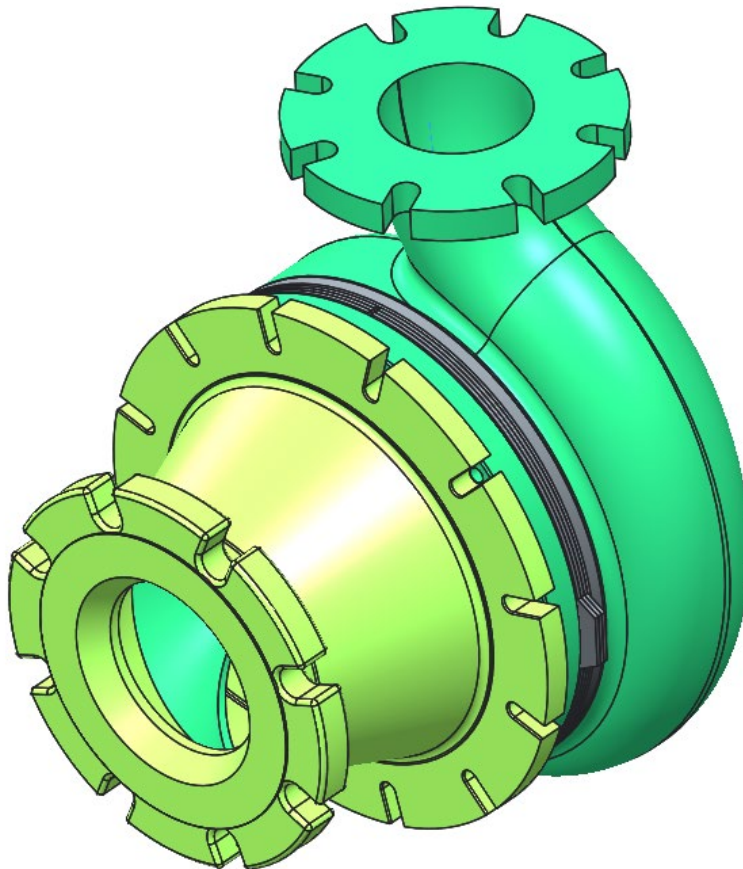




VERTICAL WET WELL TRITON SCREW PUMPS

INSTALLATION, OPERATION & MAINTENANCE MANUAL



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SECTION 1: CAUTIONS AND WARNINGS

DANGER

Wear eye protection, rubber gloves, and aprons when working on or inspecting this pump.

DANGER

Disconnect electrical power and lock out and tag out circuit breakers to pump motor and associated equipment when inspecting or making adjustments. Duplex pumps with alternating relays must both be locked out; otherwise, the pump you are working on may start as “the alternate”. Visually confirm that the pump has come to a complete stop before proceeding.

DANGER

This pump may start automatically if wired to float switches or other equipment. Before inspecting or working on this equipment, always isolate electrical power. If duplex pumps are in use with an alternating relay installed your control panel, open circuit breaker to both pumps. Otherwise, the pump may not be isolated and could start automatically.

DANGER

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.

DANGER

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.

DANGER

Keep hands, feet, and clothing away from moving machinery.

DANGER

Do not allow people under or near the pump assembly while it is being lifted.

DANGER

Enter tanks or pits with extreme caution and only when using a self-contained breathing apparatus and only when a harness and tether is tied around your waist. Two people should be stationed outside the pit or tank holding onto the harness and tether so they can pull you out of the pit in an emergency. Consult the confined space entry procedures that have been recommended for your location. Pits or tanks may contain dangerous gases that can cause death.

DANGER

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 either a) suction and discharge piping in place, or b) 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.

CAUTION

Never operate a screw-centrifugal pump with closed suction or discharge valves. This will destroy the pump and could be dangerous to personnel.

CAUTION

This pump uses oil which if spilled can cause a slipping hazard and danger to personnel.

CAUTION

This pump may handle dangerous or contaminated fluids. After wear has taken place there may be 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.

CAUTION

Lift pump and motor assembly by the lifting eyes on the pump base only. Lifting by any other parts of this equipment is dangerous and may damage equipment. Do not lift pump and motor assembly using the motor lifting eye.

CAUTION

Lift pump and motor with properly sized and rated lifting equipment. Consult Vaughan Co. shipping department for weight of your equipment if you are in doubt.

