearing or packing
10. Specific gravity or viscosity of fluid higher than design
11. Worn pump
12. Damaged pump
13. Partial freezing of pump liquid

ABNORMAL NOISE

1. Motor noise
2. Pump bearing running dry
3. Broken column bearing retainers
4. Broken shaft or oil tubing
5. Impeller dragging on bowl case
6. Cavitation, due to insufficient N.P.S.H.A. and/or submergence
7. Foreign material in pump
8. Excessive fluid velocity in pipe system

H2: IMPELLERS

TROUBLE SOURCE	PROBABLE CAUSE	REMEDY
Wear on exit vanes and shrouds	Abrasive action	Replace impeller if excessive. Consider coating or upgrading material.
Pitting on entrance vanes of impellers	Cavitation	Correct condition or upgrade material to extend life.
Pitting on impellers and bowl castings	Corrosion/Erosion	Investigate cost of different materials vs. frequency of replacements.
Wear on impeller skirts and/or bowl seal ring area	1. Abrasive action or excess wear impeller skirts to function as bearing journal 2. Impeller set too high	1. Install new bearings and wear rings. Upgrade material if abrasive action. 2. Re-ring and adjust impellers correctly.
Impeller loose on shaft (extremely rare occurrence)	1. Repeated shock load by surge in suction or discharge line (can loosen first or last stage impellers) 2. Foreign material jamming impeller (may break shaft or trim over loads before impeller becomes too loose) 3. Differential expansion due to temperature 4. Parts improperly machined and/or assembled 5. Torsion loading on submersible pumps	1. Re-fit impellers. If collet mounted, consider changing to key mounting. 2. Remove cause of jamming. 3. If collet mounted, consider change to key mounted. Avoid sudden thermal shock. 4. Correct parts if necessary and refit. 5. Add keyway to collet mounting.

H3: BEARINGS

TROUBLE SOURCE	PROBABLE CAUSE	REMEDY
Bearing seized or galling on shaft	Running dry without lubrication	Check lubrication, look for plugged suction or evidence of flashing.
Bearing failure or bearing seized	High temperature failure	Check pump manufacturer for bearing temperature limits
Excessive shaft wear under rubber	Rubber bearings will swell in hydrocarbon, H.S., and high temperature	Change bearing material
Premature bearing wear	Abrasive action	Consider conversion to water flushing on all bearings, pressure grease or oil lubrication.
Uneven wear on bearings, uniform wear on shaft	Pump's non-rotating parts misaligned	Check mounting and discharge pipe connection, dirt between column joints. Correct misalignment, replace bearings and repair or replace shaft.
Uniform wear on bearings and shaft	Abrasive action	Replace parts. Consider changing materials or means of lubrication.
Uniform wear on bearings, uneven wear on shaft	1. Shaft run-out caused by bent shafts, shafts not butted on couplings, dirt or grease between the shafts 2. Shaft ends not properly faced	1. Straighten shaft or replace, clean and assemble correctly. 2. Face parallel and concentric.

H4: SHAFT AND COUPLING

TROUBLE SOURCE	PROBABLE CAUSE	REMEDY
Bent shaft	Mishandling in transit or assembly	Check straightness. Correct to .005"/ft total run-out or replace.
Shaft coupling elongated (neck down)	1. Motor is started while pump running in reverse 2. Corrosion 3. Pipe wrench fatigue on reused couplings 4. Power being applied to shafts that are not butted in coupling	Look for faulty check valve. Could also be momentary power failure or improper starting timers.
Shaft coupling unscrewed	Pump started in reverse rotation	Shafts may be bent. Check shafts and couplings. Correct rotation.
Broken shaft or coupling	1. Can be caused by same reasons listed for coupling elongation 2. Can also be caused by bearings seized due to lack of lubrication 3. Foreign material blocking impellers or galling wear rings 4. Metal fatigue due to vibrations 5. Improper impeller adjustment or continuous up-thrust conditions causing impeller drag	1. Same as above 2. Same as above for bearing seizure 3. Add strainers or screens. 4. Check alignment of the pump components to eliminate vibration. 5. See Section F (Engineering) for correction.

H5: BOWLS

TROUBLE SOURCE	PROBABLE CAUSE	REMEDY
Wear on bowl vanes	Abrasive action	Coat bowls. Upgrade material or rubber line.

H6: PACKING BOX

TROUBLE SOURCE	PROBABLE CAUSE	REMEDY
Excessive leakage	1. Improper packing 2. Incorrect type or defective packing 3. Worn shaft or sleeve	1. Repack correctly. 2. Repack with the correct grade for service. 3. Remachine or replace scored parts.
Packing box overheated	1. Improper packing procedure 2. Packing too tight 3. Insufficient lubrication 4. Incorrect type of packing	1. Repack correctly. 2. Repack with the correct grade for service. 3. Remachine or replace scored parts.
Packing wears prematurely	1. Improper packing 2. Insufficient lubrication 3. Shaft or sleeve scored 4. Incorrect type of packing	1. Remove cause. 2. Replace worn parts. 3. Remachine or replace

I: ORDERING PARTS

Please contact your TACO representative with the serial number of the pump for more information. The serial number of the pump can be found on the pump information tag.

NOTES

NOTES

Limited Warranty

Commercial Pump Warranty Terms

(Models FI, CI, FE, CE, KV, KS, TA)

Taco, Inc. will repair or replace without charge (at the Company's option) any commercial pump product or part which is proven 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 or 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.

Taco, Incorporated offers this warranty in lieu of all other express or implied warranties. No warranties are made for merchantability or fitness for use and there are no warranties which extend beyond the description contained herein. Taco, Inc. will not be liable for any special, incidental, or consequential damages.

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