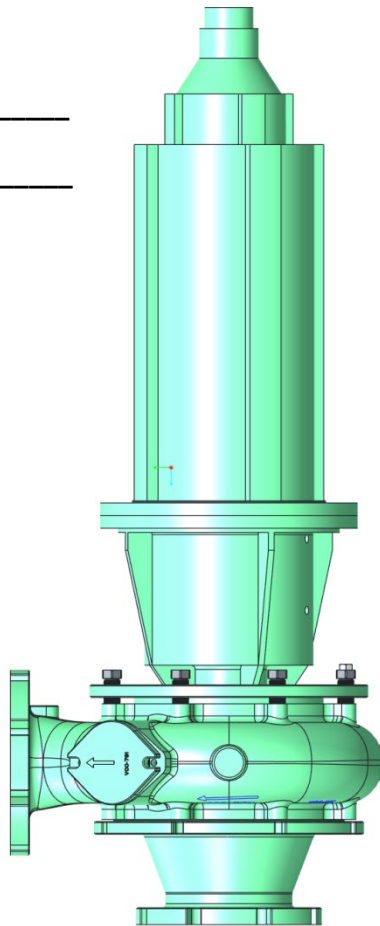




**BEARING HOUSING STYLE
SUBMERSIBLE TRITON SCREW PUMP
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL**

Pump Model _____

Serial Number _____



VAUGHAN CO., INC.

364 Monte Elma Road, Montesano, WA 98563
Phone: 1-360-249-4042 / Fax: 1-360-249-6155
Toll Free Phone (US only): 1-888-249-CHOP (2467)
Web Site: www.chopperpumps.com
E-mail: info@chopperpumps.com



**BEARING HOUSING STYLE SUBMERSIBLE SCREW PUMP
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL
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SECTION 1: IMPORTANT SAFETY INFORMATION

IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

This equipment is intended for installation by technically qualified personnel. Failure to install it in compliance with national and local electrical codes, building codes and within Vaughan Co. recommendations may result in electrical shock, personal injury or death, fire hazard, unsatisfactory performance, and equipment failure. If further assistance is required contact your local representative or Vaughan Co. *Keep this manual in a safe location for future reference.*

⚠ DANGER Indicates a hazard, which, if not avoided, will result in death or serious injury.

⚠ WARNING Indicates a hazard, which, if not avoided, could result in death or serious injury.

⚠ CAUTION Indicates a hazard, which, if not avoided, may result in minor or moderate injury or damage to the equipment.

NOTICE Indicates special operation or maintenance information.

- Isolate the pump hydraulically and electrically before servicing or inspecting pump. Lock out both power source and isolation valves.
- This pump may handle dangerous or contaminated fluids. There are sharp corners, edges and pinch areas which can cause serious injury. Be careful; wear protective gloves whenever possible. If you cut yourself, seek medical help immediately to avoid serious infection.
- This pump may start automatically if wired to float switches or other equipment. Before inspecting or making adjustments disconnect electrical power and lock out circuit breakers to pump motor and associated equipment. Duplex pumps with alternating relays must both be locked out; otherwise the pump you are working on may not be isolated and could start as “the alternate”. Visually confirm that the pump has come to a complete stop before proceeding.
- Motors may be equipped with built-in thermal overloads to shut off the motors in the event the temperature gets too high (as a result of low voltage, poor ventilation, overloaded lines, etc.) These motors can restart automatically as the motor cools down. DO NOT work on the pump or motor without first disconnecting and locking out the power supply.
- Enter tanks or pits with extreme caution and only after an instrument check of the pit/tank has been completed to verify the absence of dangerous gases and the presence of safe levels of oxygen. Never enter a tank or pit without a safety harness and lifeline, and an air pack. Never enter the pit without rescue personnel standing by. Follow all national and local requirements for confined space entry.
- Keep all pit openings covered when not in use. In addition to the injuries from falling, pits may contain poisonous gases or liquids.
- Lift pump and motor by pump lifting bail only. Lifting by any other parts of this equipment is dangerous and may damage equipment. Inspect the lifting bail to be sure it is not damaged. Replace immediately if the bail is weakened in any way.
- Do not allow people under the pump assembly while it is being lifted.
- Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes should be worn at all times.
- Do not allow liquid to be trapped in pump or piping between two closed valves. Always drain or vent the piping/pump between two closed valves. Failure to vent or drain could allow dangerous pressures to build causing rupture damage resulting in injury, death, and equipment damage.

- Never operate a pump with closed or blocked discharge valves. This will destroy the pump and could be dangerous to personnel.
- Safety apparel to be worn when working on or making adjustments to pumps should include:
 - Heavy work gloves when handling parts with sharp edges, especially impellers.
 - Safety glasses (with side shields) for eye protection
 - Steel-toed shoes for foot protection when handling parts, heavy tools, etc.
 - Other personal protective equipment to protect against hazardous/toxic fluids and gases.
- Do not operate this equipment unless safety guards or devices are in place and properly adjusted.
- Let the pump cool to ambient temperature before beginning work on it. A warm pump can contain compartments of pressurized fluid, which may vent violently during disassembly.
- Never apply heat to remove parts unless specifically directed to do so in overhaul instructions. Use of heat may cause an explosion due to trapped fluid, resulting in severe physical injury and property damage.
- Pressure may build up in the standard mechanical seals used in Vaughan pumps. Whenever checking or maintaining the oil in the Vaughan Cartridge Seal, or the metal bellows seal with seal oil chamber, make sure the pump and seal are cool to the touch. Use care when removing the oil chamber plugs and pressure relief valve, in case any residual pressure exists. If pressure exists, the plug could become a projectile and/or contaminated oil could spray.
- As it is possible to run Vaughan Chopper and Screw pumps dry, for quality assurance or troubleshooting reasons, it is extremely important to ensure suction and discharge connections are always properly guarded to prevent anything (i.e. foreign objects or pump parts) from being thrown from the pump as a projectile. All pumps must be run with suction and discharge piping in place, or blind flanges installed on suction and discharge connections. Blind flanges should be vented to avoid pressure build-up. Note that cast rotating parts could break if metal to metal contact occurs while the pump is running dry.
- Shut pump off when adjusting fittings to avoid being sprayed with pumpage. Pumped materials may be hot, corrosive, poisonous, infectious, or otherwise dangerous to personnel.
- Pump motors are connected to high voltage. Allow only qualified electricians to service this electrical equipment only in accordance with the latest revision of the National Electrical Code and other applicable requirements.
- Make certain all personnel are clear of equipment before operating.
- This equipment may not meet explosion proof requirements for hazardous environments unless specifically ordered for this purpose. Introducing non-explosion proof equipment into a hazardous environment as defined by the National Electrical Code can cause a dangerous explosion.
- This pump uses oil which, if spilled, can cause a slipping hazard and danger to personnel.
- Keep hands, feet and clothing away from moving machinery.
- Never clean, oil, adjust, or repair machinery while in motion.
- Keep electrical control panel area clear to avoid to avoid hazard to personnel. If a person should trip and fall into an open panel enclosure, serious electrical burns can result.
- Keep electrical control panel doors closed except to make adjustments or repairs by a qualified electrician.
- Overheated pumps can cause severe burns and injury. If overheating of pump casing occurs:
 - Shut down pump immediately.
 - Wait for pump to cool to air temperature.
 - Slowly and cautiously vent pump at drain plug.
 - Trouble shoot cause of overheating.

If there are any questions regarding the safe and proper methods for operating or servicing this pump, please contact Vaughan Company for assistance.

SECTION 2: DESCRIPTION OF VAUGHAN SUBMERSIBLE SCREW PUMP

The Vaughan submersible Triton screw pump is specifically designed for pumping whole solids. The pump is typically supplied with a guide rail bracket to mount the pump base elbow, and an automatic oil level monitor (for pump shutdown in case of seal failure). Replacement pumps or portable pumps may not have all of these components. Float switches and recirculation valves are also available.