CAUTION

Do not operate this equipment unless safety guards or devices are in place and properly adjusted.

CAUTION

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.

CAUTION

Never clean, oil, or repair machinery while in motion.

CAUTION

Keep all pit openings covered when not in use. Open pits may contain poisonous gases or liquids that can injure a person in addition to the injuries from falling.

CAUTION

Make certain all personnel are clear of equipment before operating.

CAUTION

Keep electrical control panel area clear to avoid hazard to personnel. If a person should trip and fall into an open panel enclosure, serious electrical burns can result.

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

DESCRIPTION OF VAUGHAN WET-WELL SCREW PUMP

The Vaughan vertical wet-well screw pump is specifically designed for pumping whole solids. The pump is supplied with a deck plate to mount the pump, automatic oil level monitor (for pump shutdown in case of seal failure), and a discharge flange above the deck plate with a pressure gauge tap.

A. DESCRIPTION OF MAJOR COMPONENTS

Note: Please use the wet-well 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 CD-4MCu materials are also available.

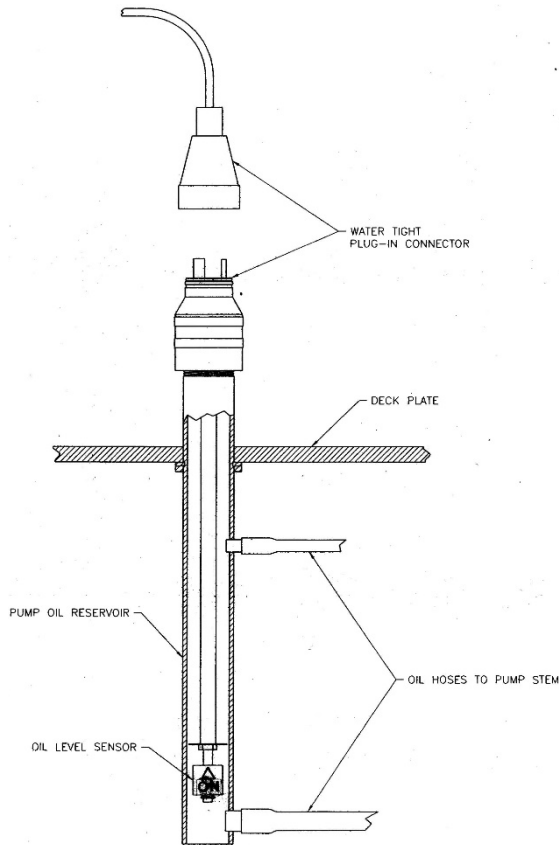
SUCTION CONE: The inlet cone serves the function of a “wear plate”, sealing in the pressure at the intake of the pump. The pressure generated by the impeller is kept inside the pump by the close clearances between this suction cone and the impeller. The inlet cone includes a cast-in spiral groove to 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 CD-4MCu.

UPPER CUTTER: The upper cutter ring (it is screwed into the pump casing with LH threads) uses two cutting dogs to cut against cast-in teeth located on the rotating impeller hub. The upper cutter is only a feature on,

4X6A, 6X6A, 8X8B, 10X10C, and 12X12C Triton screw pumps.

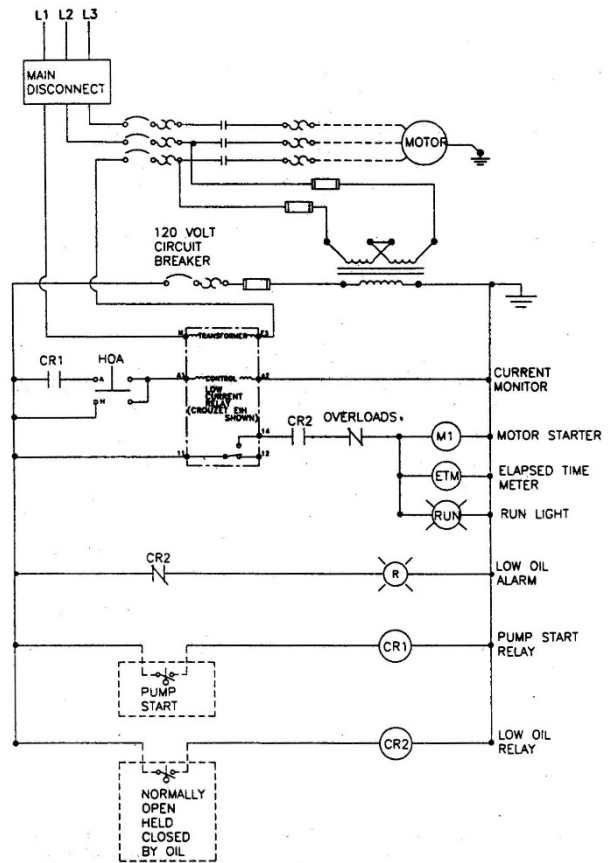
BACK CUTTER: Pumps that do not have an Upper Cutter have a Back Cutter. The Back Cutter system consists of two opposing hardened steel insert cutters. One of the insert cutters is stationary and located on the back plate of the pump, while the other insert cutter is located in the rotating impeller hub. This feature is designed to minimize ragging between the impeller hub and back plate.

