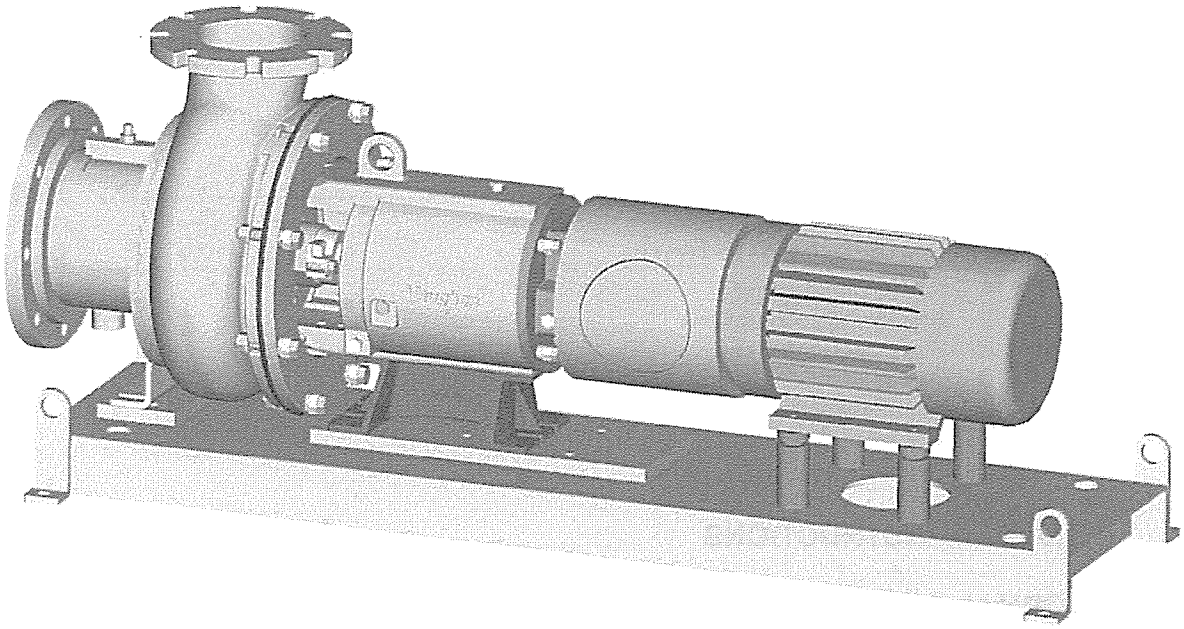
HORIZONTAL PUMPS
HE SERIES



INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

VAUGHAN COMPANY, INC.

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SECTION 1: CAUTIONS AND WARNINGS

DANGER!

- Wear eye protection, rubber gloves, and aprons when working on or inspecting this pump.
- A pump with a tandem seal may have pressure built up in the seal oil chamber. Make sure that the pressure relief valve is vented carefully with the pull ring before service.
- 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.
- 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.
- 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 may start automatically if wired to float switches or other equipment. Before inspecting or working on this equipment, always isolate electrical power.
- Keep hands, feet and clothing away from moving machinery.
- 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.
- 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 form 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.

DANGER!

- Pressure may buildup in the standard mechanical seals used in Vaughan Horizontal or Pedestal pumps. Whenever checking or maintaining the oil in the Vaughan Cartridge Seal, or the Eagle welded metal bellows seal with seal oil chamber, make sure the pump and seal are cool to the touch and use care when removing the oil chamber plugs, in case any residual pressure exists. If pressure exists, plug could become a projectile and/or contaminated oil could spray.

CAUTION!

- This pump uses oil which if spilled can cause a slipping hazard and danger to personnel.
- 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.
- Lift pump and motor by pump lifting eyes only. Lifting by any other parts of this equipment may be dangerous or may damage equipment. Do not lift pump and motor assembly using the motor lifting eye.
- 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. Do not allow people under pump assembly while it is being lifted.
- Do not operate this equipment unless safety guards or devices are in place and properly adjusted.
- 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.
- Never clean, oil, or repair machinery while in motion.
- 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.
- Keep all pit openings covered when not in use. Open pits may contain poisonous gasses or fluids that can injure a person in addition to the falling injuries.
- Make certain all personnel are clear of equipment before operating.