DESCRIPTION OF MAJOR COMPONENTS

Note: Please use the submersible screw pump exploded assembly parts list as an aid in understanding this section.

SCREW-CENTRIFUGAL IMPELLER

The impeller on the Vaughan Triton pump induces flow by propelling liquid material through the pump inlet cone and into the casing. The pumping action is a combination of positive displacement and centrifugal action. The OD of the impeller must be positioned to closely clear the ID of the inlet cone at the pump suction to achieve good pumping efficiency. The standard impeller is made of cast iron. Chrome-iron, 316SS, and CD4MCu stainless steel materials are also available.

SUCTION CONE

The suction cone serves the function of a “wear plate ring”, sealing in the pressure at the intake of the pump. The pressure generated by the impeller is kept inside the pump by the close clearances between this suction cone and the impeller. The inlet cone includes a cast-in spiral groove to channel fiber out of the cone and into the pump casing. This spiral groove stops binding from overloading the drive motor. The standard inlet suction cone is made of ductile cast iron. Other available materials are chrome iron, 316SS, and CD4MCu stainless steel.

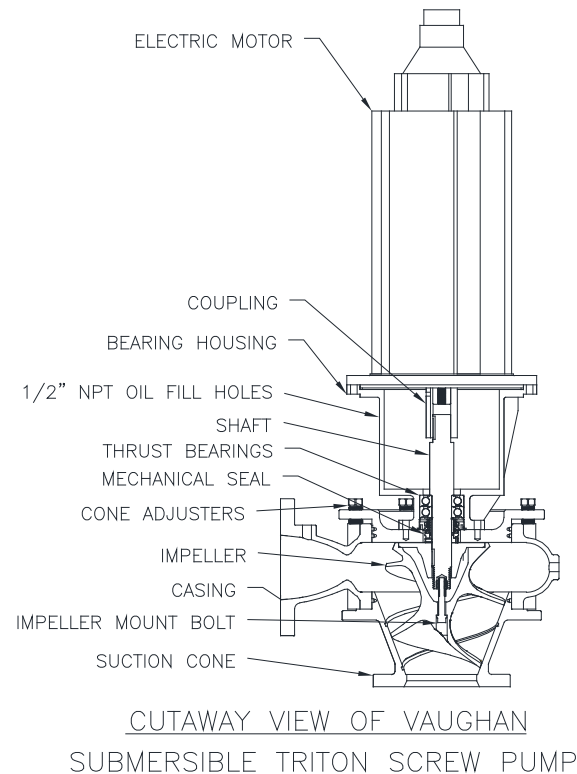
BACK CUTTER

The patented back cutter system consists of two opposing hardened steel insert cutters. One of the insert cutters is stationary and located on the back plate of the pump, while the other insert cutter is located in the rotating impeller hub. This feature is designed to minimize ragging between the impeller hub and backplate.

BEARING HOUSING AND TRIPLE MECHANICAL SEAL DESIGN

Vaughan submersible screw pumps are quite different from other types of submersible pumps because they use a bearing housing complete with thrust bearings, and a mechanical seal located below the Baldor submersible motor. The added bearing housing, bearings and seal provide added strength and rigidity. The Baldor motor uses 2 John Crane type 21 single spring mechanical seals with carbon and ceramic faces. For ultimate protection, Vaughan adds a third mechanical seal, a high quality unit equipped with silicon carbide or tungsten carbide faces. This seal isolates and protects not only the Baldor submersible motor above it, but also the oil-bath ball bearing system in the bearing housing. The seal is located immediately above the pump impeller on the pump shaft. The best indication of any problems with the mechanical seal system is a loss of oil from the clear oil reservoir.

Figure 1



AUTO OIL MONITOR SYSTEM

Vaughan Co. uses an automatic oil monitor system to monitor oil level in the clear reservoir located above pit level and to give immediate indication of a problem if oil level drops. Oil is monitored by a reed switch float in this clear reservoir. Connection to this oil switch is through a watertight Woodhead connector at the top of the reservoir. Since the oil switch has only a 30 watt capacity, shutdown of pump motor (i.e., interruption of motor starter operation) is accomplished with a standard 110 volt control relay and base, which Vaughan supplies with the pump. If the pump is to be located in a hazardous environment an intrinsically safe relay can be supplied. This relay eliminates any chance of having a spark in the reed switch. An example of motor controls system for the auto oil monitor system with a standard relay is shown in Figure 4 on page 10 of this manual.

GUIDERAIL SYSTEM

Vaughan submersible Triton pumps can be supplied with a simple stand or with a guiderail system. The guiderail system allows the pump to be withdrawn from the pit without the need for anyone to enter the pit. When mounted on the guiderail elbow or spool the pump is supported completely by the pump discharge flange and adapter bracket. If the pump is to be mounted in a hazardous environment, a non-sparking aluminum bronze adapter bracket for the pump will be supplied.

SECTION 3: PROPER APPLICATIONS FOR VAUGHAN TRITON PUMPS

Vaughan Triton Pumps are used for pumping liquid slurries or water contaminated with debris. These pumps are also useful for pumping shear-sensitive slurries which must be handled gently by the pump. The benefit of screw-centrifugal pumps is that debris laden slurries, contaminated water, or shear-sensitive slurries may be pumped with less power than with other types of non-clog pumps. Vaughan Triton pumps are routinely used to pump the following slurries:

1. Flume and wash water in food processing plants.
2. Sewage and sewage sludges.
3. Vegetable waste.
4. Mill scale.
5. Oil sludges in oil refineries.
6. Plastic debris.
7. Coal slurry.

System design is very important in making any pump work successfully in debris-laden slurries. There must be enough liquid so that liquid and material are able to flow freely to the pump. The piping must be properly designed to be large enough to reduce friction losses, yet small enough to ensure sufficient velocity to keep particles suspended

USES OF VAUGHAN PUMPS THAT MAY CAUSE TROUBLE

If the system is not designed correctly for proper handling of your material, or if the pump is incorrectly chosen for your system, the pump may not work to your satisfaction or the pump may experience early failures of seals, bearings, or wet-end components due to cavitation and the resulting vibration. Vibration will damage mechanical seals and bearings fairly quickly.

Common rules of thumb include:

1. Screw-centrifugal pumps must not ever be operated with closed suction and discharge valves. This will destroy the pump and may be dangerous to personnel.
2. A pump must be operated in the safe (solid line) portion of its pump performance curve. Operation in the dashed lines indicates vibration areas and must be avoided.
3. Operating a pump against a throttled discharge valve, or against higher than allowable head will damage the pump.
4. Never control flow by throttling a pump suction valve.

5. When pumping liquid containing debris that floats or settles in a pit, mixing with the pump may be required before pit pumpout. This can be done by initially directing the discharge back into the pit using a 3-way valve system available from Vaughan Co.
6. A slurry that is too hot cannot be pumped from an open pit. A reasonable limit at 1170 RPM is about 180° F, at 1750 RPM it's about 160° F.
7. A reliable and properly sized electrical supply must be installed for the pump to work properly. If there is too much voltage drop because of an undersized cable or transformer, the motor will not be able to provide full power to the pump and it may stall during operation.
8. Wet-well level control can be troublesome in solids handling applications. Some users simply allow the pump to run continuously, with the pump snoring a combination of air and liquid at low pit levels. This mode of operation can lead to seal and bearing failures and is not recommended. Vaughan Co. has available a low-current shut-off system that eliminates the need for a low-level float switch. Do not use a throttle valve to operate a pump at or near shutoff head at low pit levels, as this can lead to seal failures and broken shafts.

EXPECTED BENEFITS OF VAUGHAN TRITON SCREW PUMPS

Most customers who install a Vaughan pump see several advantages:

1. Minimal pump attention is required.
2. Excellent pumping efficiency, meaning that the same job can be done as with other pumps, but using less power.
3. Gentle pumping of shear sensitive slurries.
4. Long and reliable life of the Vaughan pump.