MECHANICAL SEAL DESIGN: Standard Vaughan wet-well pumps use a high-quality Vaughan-designed cartridge mechanical seal to isolate and protect the oil-bath ball bearing system from contamination from the pumpage. The seal is located immediately above the pump impeller on the pump shaft. Mechanical seal faces are made of solid silicon carbide for long life in abrasives. The best indication of any problems with the mechanical seal system is either a loss of oil from the pump stem (or column) or, in unusual cases, overflowing of the oil reservoir. The pump impeller pumpout vanes are designed to pull oil out of the pump stem if a seal failure occurs and as long as pump discharge pressure is not too high. (If the pump is operating near shutoff head, it's possible to push material up into the reservoir.)



AUTO OIL MONITOR SYSTEM: Vaughan Co. uses an automatic oil monitor system to monitor oil level and to give immediate indication of a problem if and when it occurs. Oil is monitored by a reed switch float in the oil reservoir located at the deck plate. Electrical connection to this oil switch is through a watertight Woodhead connector mounted above the deck plate. Since the oil switch has only a 50-watt capacity, shutdown of pump motor (i.e., interruption of motor starter operation) is generally accomplished with a standard 110 VAC. control relay, which Vaughan supplies with the pump. If an explosion proof motor is supplied with this pump, then an intrinsically safe relay will be supplied so that there is no chance of having a spark in the reed switch in a hazardous environment. A schematic showing a possible controls setup for the auto oil system is shown below. Also shown is a cross-section of the oil reservoir and float switch.

MOTOR MOUNTING: Vaughan wet-well pumps can be belt-driven (call Vaughan Co.



for an exploded parts assembly drawing showing this configuration), but most pumps are directly driven by an induction type AC electric motor. Direct-drive pumps use a C-Face (or metric B5) flange-mounted motor bolted to a machined and piloted motor stool, which in turn is mounted to the deck plate. The pump is driven by the motor through an elastomeric (TB Woods "Sure-Flex or equal) coupling. The motor and motor stool are aligned to the shaft and pump column by machined, rabbeted fits so that motor and pump shaft alignment is automatically assured.

B. 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.

C. 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 portion of its pump performance curve. Operation in the dashed lines indicates vibration areas and must be avoided.
3. Operating a Triton pump against a throttled discharge valve or against high head will damage pumps.
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. 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.

D. EXPECTED BENEFITS OF VAUGHAN 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.
5. Wet-well pumps use standard T-frame AC electric motors, which are cost-effective and relatively easy to replace compared to special-purpose submersible motors used on submersible pumps.
6. Wet-well pumps eliminate suction piping and damage to submerged wires typical of submersible pumps.

INSTALLATION INSTRUCTIONS

A. RECEIPT INSPECTION

Prior to shipment Vaughan pumps are carefully crated and inspected to ensure arrival at your site in good condition. On receiving your pump, examine it carefully to assure that no damaged or broken parts have resulted from shipping or handling. Look for signs that the pump has been dropped, such as damaged crating, missing paint, dented-in 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 or paint 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. Be sure to remove the flange cover at time of installation.

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 Cosmoline to protect the equipment from corrosion.
2. Rotate the motor 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 ball 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 may be helpful to cover equipment with plastic.
5. The pump column and bearing housing are assembled as an oil-filled assembly

so that the seal and lower bearings are covered in oil. To avoid bearing corrosion these housings should be kept filled with ISO Grade 46 hydraulic oil to normal levels. (Note that the top bearing is grease lubricated. An air gap should be left below the top two bearings. Do not over fill.)