SECTION 2: DESCRIPTION OF THE VAUGHAN E-SERIES HORIZONTAL CHOPPER PUMP

The Vaughan end-suction horizontal chopper pump is specifically designed for pumping debris-laden liquid slurries. Debris is chopped by the pump impeller slicing against it at the suction plate or "Cutter Bar" as it enters the pump, so that particle size is reduced and down-stream plugging problems are greatly reduced. In this way the pump impeller serves a dual function of both pumping and chopping.

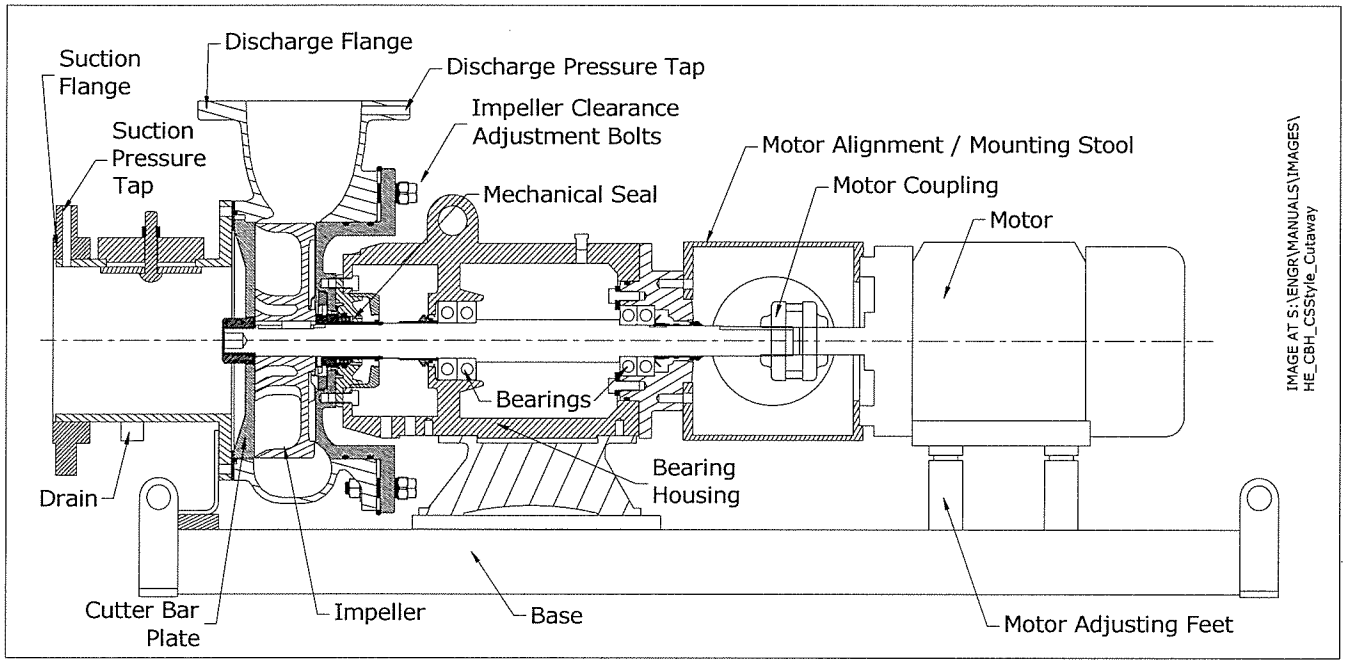
The HE Series chopper pumps offer additional improvements over the previous standard horizontal chopper pumps:

1. The back pullout casing design allows for easy removal of the rotating assembly without disconnecting suction or discharge piping.
2. The impeller-to-cutter bar and impeller-to-upper cutter clearances 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.
4. The HE Series with Vaughan Cartridge Seal has the additional advantage that it does not need a water flush to the mechanical seal.

A. DESCRIPTION OF MAJOR COMPONENTS

CHOPPER IMPELLER: The impeller on the Vaughan pump serves two purposes. It induces flow by propelling liquid material through the pump casing, and also chops solids by slicing against the cutter bar. The leading edge of each impeller blade is sloped forward to create a knife edge. As material enters the pump, it is caught and cut between the knife edges on the impeller blades and the stationary bars of the cutter bar. The standard impeller is made of cast steel and is heat treated to Rockwell 60C.

CUTTER BAR PLATE: The cutter bar plate serves two functions. First, it serves the function of a "wear plate", sealing the intake of the pump. The pressure generated by the impeller is kept inside the pump by the close clearances between the cutter bar plate and the impeller. Second, the cutter bar plate includes two shear bars which span the entrance to the pump. Material is chopped by the pump impeller cutting against these stationary shear bars. The standard cutter bar is made of alloy steel and is heat treated to Rockwell 60C.