SECTION 4: INSTALLATION INSTRUCTIONS

A. RECEIPT INSPECTION

Prior to shipment Vaughan pumps are carefully crated and inspected to ensure arrival at your plant in good condition. On receiving your pump, examine it carefully to assure that no damaged or broken parts have resulted from mishandling during shipping. Look for signs that the pump has been dropped, such as missing paint, dented flanges, cracked housings, or leaking oil. Turn the pump shaft by hand and verify that it turns over smoothly. If the shaft binds, look for debris between impeller and suction cone. Otherwise, shaft binding could indicate damage. If damage has occurred, report to your carrier immediately, and consult your local Vaughan representative or call Vaughan Co. for advice.

B. STORAGE CONSIDERATIONS

If equipment is to be stored for longer than two weeks, take the following action:

1. Coat exposed steel with a light layer of grease or protective spray-on lubricant to protect the equipment from corrosion.
2. Rotate the pump shaft 1-1/4 turn once each week to keep the bearings from sitting in one position for extended periods of time.
3. Avoid storing rotating equipment near other vibrating equipment. The vibrations can damage the bearings and result in premature failure once the equipment is started up.
4. Store rotating equipment in a clean, dry, heated area away from areas where it could be damaged from impact, smoke, dirt, vibration, corrosive fumes or liquids, or from condensation inside the motor or pump. It is helpful to cover equipment with plastic.
5. The bearing housing located below the submersible pump motor is about 85% oil-filled. (An air bubble needs to be kept in this housing to avoid ruining the seal from high pressure if outside temperature increases during shipping or storage.) These housings should be kept 85% filled with ISO Grade 46 hydraulic oil during storage to be sure the bearings are kept covered to avoid corrosion.

C. MOUNTING THE PUMP AND GUIDERAIL SYSTEM IN YOUR PIT

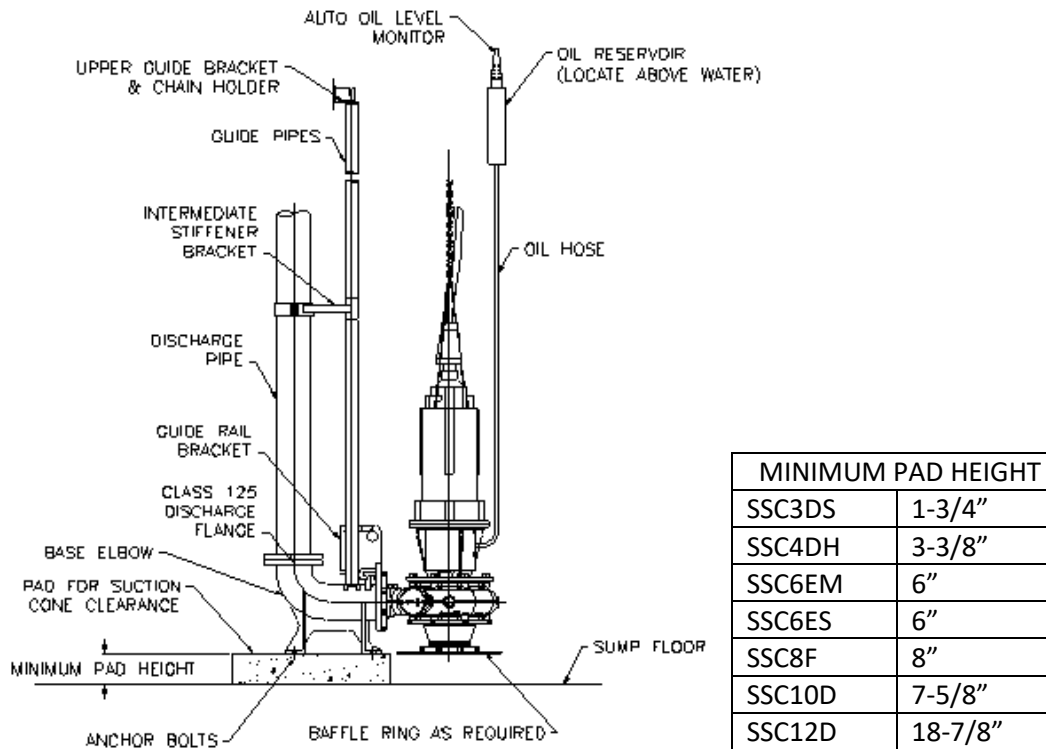
The Vaughan submersible pump is heavy and will require a crane to lift it into position over your pit. Lifting the pump by the bail installed on the motor is the only recommended method for lifting.

WARNING

Lifting provisions included with Vaughan submersible pumps are rated for overhead lifting; however, do not allow people under Vaughan equipment during hoisting operations. Lift pump and motor with an adequately sized hoist, crane, or forklift. Consult the Vaughan Co. shipping department for weight of your equipment if you are in doubt

If the pump is to be mounted on a guiderail system, the base elbow will have to be bolted to the mounting pad, and the guiderail upper bracket will have to be bolted either to your access cover frame or to some other structural member. The base elbow will need to be mounted on a pad to raise the suction cone high enough off the pit floor to prevent suction blockage of the pump. The chart in Figure 2 gives the minimum acceptable height of the pad for each model of pump. The pad must be anchored to the floor of the pit. The pump and elbow should be mounted at least 12" away from the nearest vertical wall in the pit. Vaughan Co. recommends the use of expansion type anchor bolts. Figure 3 provides size, quantity, and location of the anchor bolts required to mount the base elbow or spool.

Figure 2



NOTICE

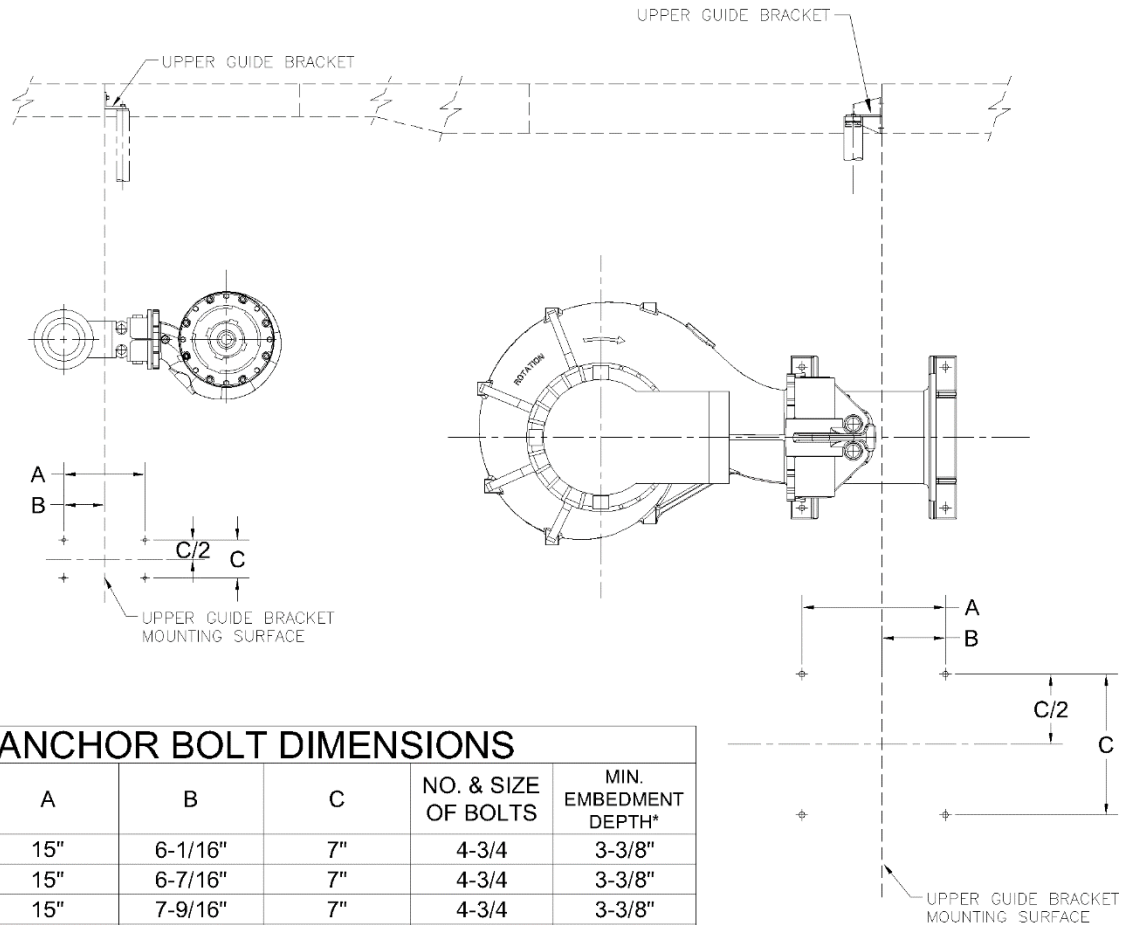
Before installing the pump on the guide rails, the lower bearing housing must be completely filled with oil and correct pump rotation verified.

