1. CAUTIONS AND WARNINGS .......................................................... Page 3
2. DESCRIPTION OF SUBMERSIBLE CHOPPER PUMP .................. Page 4
   A. Description of Major Pump Components
   B. Proper Applications for Vaughan Chopper Pumps
   C. Uses of Vaughan Pumps that May Cause Trouble
3. INSTALLATION INSTRUCTIONS .................................................. Page 7
   A. Receipt Inspection
   B. Storage Considerations
   C. Mounting the Pump and Guiderail System in your Pit
   D. Piping
   E. Controls
   F. Submersible Motor
4. PUMP STARTUP INSTRUCTIONS .................................................. Page 10
5. STARTUP AND CERTIFICATION CHECKLIST ............................... Page 11
6. NORMAL OPERATION OF PUMP .................................................. Page 13
7. SHUTDOWN INSTRUCTIONS ....................................................... Page 14
   A. Manual Shutdown
   B. Automatic Shutdown
   C. Emergency Shutdown
8. MAINTENANCE ............................................................................ Page 14
   A. Routine Maintenance
   B. Corrective Maintenance
9. TROUBLESHOOTING ............................................................... Page 16
10. WARRANTY ................................................................................. Page 17
CAUTIONS AND WARNINGS

CAUTION
Disconnect power to the pump before lifting the pump up out of the pit. Be extremely careful to avoid damage to the power cable when lifting or handling this pump.

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

CAUTION
This pump is a “Chopper Pump”. There are sharp corners, edges and pinch areas which can cause serious cuts. Be careful; wear protective gloves whenever possible. If you cut yourself, seek medical help immediately to avoid serious infection.

CAUTION
Lift pump and motor by pump lifting cable only. Lifting by any other parts of this equipment may be dangerous or may damage equipment. Inspect the lifting bail regularly to be sure it is not damaged or frayed. Replace immediately if the cable is weakened in any way.

CAUTION
Lift pump and motor with an adequately sized hoist or crane. Consult Vaughan Co., Inc. shipping department for weight of your equipment if you are in doubt.

DANGER
Do not allow people under pump assembly while it is being lifted.

DANGER
Disconnect electrical power and lock out and tag out circuit breakers to pump motor and associated equipment when inspecting or making adjustments. Note that duplex pumps with alternating relays must both be locked out; otherwise, you cannot be sure which pump you have isolated and it could start up unexpectedly.

CAUTION
Keep all pit openings covered when not in use.

DANGER
Reliance submersible motors used on these pumps meet explosion proof requirements for hazardous environments. However, the guiderail system or oil monitor system may not meet explosion-proof requirements 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. Consult Vaughan Co. for help or advice.

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

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 in your control panel, open circuit breaker to both pumps. Otherwise, the pump may not be isolated and could start unexpectedly.
DANGER
Keep hands, feet and clothing away from moving machinery.

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, or otherwise dangerous to personnel.

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

CAUTION
Keep electrical control panel area clear to avoid personnel hazard.

CAUTION
Make certain all personnel are clear of equipment before operating.

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.

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

SECTION 2: DESCRIPTION OF VAUGHAN SUBMERSIBLE CHOPPER PUMP

The Vaughan submersible chopper pump is specifically designed for pumping trash laden material from wet pits in industrial and municipal plants. The pump can be used in the recirculating mode of operation to mix the pit before pumpout, but a recirculation system of external piping, or an add-on recirculation valve system onto the guiderail elbow must be obtained from Vaughan Co. Material is chopped up by the pump so that particle size is reduced and downstream plugging problems are reduced.

The E-Series chopper pumps offer additional improvements over the previous standard submersible chopper pumps:

1. The backpullout casing design allows for easy removal of the rotating assembly.
2. The impeller-to-cutterbar clearance can be adjusted externally without the use of shims or the need for pump disassembly.
3. New techniques for improving the hydraulic efficiency have been implemented.

CROSS-SECTION OF SE SERIES SUBMERSIBLE PUMP
A. DESCRIPTION OF MAJOR PUMP COMPONENTS

Note: Please refer to the illustrations in this manual which show the pump cross-section and the submersible chopper pump mounted on Vaughan's guiderail system. These pictures will help you understand this section more fully.