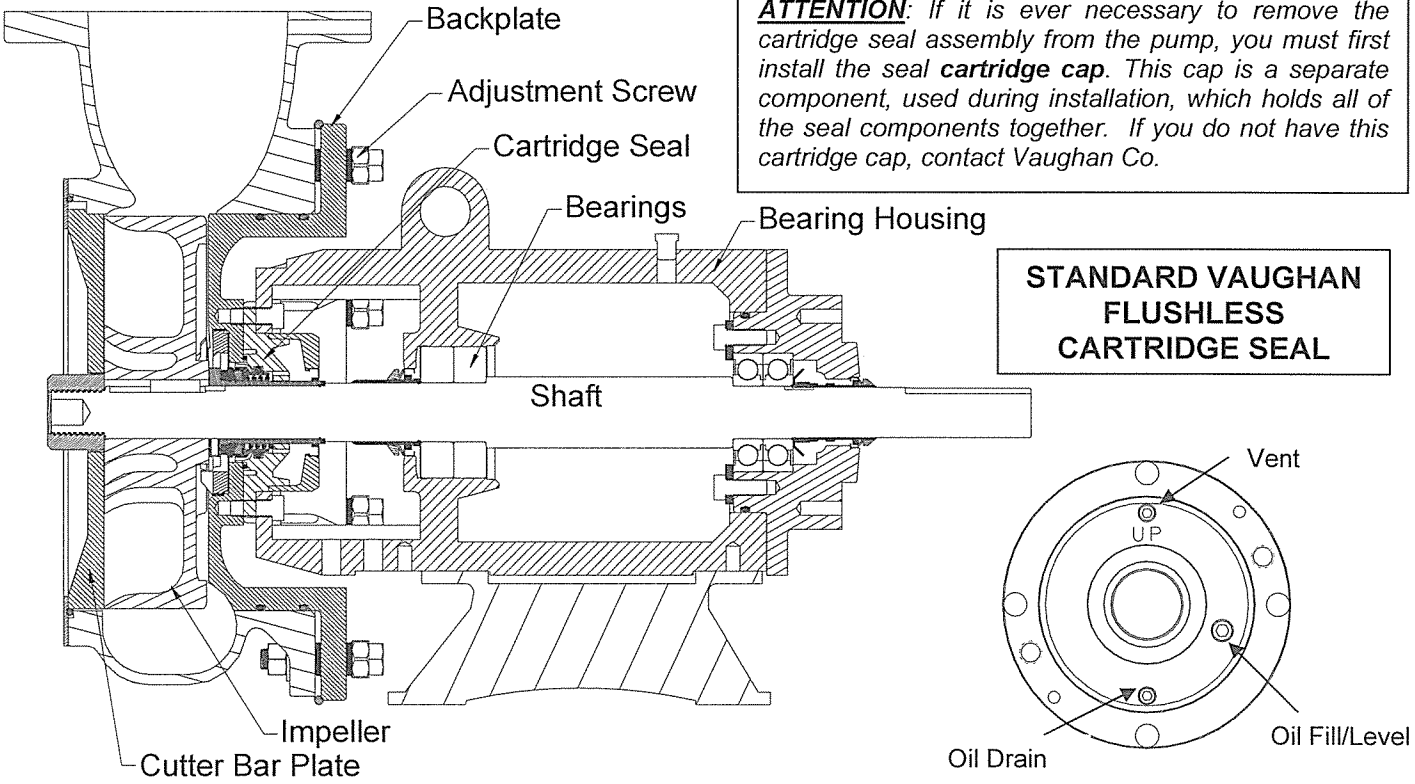


DISINTEGRATOR TOOL: The disintegrator tool, used only when appropriate, is an auxiliary cutter to help prevent blockage at the suction end of the pump. Matted or solid material which would tend to block the opening of the pump can be broken by this tool so flow can continue into the pump. The disintegrator tool is particularly helpful in vegetable and manure pumping. This tool can cause problems if misapplied, because stringy material such as rags, hair, and other fibers can wrap on it and make a ball that can eventually block flow into the pump. If the pump is installed with a disintegrator tool, and suction blockage becomes a problem due to wrapping, the tool should be removed and replaced with a hardened set screw available from Vaughan Co. or from a local bolt house.