VAUGHAN SUBMERSIBLE PUMP BASE ELBOW ANCHOR BOLT INFORMATION

Figure 3

3"–10" BASE ELBOWS

6"&12"–20" BASE SPOOLS



ANCHOR BOLT DIMENSIONS

BASE SIZE	A	B	C	NO. & SIZE OF BOLTS	MIN. EMBEDMENT DEPTH*
3" Elbow	15"	6-1/16"	7"	4-3/4	3-3/8"
4" Elbow	15"	6-7/16"	7"	4-3/4	3-3/8"
6" Elbow	15"	7-9/16"	7"	4-3/4	3-3/8"
6" Spool	11-13/16"	-1-5/8"	9-3/16"	4-3/4	3-3/8"
8" Elbow	11"	3-7/16"	9-1/2"	4-3/4	3-3/8"
10" Elbow	19-11/16"	12-3/16"	9-1/2"	4-3/4	3-3/8"
12" Spool	14-11/16"	2-9/16"	24-1/2"	4-1	4-1/2"
20" Spool	26"	11-3/16"	26"	4-1	4-1/2"

*MINIMUM EMBEDMENT DEPTH IS FOR SUP-R-STUD ANCHOR BOLTS IN 2000PSI OR GREATER STRENGTH CONCRETE

Figure 2 shows a typical installation of a submersible pump mounted in a pit. Note, that a baffle ring may be supplied with your pump to minimize vortexing at low water level. Normally the customer or the contractor will supply 2" Sch 40 galvanized or stainless steel pipe for the actual guiderails. All other components in the guiderail system are available from Vaughan. When lifting a submersible pump on the guiderail system, use caution to avoid binding of the guide rail bracket on the guiderails. Adjusting the angle on which the lifting cable pulls up on the lifting bail can relieve a great deal of the binding that might otherwise occur.

Vaughan submersible pumps use a metal-to-metal connection between pump and elbow flanges for minimum mating problems over the life of the equipment.

The exact details of your pump and guiderail system, (i.e., parts breakdown, outline dimensions, and weight) are available from Vaughan Co.

D. PIPING

As a general rule in piping layout, avoid frictional losses by minimizing fittings and abrupt changes in direction and by choosing piping size carefully. Remember, that when pumping sludges that this material has significantly higher friction losses than water; so larger diameter piping is often required. If you are going uphill or going into a force main, or if there is more than one pump pumping into a common header, a check valve and isolation valve will be required on the discharge of the pump. *It is strongly recommended that you provide a pressure tap in the valve box or in the piping just above or out of the pit so that you can measure the actual operating conditions of the pump during startup. Also, if you are ever required to do any troubleshooting, this fitting will be required.* For pumping suspended solids, maintain at least 3-5 fps velocity in horizontal runs, and 8-10 fps in vertical runs. Otherwise, material can settle and plug the discharge line, particularly at elbows. Check Hydraulic Institute Standards for proper piping installation practices.

NOTICE

Never use force to draw piping to pump flange. Excess forces on the pump will reduce seal and bearing life. Be sure all piping connections are tightened and properly supported before operation of the pump.

E. CONTROLS

If your installation is considered a hazardous location, be sure that an electrician experienced in hazardous environment wiring and controls is involved with your installation and that the control relay used for the Auto Oil Monitor System is an "intrinsically safe" relay. See the next section on the Auto Oil Monitor System Installation.

Vaughan Triton Pumps, require positive motor protection with correctly sized breakers, starters, and overload protection. Carefully, thought out overload protection for your expensive submersible motor is critical to avoid motor burnout.

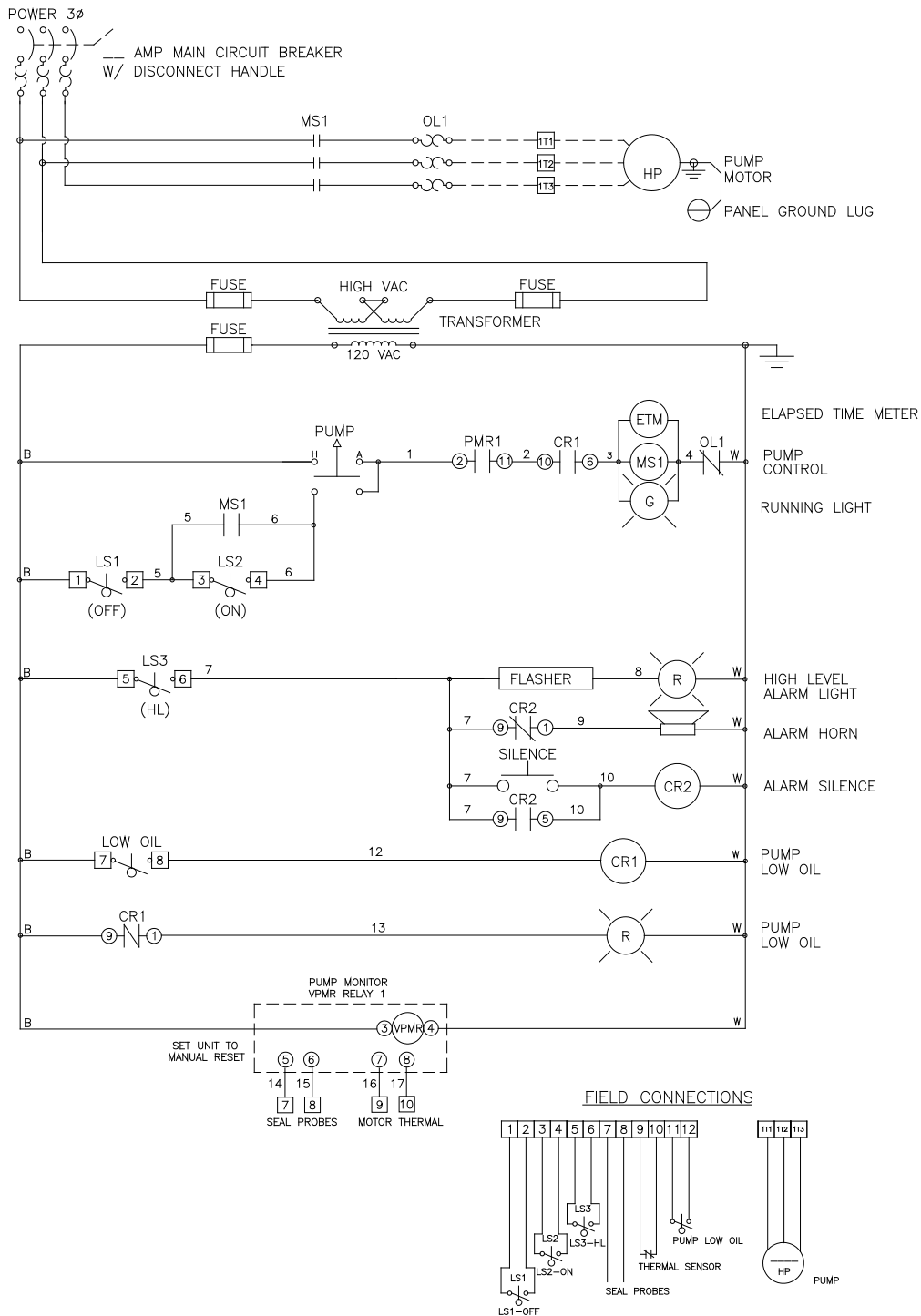
The Baldor submersible motors have two protective devices, the seal failure moisture probe and the normally closed thermostatic switches. Both of these devices must be incorporated into the controls along with the Vaughan auto oil level monitor. Failure to connect the motor protective devices will compromise your warranty. The controls schematics shown in Figure 4 show these items wired into the system. Also, please see the Baldor/Reliance Installation and Operating Manual for more details on these devices.