CHOPPER IMPELLER: The impeller on the Vaughan pump serves two purposes. First, it induces flow by drawing liquid into the pump and then accelerating it into the pump casing. Second, the impeller provides chopping capability for the pump. The leading edge of each impeller blade slopes forward to creating a knife edge so that as material enters the pump, it is caught and cut between impeller blade and the cast stationary shear bars at the inlet openings of the cutter bar plate. The impeller is held onto the pump shaft by a special “cutter nut”.

CUTTER BAR PLATE: The cutter bar plate also serves two functions. First, it acts as a “wear plate” to seal pressure generated by the rotating impeller inside the pump. Second, the cutter bar provides two shear bars at the entrance to the pump so that material may be chopped by the pump impeller acting against these stationary shear bars.

DISINTEGRATOR TOOL: The disintegrator tool, an option on submersible pumps, is an auxiliary cutter located below the pump inlet to help prevent blockage. Matted material which tends to block the opening to the pump can be cut up or knocked away by this tool until flow can resume into the pump. The disintegrator tool has the disadvantage, however, that material which tends to wrap – material like rags, hair, and nylon fiber – can ball up on the tool and eventually block flow into the intake openings of the pump. (Vaughan Co. does not recommend the use of a disintegrator tool whenever you are pumping sewage or sewage sludge.) If the pump is installed with a disintegrator tool and if suction blockage becomes a problem due to wrapping (problems usually show up as a reduced flow or severe vibration), then the tool should be replaced with a suitable stainless steel set screw.

SEVERE DUTY LOWER SEAL IN SUBMERSIBLE MOTOR: The submersible motors utilized by Vaughan Co. (either Reliance or Yeomans) are designed with two mechanical seals. One above (the upper seal) and one below (the lower seal) an oil chamber located below the rotor and stator. Normally these seals are John Crane Type 21 with carbon / ceramic faces. Vaughan Co. has replaced the lower seal with a Sealol 680 or AES SAI/I100 with silicon carbide faces to better handle the trash-laden slurries that Vaughan pumps encounter. The 680 seal is further protected by a patented stainless steel cylindrical shroud made by Vaughan Co.
GUIDERAIL SYSTEM:
Vaughan submersible chopper 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 the pump is supported completely by the pump casing discharge flange and adapter bracket. If the pump is to be mounted in a hazardous environment, you need to inform us so that we can supply a non-sparking aluminum bronze adapter bracket for the pump.

B. PROPER APPLICATIONS FOR VAUGHAN CHOPPER PUMPS

Vaughan Chopper Pumps are used for pumping liquid slurries contaminated with debris which can be chopped and mixed into the slurry. The benefit of this approach is that a more homogenous slurry is pumped, making some slurries pumpable (which might otherwise not be pumpable) and eliminating downstream plugging in other equipment. Also, screens located upstream of the pump may often be eliminated, cutting labor costs. Vaughan pumps are routinely used to pump the following slurries:

1. Sewage and sewage sludge
2. Fish waste.
3. Vegetable waste.
5. Aluminum chips from machining operations.
6. Lead oxide and plastics in battery plants.
7. Oil sludges in oil refineries.
8. Wood chips and paper waste.
10. Feathers mixed with blood and water in poultry plants.
11. Animal fat in rendering and hide processing plants.
13. Coal slurry.

System design is very important in making any pump work successfully in pumping debris-laden slurries. There must be enough liquid so that material can be pumped. Also, liquid and material must be able to flow freely to the pump.

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 or bearings. The following problems can be experienced:

1. When pumps vibrate, they are damaged.
2. A pump must be operated in the solid line areas of its pump performance curve. Operation in the dashed lines indicates vibration areas.
3. Operating a pump against very low backpressure damages pumps.
4. Operating a pump against too much backpressure damages pumps.
5. Chopper pump impellers with the largest number of blades are the most efficient, but they also provide the poorest solids handling. Added impeller blades block the inlet and cause increased binding on fiber during chopping. When pumping sewage and similar slurries, choose impellers with the least number of blades.
6. When pumping materials that float or settle in a pit, agitation and chopping with the pump are required before pit pumpout.
7. You cannot pump slurry that is too hot from an open pit. 65 deg C (149 deg F) is a reasonable upper limit for non-hazardous pits.
8. You must have a reliable electrical power supply for a pump to work properly. If you have 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 will stall during chopping of debris.

SECTION 3: 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 cutter bar. 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 1/4 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 is helpful to cover equipment with plastic.

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 stainless steel bale over the motor is the only recommended method for lifting.