MOTOR MOUNTING: Vaughan horizontal End-Suction pumps are usually directly driven by C-Face electric motors through a TB Woods Sure-Flex elastomeric coupling. The motors are rigidly mounted to the pump bearing housing by a machined and piloted motor stool. This piloted mounting ensures proper motor and pump shaft alignment without requiring special alignment of the motor and pump shafts at your plant. If your pump is belt-driven, it will either have the motor mounted to the side of the pump or overhead, depending on how it was ordered. Belt driven pumps have arrangements for motor movement to adjust the belt tension. It is advisable to use flexible conduit to the motor so that the motor can moved with the rotating assembly for adjustment or service to the wetted parts of the pump.

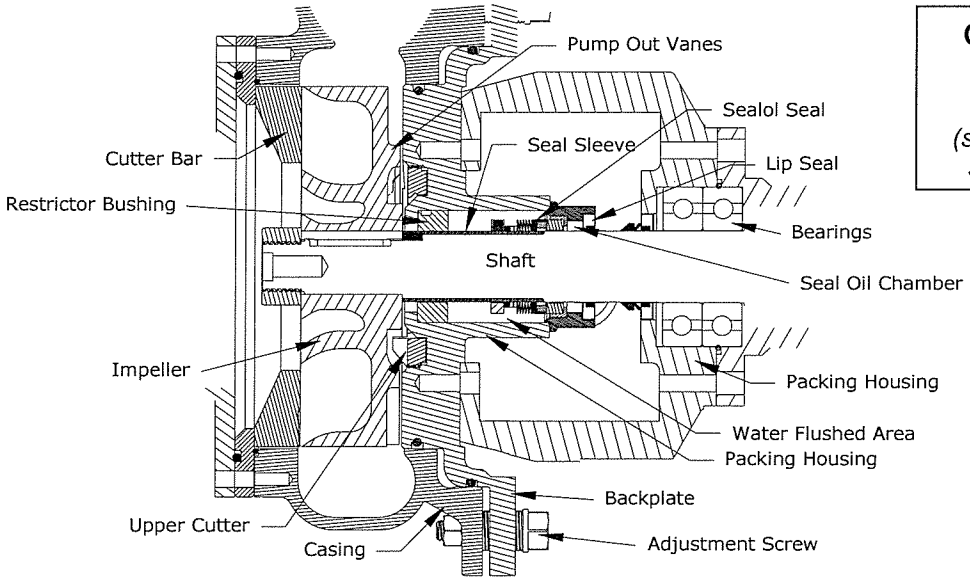
FLUSHLESS MECHANICAL SEAL (Vaughan E-Series Cartridge Seal, STANDARD): The HE Series End-Suction Chopper Pump is usually supplied with a Vaughan flushless, cartridge-type mechanical seal placed directly behind the impeller, shown below. **This seal will not require any water flush to keep it clean.** The only maintenance required of the Vaughan Cartridge Seal is a yearly check of the oil condition. There are two 1/8" and one ¼" pipe plugs located on the outboard end of the seal. If you find oil that is contaminated or dirty, it can be changed. Drain the oil and refill (see diagram below). For 3"-6" pumps, use 2 oz. and for 8"-12" pumps, use 6 oz. of ISO 46 Turbine oil to refill. This will fill the seal approximately 1/3 full, which is correct.

***ATTENTION**: If it is ever necessary to remove the cartridge seal assembly from the pump, you must first install the seal **cartridge cap**. This cap is a separate component, used during installation, which holds all of the seal components together. If you do not have this cartridge cap, contact Vaughan Co.*



DANGER: Pressure may buildup in the standard mechanical seals used in Vaughan Horizontal or Pedestal pumps. Whenever checking or maintaining the oil in the Vaughan Cartridge Seal, or the Eagle welded metal bellows seal with seal oil chamber, make sure the pump and seal are cool to the touch and use care when removing the oil chamber plugs, in case any residual pressure exists. If pressure exists, plug could become a projectile and/or contaminated oil could spray.

MECHANICAL SEAL (Welded bellow type, NON-STANDARD): The HE series End-Suction Chopper pump may also be supplied with a welded bellows mechanical seal with silicon carbide faces. This seal system can be used safely without a seal flush in sewage lift stations where the pumpage is mostly water. For best seal life in sludge or abrasive slurries, always flush the seal chamber with 6-10 GPH of water from a seal flush system pressurized to at least 10 psi above the pump discharge pressure. A flow control device, such as a Rotameter, should always be used to throttle the flow to 6-10 GPH. (Too much flow and pressure can erode the insides of the stuffing box.) See the recommended seal flush installation diagram on page 11.