WARNING

Submersible motors used on these pumps meet explosion proof requirements for hazardous environments. However, the guiderail system or oil monitor system may not meet the requirements for installation in a hazardous environment unless specifically ordered for this purpose. Introducing equipment not rated for a hazardous environment as defined by the National Electrical Code can cause a dangerous explosion. Consult Vaughan Co. for help or advice.

Figure 4

SAMPLE SCHEMATICS FOR SUBMERSIBLE PUMP NON-EXPLOSION PROOF



F. SUBMERSIBLE MOTOR

FORM V454



Read the Baldor submersible motor Application, Installation and Operation Manual before operating this equipment.

Please note that the Baldor submersible motor is designed to be cooled by the liquid in the pit. It can operate only 15 minutes in air before overheating and automatic opening of the internal thermostatic switches. For proper cooling and operation of this motor, it must be covered by liquid, or if it's uncovered, it must not operate for more than 15 minutes in air. Also, this motor is designed for explosion proof use in liquids at temperatures up to 104°F (40°C). In non-hazardous environments it can operate up to 149°F (65°C). This motor is not rated for use in liquid temperatures which exceed these limits.

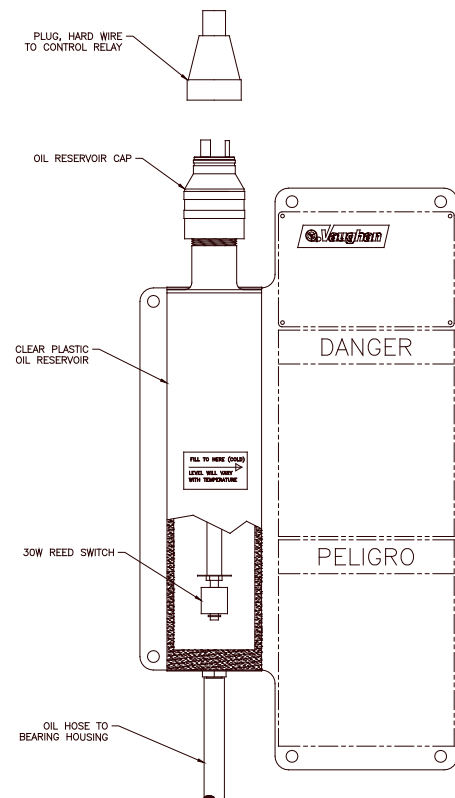
Also, the biggest cause of problems with submersible motors is electrical cable damage or damage to the cable cap assembly. *Do not stretch the cable! And never lift the pump by the electrical cable!* Otherwise, it will be damaged. Damage shows up as moisture probe or thermostatic switch failures (damage to the smaller of the two wires) or can result in a short of the main power cables.

G. AUTO OIL LEVEL MONITOR

The Vaughan Automatic Oil Level Monitor (OLM) System constantly monitors oil level in the bearing housing below the submersible motor. The auto OLM system is totally independent of the protective functions built into the submersible motor. The auto OLM system is designed to shut the pump down whenever oil level drops below a preset level. If desired, an alarm can be sounded on low oil level to alert the operators of a problem in the mechanical seal system.

Figure 5

The system is composed of a small liquid level switch mounted in the oil reservoir, and a control relay mounted in the control panel with the motor controls. Vaughan Co. supplies both the pump-mounted oil monitor/oil reservoir with connectors, and the control relay with 8-pin base for mounting in the customer's panel. The Auto OLM system allows the pump to operate normally as long as the oil is at an acceptable level in the reservoir. However, on loss of oil, usually due to seal damage, the oil level drops, the oil switch then opens, the control relay in the panel becomes de-energized, and the control relay contacts wired in series with the pump motor starter open up and interrupt voltage to the starter. This sequence of events shuts down the pump. The schematics presented in this manual illustrate how Vaughan Co. intends this system to work.



NOTICE

Be sure the oil reservoir is located above flood level. If water is allowed to enter the oil reservoir, it will end up contaminating the pump and cause premature bearing and seal failure.

Because the bearing housing in the pump is completely full of oil, you will be able to see a "thermometer effect" in the oil reservoir. That is, oil height in the clear reservoir will move up as oil heats up, and will contract and fall in the reservoir during cooldown. This is normal. If you overfill the reservoir at startup, you may see some overflow of oil out the vent hole of the cap during heatup. But as long as the oil switch does not shut the pump down or keep the pump from starting up after cool down, you do not have a seal leak. There is a fill line on the side of the reservoir indicating correct oil level at startup with the system cold.

SECTION 5: STARTUP INSTRUCTIONS

NOTICE

Review safety information in Section 1 of this manual before proceeding.

The submersible Triton pump cannot be properly started unless the pump is out of the pit. With the pump out of the pit, laying horizontally, take the following action:

CAUTION

When performing start up on new or rebuilt pumps, there is a risk of foreign objects or broken pump parts being thrown from the pump suction or discharge opening as a projectile. Discharge flange should be blocked, and suction opening should be covered with a heavy screen to protect personnel during rotation check.

1. Perform the rotation check. When checking pump rotation, at the control panel, hit the "ON" button, then the "OFF" button as fast as possible to merely "jog" the motor. If the impeller turns counterclockwise (as seen from the intake), then you are ready to start the pump. If the impeller turns clockwise, (wrong direction), then open the circuit breakers to the motor panel following your plant's lockout/tagout procedures for locking and tagging out breakers, and then reverse any two leads to the motor starter in the control panel. Then close the breakers to the panel, and recheck the motor direction to be sure it's correct. *If the pump is allowed to run backwards for any significant length of time, the pump can be damaged.*

WARNING

Stay clear of pump suction while performing pump rotation check. Serious injury or loss of limb is possible if clothing or hands are caught by the impeller.

WARNING

Lockout power after performing rotation check. The following steps are to be performed with the power off and locked out.

2. Remove both ½" NPT pipe plugs from the bearing housing below the motor. Then using Teflon tape or sealant, install the oil reservoir hose in the upper hole (nearest to motor) as a vent. Fill through the other with ISO grade 46 oil until the housing is completely full. (Having the fill hole elevated slightly above the motor flange will reduce the possibility of air pockets.) Install plug in the fill hole and plug the end of the oil hose. After the pump is installed onto the guiderail elbow, trim the hose to length, connect it to oil reservoir, and zip tie it to the motor cables. Add oil through the reservoir to complete the filling operation.

Vaughan Co. uses Chevron Rando HD-46 which is ISO grade 46 hydraulic oil. The following oils have the viscosity and rust inhibiting additives to make them excellent alternates for the Rando HD 46: Shell Turbo 46, Texaco Regal 46, Mobil DTE 846, and Exxon Teresstic 46. Most ISO grade 46 hydraulic oils and ISO grade 46 turbine oils should be compatible with Rando HD 46 supplied in our pumps. So if you wish to add equivalent weight hydraulic or turbine oil that is acceptable.

3. Install the pump on the guiderail system. Solid mounting of the pump onto the guiderail elbow helps keep vibrations minimized during operation of the pump. Anything you can safely do to make sure the pump is firmly seated onto the elbow will be helpful.
4. Add oil through the reservoir to complete the filling operation.
5. Clean all construction debris from the wet well.