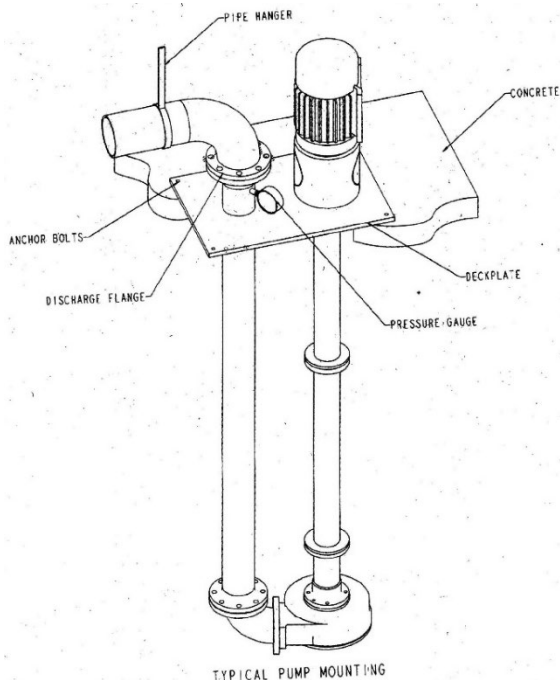
C. PUMP MOUNTING

The Vaughan wet-well pump is heavy and will require a crane to lift it into position over your pit. Lifting the pump by the lifting eyes on the deck plate is the only recommended method for lifting. If the pump is long, it's advisable to support the center of the pump column during lifting to avoid bending any of the stem sections. ***Do not lift by the motor lift eye.***

When locating the pump in the pit, position the pump so that the lower pump casing (or volute) is located at least 12" away from the nearest vertical wall in the pit. Pump length should have been chosen so that the pump inlet is located about 12" above the pit floor. Smaller 3" and 4" pumps may be located no closer than 6" from the floor as a minimum. Mounting the pump intake too close to the pit floor can cause vibrations and keep material from getting into the pump.

The pump deck plate should be bolted or clamped to the upper deck or floor to minimize operational vibrations. Vaughan Co. typically recommends 1/2" expansion-type anchors for use in concrete for pumps 3-6" discharge size, 3/4" anchors for 8-12" size pumps.

The exact details of your pump, (i.e., parts breakdown, outline dimensions, and weight) are available from Vaughan Co. The illustration on the next page shows a typical wet-well pump installation.



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 each pump. Note that there is a 1/4" NPT pressure tap above the deck plate and just below the discharge flange for installation of pressure gauge for testing purposes, particularly important at pump startup.

Also, if you are ever required to do any troubleshooting, a pressure gauge will also be required. Vaughan Co. does not recommend the use of an expansion joint on the pump discharge as this can impose large forces onto the pump and can also cause pump and piping vibrations by making the discharge piping system too flexible.

E. MOTOR AND CONTROLS

Most motors provided on Vaughan pumps are TEFC C-Face mounted and are not designed for hazardous environments or rated as explosion proof. However, some applications require explosion-proof motors. If your pump is located in a hazardous location, be sure you ordered and received your pump with an explosion-proof motor and that you use an electrician experienced in hazardous environment wiring and controls.

Vaughan Chopper Pumps, because they cut and condition the material they pump, require motor protection with correctly sized breakers, starters, and overload protection. A Chopper Pump can jam and stall on material too tough to chop, such as steel rebar. Therefore, carefully chosen overload protection for your expensive motor is critical to avoid motor burnout. Note that nuisance tripping during chopping can occur if you do not have an adequately sized and adjusted circuit breaker. The circuit breaker should never open during chopping, it should generally be sized for 125% of motor full load amperage rating, and it should only open during a short circuit, not during motor overloads. The starter overloads should trip out on motor overload and are typically size for 110% of motor full load amperage rating.

If your pump and motor are located in a hazardous environment, be sure 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.

F. AUTO OIL LEVEL MONITOR

The Vaughan Automatic Oil Level Monitor (OLM) System constantly monitors oil level in the pump column and bearing housing below the deck plate level. The auto OLM system is designed to shut the pump down whenever oil level drops below a preset level, but to make this system work, your

electrician must connect the OLM to your controls. If desired, your controls can be set up to actuate an alarm on low oil level to alert the operators of a problem in the mechanical seal system.