OPTIONAL WELDED BELLOWS SEAL

(standard flushless cartridge seal is shown on page 4.)

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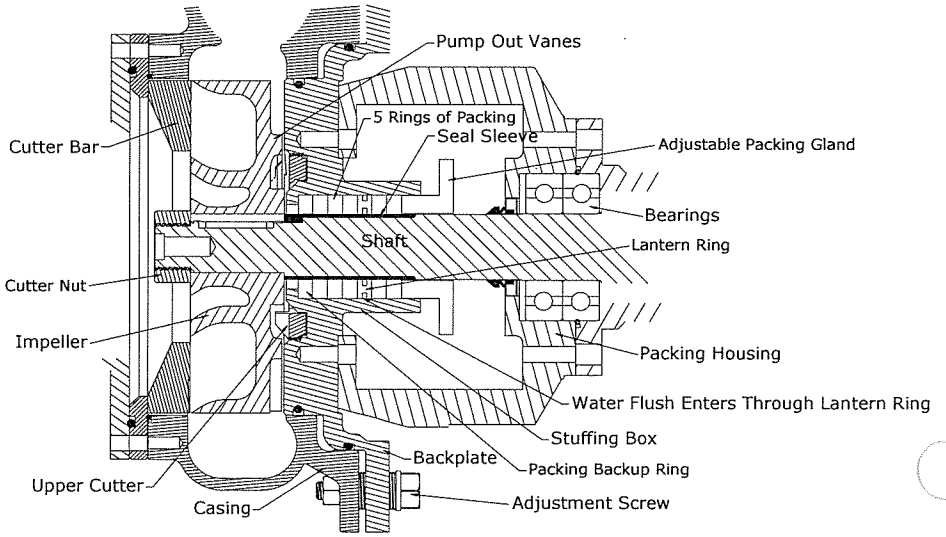
PACKING (NON-STANDARD): If your pump was ordered with packing, the packing is typically ½" TFE-impregnated graphite packing with reinforced Kevlar corners. The lantern ring is split glass-filled TFE. All packing components run on a Nickel-Chrome-Boron coated 316 stainless steel shaft sleeve. Packing should always be water flushed. Grease flushing of packing is rarely a reliable method of cooling and lubricating packing. Supply 6-10 GPH seal water at a pressure of about 10 psi above pump discharge pressure. Regulate seal water flow and gland nut tightness until about 6-10 drops per minute leak externally from the packing.



OPTIONAL PACKING ARRANGEMENT

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 chopping the pumpage is that a more homogenous slurry is pumped, making some slurries pumpable that would normally not be, and eliminating downstream plugging in piping and other equipment. Screens located upstream of the pump may often be eliminated, which will cut labor costs. Vaughan pumps are routinely used to pump the following slurries:

1. Sewage and sewage sludge
2. Fish waste.
3. Vegetable waste.
4. Mill scale.
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.
9. Animal manures (dairy cow, pigs, and chicken).
10. Feathers mixed with blood and water in poultry plants.
11. Animal fat in rendering and hide processing plants.
12. Plastic debris.
13. 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 or bearings due to cavitation and the resulting vibration. Vibration will damage mechanical seals and bearings fairly quickly.

Common rules of thumb include:

1. A pump must be operated in the safe portion of its pump performance curve. Operation in the dashed lines indicates vibration areas.
2. Operating a pump against very low backpressure damages pumps.
3. Operating a pump against too much backpressure damages pumps.
4. 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.
5. When pumping materials that float or settle in a pit, mixing and chopping with the pump may be required before pit pumpout. This can be done by initially directing the discharge back into the pit.
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 will stall during chopping of debris.

D. EXPECTED BENEFITS OF VAUGHAN PUMPS

Most customers who install a Vaughan pump see several advantages:

1. Minimal pump attention is required.
2. Chances of pump plugging or binding on tough solid or fibers are minimized.
3. Minimal plugging problems downstream, because the material is preconditioned.
4. Elimination of ancillary grinders or comminutors upstream of the pump.
5. Long and reliable life of the Vaughan pump.