When steps 1 – 5 are complete the pump is ready for startup and may be energized.-

The startup instructions are incorporated into the Startup And Certification Checklist. When the Startup And Certification Checklist is completed please send a copy of the completed checklist to: STARTUP@CHOPPERPUMPS.COM. We will verify that the pump and system are properly matched to protect your investment and our reputation.



DATE: _____

Project Name: _____ Location: _____

Pump S/N: _____ Equipment ID/Tag#: _____

Startup Performed By: _____

Customer Contact Info _____

Contractor Contact Info _____

Engineer Contact Info _____

PRE-STARTUP CHECKLIST

- Was rotating equipment stored in a clean, dry heated area away from areas where it could be damaged from impact, smoke, dirt vibration, corrosive fumes, or liquids, or from condensation inside the motor or pump?

Yes _____ No _____

- If no, are you aware of any damage the equipment may have sustained?

- Was the shaft rotated 1-1/4 turn once each week?

Yes _____ No _____

- If no, how often was the shaft rotated?

- Was the exposed steel covered with a light layer of grease or Cosmoline to protect the equipment from corrosion?

Yes _____ No _____

- Was the bearing housing kept filled with ISO Grade 46 hydraulic oil (does not apply to SE Submersibles)?

N/A _____ Yes _____ No _____





DATE: _____

PUMP S/N: _____ EQUIPMENT ID/TAG#: _____

PROJECT NAME: _____ LOCATION: _____

STARTUP PERFORMED BY: _____

CUSTOMER CONTACT INFO _____

CONTRACTOR CONTACT INFO _____

ENGINEER CONTACT INFO _____

VAUGHAN SUBMERSIBLE SCREW CENTRIFUGAL PUMP STARTUP AND CERTIFICATION CHECKLIST

Email completed form to: STARTUP@CHOPPERPUMPS.COM

- Pump Shaft turns freely by hand? Yes ___ No ___
- Pump is turning CCW as viewed from the pump end? Yes ___ No ___
- Is pump properly filled with Rando HD-46 oil (or equal)? Yes ___ No ___
- Is the oil level in the middle of the range of the oil reservoir? Yes ___ No ___
- Is Auto Oil Level monitor properly connected? Yes ___ No ___
- Moisture Sensor Relay connected and tested to ensure proper function? Yes ___ No ___
- All piping attached to pump is being independently supported? (not by the pump) Yes ___ No ___
- All piping joints are leaktight? Yes ___ No ___
- Are discharge valves open? Yes ___ No ___
- Does Inflow splash down into sump? Yes ___ No ___
- Has wet well been cleaned of all construction debris? Yes ___ No ___

ELECTRICAL DATA

Motor Mfr: _____ HP: _____ RPM: _____

Nameplate Voltage: _____ Nameplate F.L. Amperage: _____

Operating Voltage: L1 – L2: _____ L2 – L3: _____ L1 – L3: _____

Operating Amperage: L1: _____ L2: _____ L3: _____

SYSTEM DATA

What type of material are you pumping? _____

Temperature (°F) _____ Specific Gravity _____ %Solids _____

Describe your piping system:

Pipe Size (inch): _____ Total equivalent length of pipe (feet) _____

Elevation change from water level to discharge point (feet) _____

Estimated Total Head (feet): _____ Design Flow (GPM): _____

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PUMP OPERATING DATA

Pump Model: _____ Impeller Diameter: _____

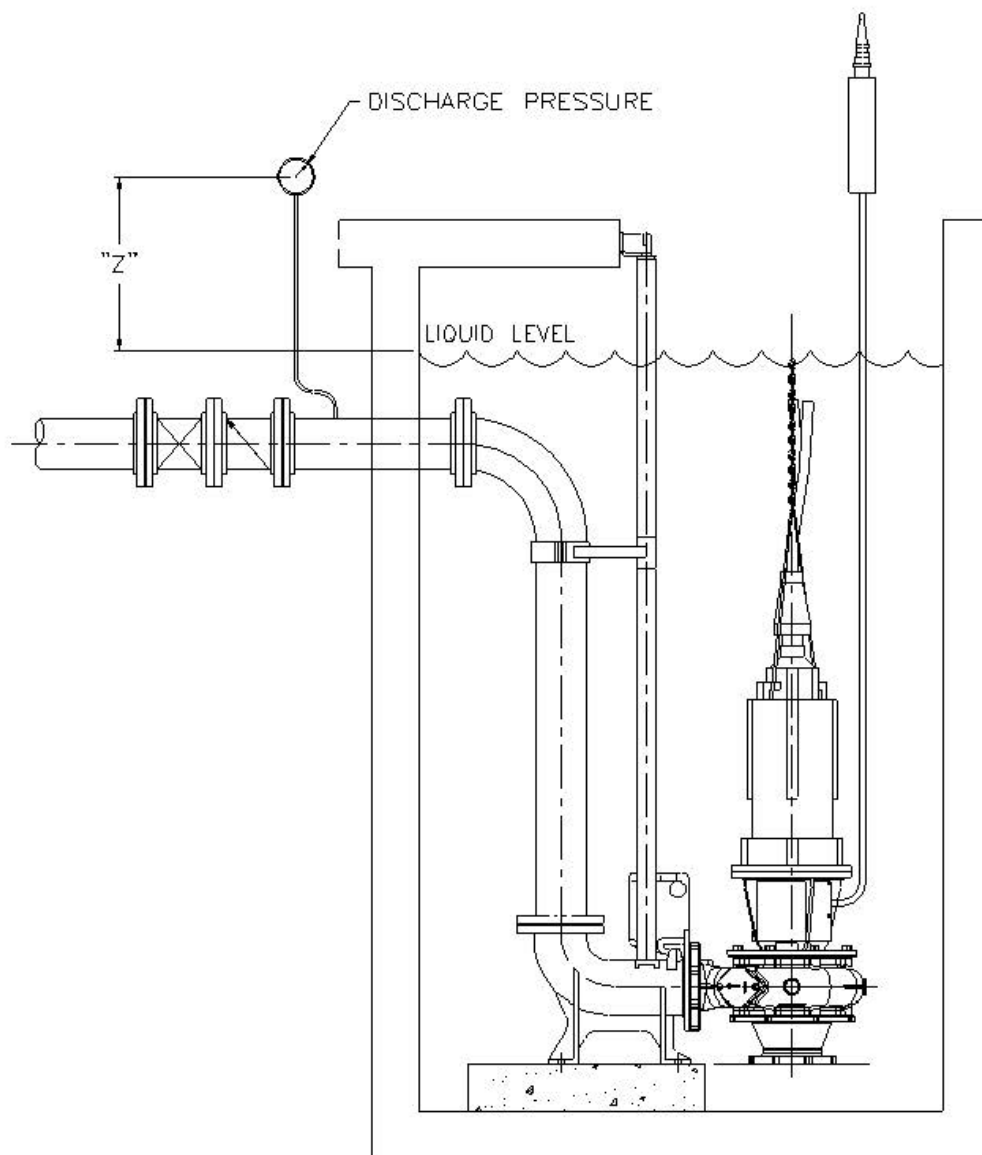
Discharge Pressure (psig): **Pump Off (psi):** _____ **Pump On (psi):** _____

Dim "Z" (feet) _____ (distance from liquid level to pressure gauge)

Observed Flow (GPM): _____

Is pump running quietly? _____ Noisily? _____ Very Noisily? _____

NOTE: If pump is not running quietly, please contact us immediately for help. Severe vibration can damage the pump very quickly.



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SECTION 6: NORMAL OPERATION

NOTICE

Pump speeds and operating conditions must fall within the acceptable limits of the performance curve of the pump..

NOISE

The Vaughan pumps which operate at either 1750 RPM or 1170 RPM are normally quiet running, and the major source of noise is the electric motor. Higher head pumps operating at 3510 RPM, however, will be noisier due to the nature of the pump design. Typically, noise level will be around 90-93 dbA in this pump. (However, mechanical vibrations should be minimal.)