**CAUTION**
Lift pump and motor with an adequately sized hoist, crane, or forklift. Consult Vaughan Co., Inc. shipping department for weight of your equipment if you are in doubt.

**DANGER**
Do not allow people under pump assembly while it is being lifted.
If the pump is to be mounted on a guiderail system, the elbow will have to be bolted to the floor, and the guiderail upper bracket will have to be bolted either to your access cover frame or to some other structural member. 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 Molly Parabolt anchor bolts, or equal, 1/2" x 5 1/4" long. Please note that before startup, the pump should be located out of the pit where correct pump rotation may be verified.

The drawing above shows a typical installation of a submersible pump mounted in a pit, with dimensions on where to mount the anchor bolts for the different size elbows.

Normally the customer or the contractor will supply 2" standard 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 discharge bracket on the guiderails. Adjusting the angle on which the lifting cable pulls up on the motor lifting bail can relieve a great deal of the binding that might otherwise occur.

After startup, when lowering the pump into a pit on a guiderail system, it may be helpful to turn the pump on while the pump is mating to the elbow so that any debris may be flushed away from the mating surfaces, thus minimizing chances for leakage later. (Never do this with 3510 RPM pumps.) Vaughan submersible pumps use a metal-to-metal connection between pump and elbow for minimum mating problems over the life of the equipment.

Always take care to avoid damaging the motor cables and the epoxy joint where the cables enter the motor. If the cables are stretched, pulled, or crushed, they will be damaged.

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

DANGER

Reliance submersible motors used on these pumps meet explosion proof requirements for hazardous environments. However, the guiderail system or oil monitor system may not meet explosion-proof requirements 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. Consult Vaughan Co. for help or advice.

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, usually at least 6".

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 1/4" NPT 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.

CAUTION
Be sure that all piping connections are tightened and properly supported before operation of this 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.

Vaughan Chopper Pumps, because they cut and condition the material they pump, require positive motor protection with correctly sized breakers, starters, and overload protection. A Chopper Pump can jam and stall on material too tough to chop, and therefore, carefully thought out overload protection for your expensive submersible motor is critical to avoid motor burnout.

Also, the Reliance and Yeomans submersible motors have two protective devices, the seal failure moisture probe and the thermostatic switches. Both of these devices must be incorporated into the controls. The sample controls schematics presented below shows these items wired into the system. The recommended Warrick type 2800 moisture sensing circuits should be installed within 150 feet of motor moisture probes. Also, please see the Reliance (or Yeomans) Installation and Operating Manual for more details on these devices.

Sample Controls Schematic

F. SUBMERSIBLE MOTOR

Please read the Reliance, or Yeomans, submersible motor Application, Installation and Operation Manual before operating this equipment.

Please note that the Reliance 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.

The Yeomans CLC motors are designed for continuous operation in air. They do not carry a UL or FM approval for use in an environment requiring explosion proof equipment.

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.

**SECTION 4: PUMP STARTUP INSTRUCTIONS**

1. *Please review all warnings on page 3!*

2. *The submersible chopper 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:*

   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 side), then you are ready to start the pump.

   If the impeller turns clockwise, (wrong direction), then 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 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.

3. *Solid mounting of the pump onto the guideway elbow helps keep vibrations minimized during operation of the pump. Anything you can do safely to make sure the pump is firmly seated onto the elbow will be helpful. If after startup the pump is vibrating, it may be helpful to lift the pump up and reseat it onto the elbow several times. And 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.)*

4. *When the STARTUP AND CERTIFICATION CHECKLIST is completed, you may start up the pump. Please make a photocopy of the completed checklist and mail it or FAX it to your local Vaughan representative or to Vaughan Co. Engineering. We will verify that the pump and system are properly matched to protect your investment.*

   *CAUTION*

   Pump speeds and operating conditions must fall within the acceptable limits of the performance curve of the pump.
VAUGHAN SUBMERSIBLE SE SERIES CHOPPER PUMP
STARTUP AND CERTIFICATION CHECKLIST

Pump Serial No. ______________________ Date: ______________________
Contact name of person performing startup: ______________________
Contact phone number: _______________________
Pump shaft turns freely by hand? YES □ NO □
All piping attached to pump is being independently supported? (not by the pump) YES □ NO □
All piping joints are leaktight? YES □ NO □
Pump is turning CW as viewed from the motor end? YES □ NO □
Moisture Sensor Relay connected and tested to ensure proper function? YES □ NO □