The OLM system is composed of a small liquid level switch, mounted in the oil reservoir, and of 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 level 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 schematic presented earlier in this manual illustrates how Vaughan Co. intends this system to work.

STARTUP INSTRUCTIONS

NOTES:

1. Vaughan pumps are designed and built for automatic alignment of motor and pump shafts during assembly. No further alignment is necessary.
2. Vaughan Co. uses Chevron Rando HD-46 Hydraulic Oil in the pump column. Other equivalent oils are: Shell Turbo 46, Texaco Regal 46, Gulf Harmony 46 and Exxon Teresstic 46. Note also that most ISO grade 46 hydraulic oil and ISO grade 46 turbine oils should be compatible with the Rando HD-46 but only a few brands have the rust inhibitors we recommend for optimum pump life. The pump is shipped from the factory with oil, but once the pump is installed in your pit, it may need additional oil to make sure the oil monitor switch is covered with oil. **DO NOT OVERFILL** as this will wash

- grease out of the upper bearings; add only enough to cover the switch plus 1"
3. Do not completely fill the pump column with oil. Fill only until the float switch is covered with oil plus one additional inch. The pump requires some air space at the top of the pump column to avoid over-pressurizing the system during heat-up of the oil. The upper bearings are grease lubricated so over-filling will wash out the grease.
4. When performing the pump rotation check to ensure that the pump is turning Clockwise (as viewed from the motor end). At the control panel, push the "ON" button, then the "OFF" button as fast as possible in sequence to merely "jog" or "bump" the motor. If the motor turns clockwise, then you are ready to start the pump. If the motor turns counterclockwise, (wrong direction), then have your electrician open the circuit breakers to the motor panel using your plant's normal safety precautions for locking and tagging out breakers, and then reverse any two leads to the motor starter in the control panel. Then re-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 impeller bolt can unwind, and then the impeller will come loose on the shaft and damage the pump.
5. When the STARTUP AND CERTIFICATION CHECKLIST is completed satisfactorily, review the safety warnings at the beginning of this manual and then start up the pump. Please fill out the STARTUP AND CERTIFICATION CHECKLIST which follows and send a copy of it to: STARTUP@CHOPPERPUMPS.COM. We will review your installation to make sure the pump is properly matched to your system to protect your investment.



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: _____

Project Name: _____ Location: _____

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

Startup Performed By: _____

Customer Contact Info _____

Contractor Contact Info _____

Engineer Contact Info _____

**VERTICAL WET-WELL SCREW CENTRIFUGAL PUMP
STARTUP AND CERTIFICATION CHECKLIST**

Email completed form to: STARTUP@CHOPPERPUMPS.COM

- Pump Shaft turns freely by hand? Yes _____ No _____
- All guards are in place? Yes _____ No _____
- Pump is turning CW as viewed from motor end? Yes _____ No _____
- Is pump properly filled with oil? Yes _____ No _____
- Is the oil level in the middle of the range of the reservoir? Yes _____ No _____
- Is Auto Oil Level monitor properly connected and functioning? Yes _____ No _____
- Are discharge valves open? Yes _____ No _____
- All piping attached to pump is being independently supported? (not by the pump) Yes _____ No _____
- Flexible joint is connected to pump discharge? Yes _____ No _____
- If yes, is piping anchored between expansion joint and pump discharge, per H.I. Standards? Yes _____ No _____
- All piping joints are leak tight? Yes _____ No _____
- Has wet well been cleared of all construction debris? Yes _____ No _____
- Does Inflow splash down into sump? 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: Total equivalent length of pipe (feet): _____

Pipe Size (inch): _____ Elevation change from water level to discharge point (feet) _____