VAUGHAN HORIZONTAL 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 guards are in place?	YES ☐	NO ☐
All piping attached to pump is being independently supported? (not by the pump)	YES ☐	NO ☐
Is the pump casing vented and filled with liquid?	YES ☐	NO ☐
All piping joints are leaktight?	YES ☐	NO ☐
Pump is turning CW as viewed from the motor end?	YES ☐	NO ☐
Is the oil level in the middle of the range of the sight glass? Is the vent in the top bearing housing plug open?	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 (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): _____

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PUMP OPERATING DATA

Pump Model _____ Impeller Diameter _____

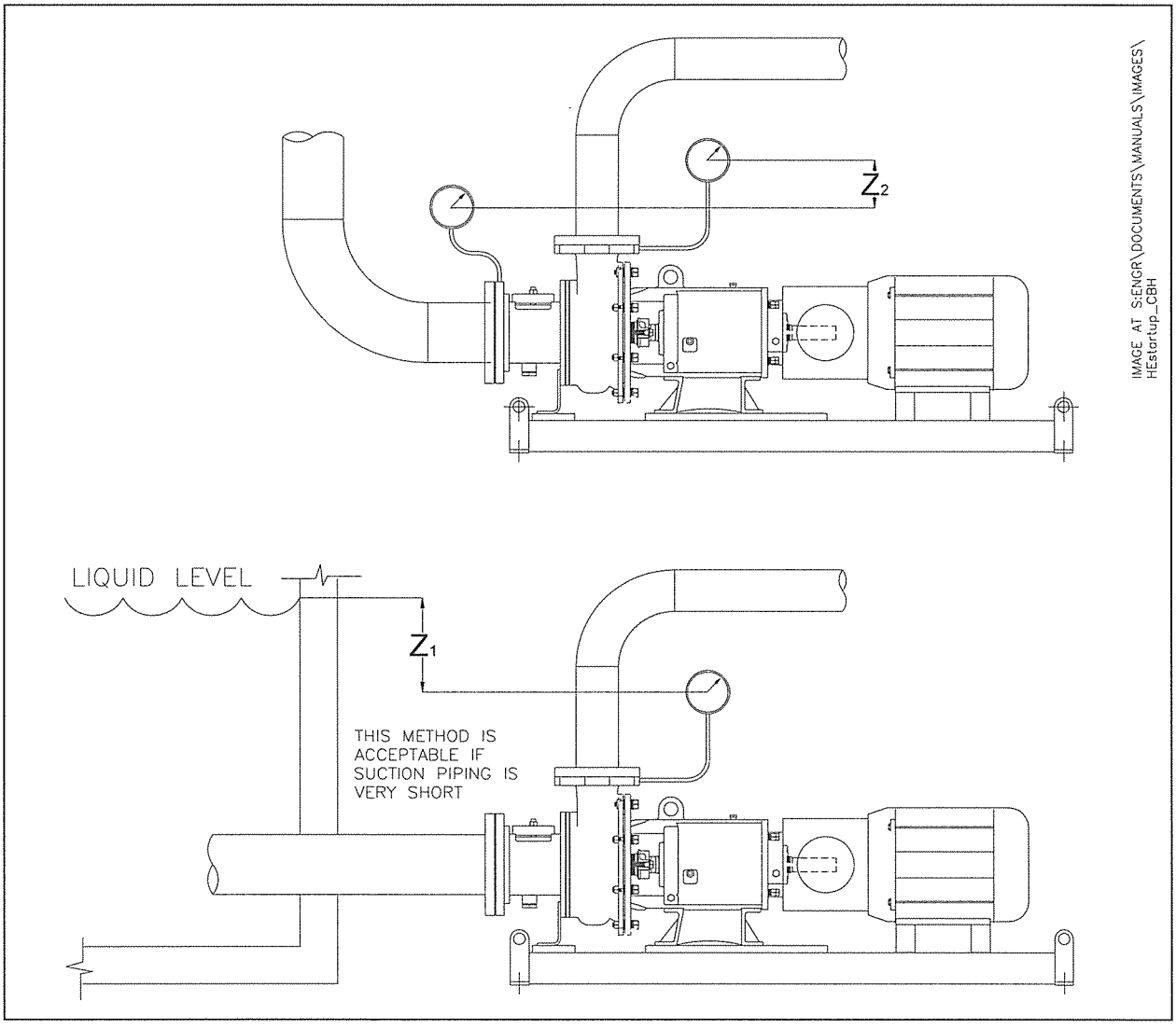
Discharge Pressure (psig) _____ Dim "Z1" _____feet
(distance from liquid level to pressure gauge)

Suction Pressure (psi or in. Hg if negative)_____, Dim "Z2" _____ feet.
(vertical distance between gauges)

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 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. 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 cutter bar. Otherwise, shaft binding could indicate damage. If damage has occurred, report to your carrier immediately, and consult your local Vaughan representative.