VIBRATION

Vibration, like noise, should be minimal in the pump unless the pump is passing a great deal of debris through it. If vibration and noise are present, this may be an indication that the pump is operating at low flow, high-head conditions, which is always bad for a screw-centrifugal pump. If the pump is operating too close to zero flow (or shutoff head) the rotating impeller may be contacting the ID of the suction cone. This is a sign of trouble – contact Vaughan Co. immediately for advice. Be sure you have measured discharge pressures across the pump and have your serial number available.

Please note that every effort has been made at the factory to ensure that these pumps operate smoothly and within Hydraulic Institute Standard vibration limits. All impellers are dynamically balanced after impeller machining to 1 mil. or less of imbalance. The pump shaft is machined very straight and tightly held by bearings so that there is virtually no shaft movement. Your pump should not exhibit any significant vibration or noise in normal operation. If you feel that the pump is noisy or vibrating more than it should, please call Vaughan Company immediately to discuss. Excessive vibration and/or noise may be indicative of system mismatch or other problem that could severely shorten the life of your pump.

If after startup the pump is vibrating, it may be helpful to lift the pump up and reseal it onto the elbow several times. Sometimes reseating the pump onto the elbow with the pump running is helpful. (Only do this with 1750 or 1170 RPM pumps, **never with a 3510 RPM pump.**)

MOTOR OVERLOADS

A motor overload is not part of normal operation. If you find that the motor has tripped out on overload, have an electrician check operating amps when you restart the motor. Make sure that the motor is not pulling more than max allowable full load amps. *Note especially that repeatedly resetting the motor overload devices and restarting the motor when it repeatedly trips out again is a guaranteed way to burn out the motor!* Please pull the pump up out of the pit and see if something is stuck in the pump before you ruin this expensive motor.

OIL USAGE

The pump will not use oil when the mechanical seal is in good condition. (Perhaps after a year of operation, one or two ounces of oil might be required to bring oil up to the original level at startup. Note also the “thermometer effect” discussed in the Installation section of this manual.) If the pump uses large amounts of oil, or if the oil is contaminated, mechanical seal damage may have occurred. (Verify that the oil reservoir has not been flooded from the top.) If the seal is leaking, the unit should be repaired immediately to head off more expensive repairs. Call Vaughan Co. immediately for advice. Vaughan Co. can send out a bearing and seal system sub-assembly overnight, if necessary, to support your operations. Should repair be necessary, please carefully follow the overhaul instructions supplied with your pump. Because the Vaughan pump has a unique bearing and seal design, it is extremely difficult to repair the pump properly if you do not have detailed directions to follow.

In unusual circumstances, the oil in the reservoir will become very slightly “milky” in appearance. Generally, this happens because condensation occurs inside the reservoir as temperature and weather changes. If the oil is only slightly milky, it will not present any problems for the pump. Obviously, if too much water gets into the oil, the oil (or the seal) must be changed.

VORTEXING AND MINIMUM SUBMERGENCE

The water level in the pit must be kept high enough to avoid vortexing in the pump. The rule of thumb to avoid vortexing is to allow one foot of submergence above the inlet for every foot/second of inlet velocity. Velocity depends on flow rate and inlet diameter. The formula to find the flow velocity at the suction of your pump is as follows:

$$\text{Velocity (feet per second)} = \frac{0.4085 \times \text{GPM}}{\text{suction outside diameter}^2}$$

Minimum submergence requirements can be reduced by use of suction bells or baffle rings which reduce the velocity at the inlet. Please consult Vaughan engineering regarding applications where vortexing may be a problem.

SECTION 7: SHUTDOWN INSTRUCTIONS

MANUAL SHUTDOWN

In the manual mode of operation, a Vaughan pump is shut down by hitting the “OFF” button or turning the auto/man/off switch to the “OFF” position on the front panel of your control panel. If any repair or maintenance work is to be done on the pump, be sure to follow all the warnings at the beginning of this manual.

AUTOMATIC SHUTDOWN

Automatic operation normally shuts the pump down for you, usually on low pit level. If the pump does not shutdown when the pit is pumped out, the pump may be shutdown manually, but you will want to troubleshoot your level control system to find out why the auto operation is working improperly. If you are going to do any maintenance, adjustment or inspection on this pump or motor, be sure to follow all warnings at the beginning of this manual.

⚠ WARNING

Turn off electrical power by opening the main panel breaker and locking out the power, since in the automatic mode, the pump could start automatically if not isolated.

EMERGENCY SHUTDOWN

In any kind of emergency when the pump needs to be shutdown, hit the manual “OFF” switch or pushbutton on the front of the pump control panel. If any work has to be done on the pump or motor, open the main breaker on the pump control panel so that the pump cannot automatically restart when personnel are near the pump or motor.

SECTION 8 MAINTENANCE

MONTHLY

1. Check amperage draw to the pump motor and compare to that measured at startup. Make sure that power draw does not exceed allowable amperage to the motor at full load.
2. Visually check the condition of the oil in the clear reservoir to make sure it is not contaminated or milky.

⚠ WARNING

Never pull pump or perform maintenance operations without first locking out power source.

ANNUALLY

Remove pump from the pit and inspect for wear or damaged parts. Check impeller clearance from suction cone. It should be no greater than 0.030" maximum. Adjust and or shim the suction cone closer to pump casing, or replace impeller and suction cone as required. Check for smooth shaft rotation by rotating the pump shaft by hand. Be especially alert to rough spots on the bearings. Make sure there is no axial play in the pump shaft and that no oil is leaking across the seal faces into the pump bowl. Inspect pump bowl for wear and replace as necessary. Check for loose hardware, and tighten and replace as necessary.

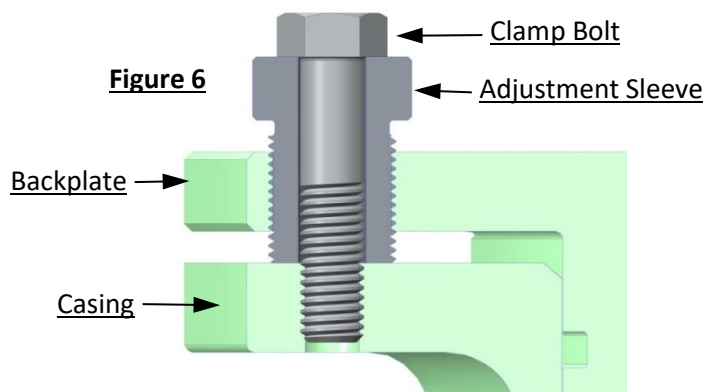
IMPELLER TO SUCTION CONE ADJUSTMENT

The following instructions describe the procedure to adjust the clearance between the Triton screw impeller and suction cone. All bearing housing style Triton submersible pumps use the external adjust sleeve configuration shown in Figure 6. Some Triton submersible screw pumps include adjustment through shims located between the pump casing and the suction cone in addition to the external adjusting sleeves.

⚠ CAUTION

Review safety information in Section 1 of this manual before proceeding.

1. Back off each of the clamp bolts on the backplate, making sure that the adjusting sleeves do not move with the bolts.
2. Choose three of the adjusters approximately equally spaced, and then unscrew the other adjusters so they are out of the way.
3. Set the three adjusters to their nominal distance:
 - a. If you have a pump that uses 1/8" split shims between the cone and casing use 1/4" keystock to set the gap between casing and backplate flange equal at the three adjusters
 - b. If you have a pump that does not use shims between the cone and casing use 3/8" keystock to set the gap between casing and backplate flange equal at the three adjusters
4. The gap between impeller and cone should now be even along the full length of the impeller. This can be verified with feeler gauges.
5. Start backing out the three adjusters (counter-clockwise) equally to keep casing square to backplate. Back out the three adjusters equally, and tighten clamp bolts, until impeller starts rubbing on cone.
 - The best way to do this is to witness mark the adjusters so you can keep track of how many "flats" or "points" you rotate them from their starting position.