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

PUMP OPERATING DATA

Pump Model: _____

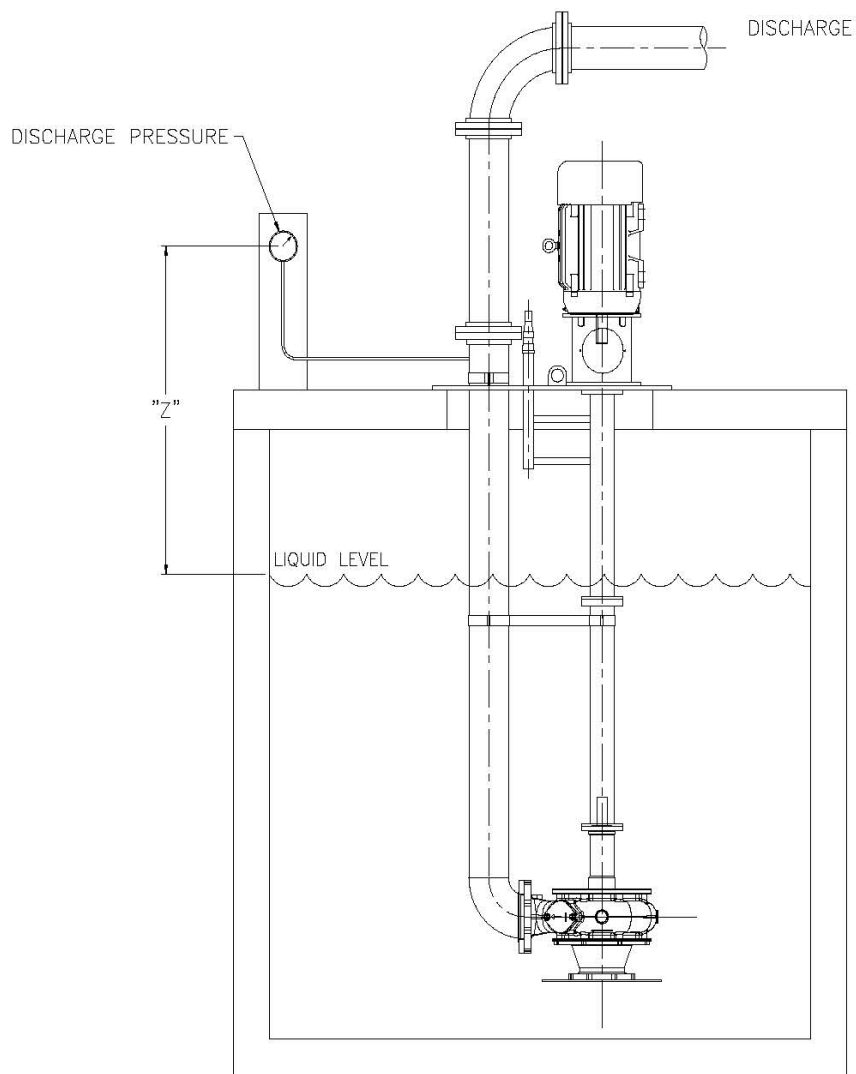
Discharge Pressure (psig): **Pump Off (psi):** _____ **Pump On (psi):** _____

DIM "Z" (distance from liquid level to pressure gauge-feet): _____

Observed Pump 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.



NORMAL OPERATION

A. NOISE: Vaughan pumps which operate at either 1750 RPM or 1170 RPM are normally quiet running (<85 dbA), 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.)

B. VIBRATION: Vibration, like noise, should be minimal in the pump.

Please note that every effort has been made at the factory to ensure that this pump operates smoothly and without vibration. For example, all impellers are dynamically balanced after impeller machining to less than 0.1 ounce of imbalance. Component alignment from top to bottom is assured by the machining methods we use. And the pump shaft is very tightly held by ball bearings so that there is virtually no shaft movement.

C. MOTOR OVERLOADS: A motor overload is not part of normal operation. If you find that the motor has tripped out on overload, when you restart the motor, have an electrician check operating amps. Make sure that the motor is not pulling more than max. allowable full load amps as indicated by the motor nameplate. Note especially that repeatedly resetting the motor overload devices and restarting the motor when it trips out again will burn out the motor! Please pull the pump up out of the pit and see if something is stuck in the pump.

D. 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.) If the pump uses large amounts of oil or if the oil is contaminated,

mechanical seal damage may have occurred. (Verify that the pump has not been flooded from the top.) If the seal is leaking, the unit should be repaired immediately to avoid more expensive repairs later. Call Vaughan Co. immediately for advice. Vaughan Co. can send out a bearing and seal system sub-assembly or a new seal overnight, if necessary, to support your operations. Should repair be necessary, please carefully follow the instructions of the Wet-Well Overhaul Manual. 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 pump column or 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.