ELECTRICAL DATA
Motor Mfr: _____________________ HP: ____________ RPM: ___________
Nameplate Voltage: __________ Nameplate F.L. Amperage: ___________
Operating Voltage: L1-L2 ________ L2-L3 ________ L1-L3 ________
Operating Amperage: I1 ________ I2 ________ I3 ________

SYSTEM DATA
What type of material are you pumping? ______________________________
____________________________________________________________
Temperature (degF) ______ Specific Gravity ______ %Solids ________
Describe your piping system: Total equivalent length of pipe _________FT
Pipe size: _____ in. Elevation change from water level to disch point (ft.) _____
Estimated Total Head (ft): ____________ Required Flow (GPM): ____________
PUMP OPERATING DATA

Pump Model _____________________   Impeller Diameter _______________

Discharge Pressure (psig) __________   Dim "Z1" ___________________ feet
Suction Pressure ________________

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.
SECTION 6: NORMAL PUMP OPERATION

A. 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.) Also, there are times, particularly at startup, when the pit may be in bad condition, and an otherwise quiet running pump will be fairly noisy, due to the large amount of chopping and conditioning work that the pump must do. In time, the pump noise should dissipate as the majority of the difficult material is broken up and homogenized.

B. VIBRATION

Vibration, like noise, should be minimal in the pump unless the pump is doing heavy chopping. If a particularly tough rag, or nylon pantyhose gets caught in the pump, temporary dynamic imbalance and some flow blockage will occur until the rag is chopped up and cleared. These conditions will create vibration that is undesirable. But this condition is generally only temporary, and the chopping action of the pump normally clears the obstruction with time.

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. The pump shaft is very tightly held by ball bearings so that there is virtually no shaft movement.

The most important action that you can take to eliminate vibration during operation is to make sure that you have a firm, solid, massive foundation to bolt the pump to during installation. Also, during repair, following the Vaughan Overhaul procedures and using Vaughan parts will give you the best chance of keeping your pump operating as smoothly as possible over time. And finally, pumping liquid below 40 deg C or 65 deg C (see page 10) and operating the pump within the allowable head/flow (solid line) portions of the performance curve will make sure that the pump does not cavitate and vibrate.

C. MOTOR OVERLOADS

A motor overload is not part of normal operation, but can happen more often in a chopper pump than in other types of “non-clog” pumps because of unpredictable chopping demands. 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. 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 unchoppable is stuck in the pump before you ruin this expensive motor.

D. EXPECTED BENEFITS OF VAUGHAN PUMPS

Most customers who install a Vaughan pump see several advantages:

1. Minimal pump attention required.
2. Minimal chances of pump plugging.
3. Minimal chances of loss of prime due to air binding.
4. Minimal problems downstream because material is preconditioned.
5. Minimal ancillary equipment required for grinding or comminuting or for mixing.
SECTION 7: 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.

DANGER
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 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. 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.

SECTION 8: 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.

ANNUALLY:

Remove pump from the pit and inspect for wear or damaged parts.

Isolate the pump electrically (open breakers) and remove pump from the pit. Inspect for suction blockage and check impeller clearance from cutter bar. The desired gap at the cutting edges is 0.010–0.020”.

If adjustment is necessary, the clearance can be adjusted externally by modifying the position of the rotating assembly. The entire rotating assembly, including the impeller, moves in and out of the casing to adjust the impeller-to-cutterbar gap. The cutterbar assembly bolts directly into the casing without shims.

To adjust (see diagram above and on Page 15):

a. Loosen the nuts and thru bolts at all (8) adjusting sleeve locations.

The adjusters can be moved in/out by completely removing the nut / thru bolt and using an Allen wrench.

Back off all adjusters (turn counterclockwise).
b. Choose (3) of the adjusting sleeves (approximately equally spaced) to adjust the gap between the backplate and the casing flange.

By turning the sleeve in a clockwise direction, you are increasing the gap between the backplate flange and the casing flange, which results in a greater clearance between the cutterbar and impeller.

Use a feeler gauge to ensure that the gap is equal at each adjusting sleeve (approximately 3/16”).

c. Once the gap is equal, be sure to turn each of the (3) adjusting screws an equal amount to keep the casing flange parallel to the backplate, which will also keep the impeller parallel to the cutterbar.

d. Use the adjusting screws to move the casing/cutterbar either in or out from the backplate to achieve 0.010” – 0.020” impeller- to-cutterbar clearance.