- *NOTE: If your Triton screw pump has metal shims between the suction cone and pump casing, you may need to remove a set of shims if you have backed out your three adjusters all the way and the impeller is NOT rubbing on the cone. If you remove a set of shims please start back at step 3.*
6. Set the cone to impeller clearance to minimum 0.010" in tight spots for all pumps. Clearance in loose spots should be a maximum of 0.020" in 3" 4" and 6" screw pumps, and 0.030" in 8", 10" and 12" screw pumps. The procedure is outlined as followed.
 - Depending on the pump model, one full turn of the adjuster is equal to 0.020" - 0.030" impeller to cone clearance. Turning the adjuster one "flat" or one "point" is equal to about 0.003" - 0.005" impeller to cone clearance.
 - Loosen clamp bolts and screw each of the three adjusters IN (clockwise) to increase impeller to cone clearance (or OUT, counter-clockwise, to decrease clearance) by equal amounts.
 - Tighten the clamp bolts on the three adjusters.
 - Check clearance between impeller and cone with feeler gauge along length of impeller. Rotate impeller 120 degrees and check again. Rotate impeller another 120 degrees and check again.
 7. Adjusters can now be fine-tuned individually to equalize clearance between cone and impeller if desired.
 8. Once the impeller to cone clearance is set, screw remaining adjusters into position against back of casing and tighten all clamp bolts.

CORRECTIVE MAINTENANCE

Because overhaul of a Vaughan Triton submersible pump is a major undertaking, the overhaul instructions are a separate procedure. Please do not try to overhaul or repair the pump without these important documents and the exploded assembly parts breakdown. The overhaul instructions were sent to you by mail when your order for the pump was placed at the factory. If you do not have a copy of these documents, please call Vaughan Co. Engineering; we will make sure you get proper instructions overnight.

TROUBLESHOOTING

The following table deals with pump and system problems but not with motor problems. The warranty for Baldor/Reliance motors is covered by Baldor/Reliance Electric, but before contacting Baldor/Reliance; please contact Vaughan Co. for advice! If you would like help, please call Vaughan Co. Engineering for troubleshooting help. We'll be glad to offer assistance.

		PROBLEM									
		Short Life of Pumping Parts	Low Discharge Pressure	Contamination or Loss of Oil	Excessive Power Required	Abnormally High Vibration	Short Bearing or Seal Life	Pump Binding or Plugging	High Bearing Temperature	Low Flow	
POSSIBLE CAUSE OF PROBLEM	SYSTEM PROBLEMS	Pump Speed too High	X			X	X	X			
		Pump Speed too Low		X			X	X			X
		Pumped Fluid Excessively Hot	X	X			X	X			X
		Pump too near Wall or Floor					X	X	X		
		Pump Rotation Incorrect	X	X		X	X	X	X		X
		System Head too High					X	X			X
		System Head too Low	X	X		X	X	X			
		Excessive Strain or Weight on Pump					X	X			
		Pumped Fluid Abrasive or Corrosive	X	X							X
		Specific Gravity Higher than Expected				X					X
		Viscosity Higher than Expected				X					X
		Operation at Low Capacity					X	X			
		Improper Parallel Operation of Pumps	X				X	X			X
		Improper Series Operation of Pumps	X			X	X	X			
	ELECTRICAL PROBLEMS	Loss of Phase				X			X		
	Low Voltage					X			X		
	Phase to Ground Leakage					X					
	MECHANICAL PROBLEMS	Pump Discharge Blocked					X				X
	Foundation not Rigid						X	X			
	Worn Bearings				X	X	X			X	
	Flooding of Oil Reservoir			X							
	Overfilling of Oil Reservoir (Thermometer Effect)			X							
	Mechanical Seal Failure			X							
	Bent Shaft						X	X			
	Impeller Damaged or Loose on Shaft	X	X		X	X		X			X
	Shaft Running Off Center						X	X			
	Lack of Lubrication				X	X	X			X	
	Improper Repair/Installation of Bearings			X		X	X				
	Dirt in Bearings						X	X			
	Impeller Hitting Insert Cutter						X				
	SUCTION PROBLEMS	Insufficient NPSH		X			X	X			X
	Gas Binding of Pump		X				X	X			X
	Vortexing in Pit at Inlet						X				X
Intake Opening Blocked		X				X				X	



VAUGHAN CO., INC. PRODUCT WARRANTY

Vaughan Company, Inc. (Vaughan Co.) warrants to the original purchaser/end user (Purchaser) all pumps and pump parts manufactured by Vaughan Co. to be free from defects in workmanship or material for a period of twelve (12) months from date of startup, not to exceed eighteen (18) months from the date of shipment from Vaughan Co. Startup data must be submitted to Vaughan Co. within 30 days of startup. If Purchaser fails to submit startup data within 30 days of startup, then Vaughan, in its sole discretion, may elect to void this warranty at any time. Purchaser must contact Vaughan Co. prior to commencing any repair attempts, or removing pump or parts from service. If Purchaser fails to contact Vaughan Co. prior to commencing any repair attempts or removing pumps or parts from service, then Vaughan, in its sole discretion, may elect to void this warranty at any time.

If during said warranty period, any pump or pump parts manufactured by Vaughan Co. prove to be defective in workmanship or material under normal use and service, and if such pump or pump parts are returned to Vaughan Co.'s factory at Montesano, WA, or to a Vaughan authorized Service Facility, as directed by Vaughan Co., transportation charges prepaid, and if the pump or pump parts are found to be defective in workmanship or material, they will be replaced or repaired by Vaughan Co. free of charge. Products repaired or replaced from the Vaughan Co. factory or a Vaughan authorized Service Facility under this warranty will be returned freight prepaid. Vaughan Co. shall not be responsible for the cost of pump or part removal and/or re-installation.

All warranty claims must be submitted in writing to Vaughan Co. not later than thirty (30) days after warranty breach occurrence. The original warranty length shall not be extended with respect to pumps or parts repaired or replaced by Vaughan Co. under this Warranty. This Warranty is voided as to pumps or parts repaired/replaced by other than Vaughan Co. or its duly authorized representatives.

Vaughan Co. shall not be liable for consequential damages of any kind, including, but not limited to, claims for property damage, personal injury, attorneys' fees, lost profits, loss of use, liability of Purchaser to customers, loss of goodwill, interest on money withheld by customers, damages related to third party claims, travel expenses, rented equipment, third party contractor's fees, or unauthorized repair service or parts. The Purchaser, by acceptance of delivery, assumes all liability for the consequences of the use or misuse of Vaughan Co. products by the Purchaser, its employees or others.

Equipment and accessories purchased by Vaughan Co. from outside sources which are incorporated into any Vaughan pump or any pump part are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any, which warranty, if appropriate, will be assigned by Vaughan Co. to the Purchaser. It is Purchaser's responsibility to consult the applicable product documentation for specific warranty information. Specific product documentation is available upon request. Any warranty shall be void if the total contract amount is not paid in full.

Vaughan Co. neither assumes, nor authorizes any person or company to assume for it, any other obligation in connection with the sale of its equipment with the exception of a valid Vaughan "Performance Guarantee" or "Extended Warranty," if applicable. Any other enlargement or modification of this warranty by a representative or other selling agent shall not be legally binding on Vaughan Co.

Warranty eligibility determination is at Vaughan Co.'s sole discretion.

Warranty Limitations:

This warranty shall not apply to any pump or pump part which has been subjected to or been damaged by any of the following non-exclusive list of causes:

- Misuse
- Abuse
- Accident
- Negligence
- Operated in the dashed portion of the published pump curves
- Used in a manner contrary to Vaughan's printed instructions
- Defective power supply
- Improper electrical protection
- Improper storage
- Faulty installation, maintenance, or repair
- Wear caused by pumping abrasive or corrosive fluids or by cavitation
- Dissatisfaction due to buyer's remorse
- Damages incurred during transportation
- Damages incurred during installation or maintenance

THIS IS VAUGHAN CO.'S SOLE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