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 to protect the equipment from corrosion.
2. Rotate the motor 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 cause damage to the ball bearings and cause 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. PUMP MOUNTING

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.

Vaughan pumps are heavy and will require a crane to lift into position. Lifting the pump by the lifting lugs at the base is always a safe method for lifting. Do not lift by the motor eye unless the pump has no lifting eyes at the motor end. In these cases, lift with a three point sling; one on the motor eye and two on the base eyes.

Anchors:
Vaughan pumps should be securely bolted to a level, flat floor or slab with stainless steel anchors to minimize operational vibrations. Expansion-type, cast-in place J-bolts, bolts mounted in sleeves, and epoxy anchoring systems are all acceptable anchoring means. Pumps 3-6" discharge size use 4, ½" x 7" long; pumps 8-12" size typically use 6, ¾" x 7" long anchors.

Leveling the Base:
Vaughan Co. assembles and aligns the completed pump and motor assembly on a level surface at the factory and runs the pump at speed to measure dry-run vibration levels and to ensure that no metal-to-metal contact occurs. If the base is not mounted to a level, flat surface in your installation, twisting of the base and pump could occur that can cause metal-to-metal hitting of the cutting parts during operation. Careful shimming is required to properly align the suction piping to the pump and to ensure that the pump base is level (not twisted) and properly aligned to the suction piping. As the pump is shimmed, turn the pump shaft over by hand to ensure that no metal-to-metal contact is occurring. *If metal-to-metal contact is discovered during pump startup and actual pumping, additional shimming may be required to take additional twist out of the base and pump.* Do not completely tighten the anchors until grouting is completed and is properly hardened. Note that this pump is expected to be mounted horizontally. If mounted at an angle, both sets of bearings may not receive adequate oil lubrication. Consult factory as grease lubricated bearings may be required in this situation.

Grouting:
Vaughan Co. recommends that all horizontal pumps be grouted in place. Standard horizontal baseplates include grout holes and vents to facilitate grouting. The purpose of grouting is to prevent shifting of the baseplate, to reduce vibrations (by increasing mass), and to fill in irregularities in the foundation. A typical mixture for grout is one part portland cement and two parts building sand combined with enough water to allow grout to flow under the base. Wet the concrete foundation before grouting the pump in place. A wooden form is needed around the pump base to retain the grout. Add grout until the entire underside of the pump base is filled, working air out with a stiff wire or rod through the grout holes. Cover the exposed grout with wet cloth or burlap to prevent cracking during setup. Remove the wooden forms once the grout is setup and then smoothly finish the exposed surfaces. Fully tighten the anchors only after the grout is completely hardened. Shims used for leveling and alignment may be left in place.

Direct-Drive Motor Adjusters:
Horizontal direct-drive pumps use a machined motor stool aligned to the motor C-Face end bell so that pump/motor coupling alignment is assured. Threaded adjustable motor supports are provided under each of the motor feet that are designed to just touch the pump base when aligned at the factory. The adjusters are held in place by a set-screw. After shimming and grouting, loosen each motor adjuster set-screw and reset the adjusters to that they just touch the base, then re-tighten the set-screw.

Belt-Drive Adjustments:
Horizontal side-mount belt-drive pumps have been aligned at the factory on a flat surface, but since your mounting surface may not be flat, you will need to loosen the belts and re-adjust the belt tension and alignment. (Overhead belt-drive systems may not require any belt-drive adjustment.) Belts that are too tight can cause premature belt or bearing failures, belts that are too loose may experience belt slipping and belt failure. First, align the sheaves to a long straightedge to ensure that the 4 edges of the sheaves all touch the straightedge. Then use a belt tensioning device (available from TB Woods or Browning) to properly adjust the belt tension. Vaughan's bill of material (BOM) for your particular pump and belt-drive system lists the belt tension required by the drive manufacturer. Please request the pump BOM from Vaughan Co. if you don't have it.