E. 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:

$$V \text{ (ft/s)} = 0.4085 * \text{GPM} / \text{diameter}^2 \text{ (in)}$$

Minimum submergence requirements can be reduced by use of suction bells which reduce the velocity at the inlet. Please consult Vaughan engineering regarding applications requiring a suction bell.

SHUTDOWN INSTRUCTIONS

A. 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. Be sure to turn off electrical power by opening the breaker at the control panel and by following all plant safety procedures!

B. AUTOMATIC SHUTDOWN: Automatic operation normally shuts the pump down for you, usually on low pit level. If the pump does not shut down when the pit is pumped out, the pump may be shut down manually, but do troubleshoot your level control system. 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. Be sure to turn off electrical power by opening the main panel breaker and by following all plant safety procedures, since in the automatic mode, the pump could start automatically if not isolated!

C. 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.

MAINTENANCE

A. ROUTINE 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.

QUARTERLY:

1. Motor: Inspect electric motor. Make sure

that casing drain is not plugged to ensure that motor cannot fill up with water. Clean cooling fins so that dirt buildup will not affect cooling ability of motor. Check for loose hardware and damaged wiring or conduit.

2. Pump: Inspect pump for loose hardware. Disconnect power to the Auto OLM and check the oil to ensure that it is clean and at the proper level. Make sure that pump is operating smoothly and without vibration.

SEMI-ANNUALLY:

1. Grease motor bearings.
2. Perform quarterly inspections.

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" max. Shim 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.

B. CORRECTIVE MAINTENANCE:

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

TROUBLESHOOTING

The Vaughan Vertical Wet-Well pump may be susceptible to some system problems because it can be used in a wide range of applications and systems.

Because troubles can erupt, attached to this section is a wet-well troubleshooting chart that will help you get some idea of what symptoms could indicate what problems.

If you would like help, please call Vaughan Co. Engineering for troubleshooting help. We'll be glad to offer assistance.

POSSIBLE PROBLEMS		SYMPTOMS							
		LOW FLOW	LOW DISCHARGE PRESSURE	EXCESSIVE POWER REQUIRED	HIGH VIBRATION	SHORT BEARING OR SEAL LIFE	LOSS OR CONTAMINATION OF OIL	CAVITATION NOISE	PUMP BINDING OR PLUGGING
A. SYSTEM PROBLEMS									
1.	Suction or Discharge Blocked	■	■		■			■	
2.	Gas or Air Binding	■	■		■	■			
3.	Pump Too Near Wall or Floor	■	■		■	■			■
4.	Fluid Too Hot To Pump	■	■		■			■	
5.	Pump Speed Too Low or Imp. Dia. Too Small	■	■		■				
6.	Pump Speed Too High Or Imp. Dia Too Large			■	■	■		■	
7.	Fluid Too Viscous	■	■		■				
8.	System Head Too Low				■	■		■	
9.	System Head Too High	■	■		■			■	
10.	Specific Gravity Too High			■	■				
11.	Incorrect Parallel Operation	■	■		■	■		■	
12.	Incorrect Series Operation			■	■	■		■	
13.	Pump Foundation Too Flexible				■	■			
14.	Excessive Strain or Weight On Pump Flange				■	■			
15.	Pumped Fluid Abrasive					■			■
16.	Flooding Of Pump					■	■		
B. ELECTRICAL PROBLEMS									
1.	Loss Of Phase			■					■
2.	Low Voltage			■					■
3.	Phase-To-Ground Leakage			■					
C. PUMP PROBLEMS									
1.	Wrong Direction Of Rotation	■	■		■	■		■	■
2.	Improper Repair	■	■		■	■	■	■	■
3.	Impeller/Cutterbar Binding	■	■		■				
4.	Worn Cutterbar Or Impeller	■	■		■	■			■
5.	Disintegrator Tool Wrapped With Rags	■	■		■	■		■	
6.	Bent Shaft				■	■			
7.	Stationary Seal Member Spinning In Gland				■	■		■	
8.	Rotating Seal Member Spinning On Seal Sleeve				■	■		■	
9.	Oil Leakage From Stem Or Hose					■		■	
10.	Overfilling Of Stem With Oil					■		■	
11.	Mechanical Seal Failure					■		■	
12.	Worn Shaft Or Bearings			■	■	■			
13.	Shaft Sleeve Worn or Scored					■		■	
14.	Impeller Loose on Shaft				■	■			



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.