Note: Depending on the pump model, one full turn of the adjuster is equal to 0.063” - 0.072”. Turning the adjuster one “flat” or one “point” is equal to about 0.010” - 0.012”.

e. Once the impeller-to-cutterbar clearance is correct, tighten the (5) unused adjusting sleeves against the casing flange and lock down with thru bolts and nuts.

After all nuts and thru bolts are tightened, check for smooth shaft rotation by rotating the pump’s 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 casing and adapter bracket for wear and replace as necessary. Check for loose, corroded or worn hardware and tighten or replace as necessary. Refer to the Overhaul manual for submersible pumps for more details. If needed, replace impeller and cutter bar as required.

B. CORRECTIVE MAINTENANCE

Because overhaul of a Vaughan submersible 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.

For more information, visit our chopperpumps website at http://www.chopperpumps.com
**SECTION 9: TROUBLESHOOTING**

The following table deals with pump and system problems but not with motor problems. The warranty for Reliance motors is covered by Reliance Electric. The warranty for Yeomans motors is covered by Yeomans Chicago Corporation. Before contacting Reliance or Yeomans, please contact Vaughan Co. for advice.

Attached to this section is a troubleshooting chart that will help you get some idea of what symptoms could cause what problems. If you would like help, please call Vaughan Co. Engineering for troubleshooting help. We’ll be glad to offer assistance.

<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th>Short Life of Pumping Parts</th>
<th>Low Discharge Pressure</th>
<th>Contamination of Oil</th>
<th>Excessive Power Required</th>
<th>Abnormally High Vibration</th>
<th>Short Bearing or Seal Life</th>
<th>Pump Binding or Plugging</th>
<th>High Brng Temp</th>
<th>Low Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POSSIBLE PROBLEMS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SUCTION PROBLEMS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insufficient NPSH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Binding of Pump (air trapped in eye of impeller)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vortexing in Pit at Inlet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake Openings Blocked</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SYSTEM PROBLEMS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Speed High or Impeller Dia. Too Large</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Speed Low or Impeller Dia. Too Small</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid Excessively Hot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Too Near Wall or Floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Rotation Incorrect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Head Too High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Head Too Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive Strain or Weight on Pump Flange</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumped Fluid Abrasive or Corrosive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Gravity Higher than Expected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity Higher than Expected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation at Low Capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improper Parallel Operation of Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improper Series Operation of Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ELECTRICAL PROBLEMS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase-to-Ground Leakage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MECHANICAL PROBLEMS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Discharge Blocked</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misalignment of Pump/Driver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation not Rigid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Tool Wrapped with Rags</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worn Bearings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Seal Failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bent Shaft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutter Bar Insert or Impeller Worn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impeller Damaged or Loose on Shaft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shaft Running Off Center</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Lubrication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improper Repair/Installation of Bearings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirt in Bearings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impeller hitting internal cutter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WARRANTY

Vaughan Co., Inc. warrants all pumps and pump parts manufactured by it to be free from defects in workmanship or materials for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Vaughan Co. 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, transportation charges prepaid, and if the pump or pump parts are found to be defective in workmanship or materials, they will be replaced or repaired free of charge, F.O.B. Montesano, WA. 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. assumes no liability for the consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Vaughan Co. products by the purchaser, his employees or others. Vaughan Co. will not be held responsible for travel expenses, rented equipment, outside contractor’s fees, or unauthorized repair service or parts.

This warranty shall not apply to any product or part of product which has been subjected to misuse, accident, negligence, operated in the dashed portion of the published pump curves, used in a manner contrary to Vaughan printed instructions or damaged due to a defective power supply, improper electrical protection or faulty installation or repair. Wear caused by pumping abrasive or corrosive fluids is not covered under warranty.

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.

THIS IS VAUGHAN CO.’S SOLE WARRANTY AND 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.

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 become his exclusive responsibility.
<table>
<thead>
<tr>
<th>REVISIONS</th>
<th>DATE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>REV1</td>
<td>NOV00</td>
<td>Revised instructions for adjusting sleeves</td>
</tr>
<tr>
<td>REV 2</td>
<td>MAY01</td>
<td>Updated instructions for adjusting sleeves</td>
</tr>
<tr>
<td>DEC07</td>
<td></td>
<td>Revised Startup Checklist for Moisture Sensor Relay (REV 2A, page 11 only)</td>
</tr>
</tbody>
</table>