D. PIPING

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

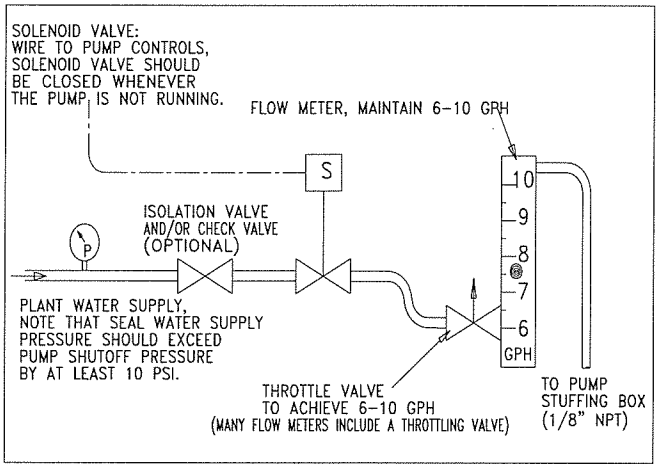
Be sure that the weight of piping connected to the pump suction and discharge flanges is properly supported. Do not expect the pump to support your piping system, as this may cause large stresses on the pump and may cause metal-to-metal interference problems during actual pump operation due to distortion of the pump or base. These stresses can result in a broken or cracked casing or premature bearing and seal failures, as well. Before bolting up piping to the pump, make sure that flanges are closely aligned.

Great care should be taken with suction piping on horizontal and pedestal pumps to avoid restricting flow to the pump. Avoid bends and fittings and keep suction piping as short as possible and as large as possible. *Suction piping must be as large or larger than the pump suction flange*. Long and restrictive runs of suction piping can contribute to gas binding problems, especially in scum and sludge transfer applications. Never install a check valve in the suction piping.

Remember that sludges have significantly higher friction losses than water, so larger diameter piping is always helpful when pumping this material. Maintaining suction velocity below 8 ft/sec is helpful. If you are pumping uphill or into a force main, or if there is more than one pump pumping into a common header, a check valve and an isolation valve will be required on the discharge of the pump. Note that Vaughan pumps have pressure taps on the suction and discharge flanges for installation of pressure gages for testing purposes, particularly important at pump startup.

E. SEAL FLUSHING

The standard mechanical seal used in Vaughan pumps since 2003 is the Vaughan flushless cartridge seal, designated "CS" in the pump model. This seal requires no external flush and is cooled and lubricated by the oil chamber that is part of the seal assembly. Other mechanical seals may be installed in your pump if it was specified this way. Seals other than the Vaughan flushless seal must be flushed with at least 6-10 gallons per hour of clean water. There is a 1/8" NPT fitting on the stuffing box for this purpose. The seal water must be supplied at a pressure at least equal to pump discharge pressure, and regulated with a flow meter to the proper flow of 6-10 GPH. A solenoid valve must be installed to switch the water on and off with the pump motor. A schematic of this system is shown above.



F. MOTORS AND CONTROLS

Most motors provided on Vaughan pumps are TEFC C-Face 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 circuit breaker. The circuit breaker should *never* open during chopping, only during a short circuit. The starter overloads should trip out on overload, and are typically size for 110% of motor full load amperage rating.

As discussed earlier, it is a good idea to run flexible conduit to the motor to facilitate the back pullout advantages of this pump.

G. HORIZONTAL BEARING SYSTEM

Horizontal Chopper pumps have oil-bath bearing lubrication. The proper oil is ISO grade 100 turbine oil. Oil level is indicated by a sight glass mounted on the side of the bearing housing. For HE pumps, the oil level is correct when oil is in the center of the sight glass. Overfilling the bearing housing can cause heating and oil spillage. The pump must be mounted horizontally.

SECTION 5: PUMP STARTUP INSTRUCTIONS

CAUTION

If the pump is allowed to run backwards for any significant length of time, the impeller can loosen, and eventually damage the pump.

CAUTION

Pump speeds and operating conditions must fall within the acceptable limits of the performance curve of the pump, not on the dashed portions of the curve.

1. All directly-driven Vaughan pumps using C-Flange electric motors are

designed and built for automatic alignment of motor and pump shafts during assembly. If your motor has feet, (4) motor adjusters will have been supplied with your pump. Tighten just enough to support the weight of the motor but no more. Check coupling offset alignment before startup to ensure motor adjuster feet have been properly adjusted. Belt-driven pumps and bare pumps purchased from Vaughan Co. and mounted on customer or dealer-supplied bases will require careful alignment of pump and motor shaft before startup.

2. Perform a pump rotation check to ensure Clockwise rotation (as viewed from the motor end) before startup. At the control panel, hit the "ON" button, then the "OFF" button as fast as possible to "jog" the motor at a slow rate. If the motor turns clockwise, you are ready to start the pump. If the motor turns counterclockwise, (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 reverse any two leads on the motor starter in the control panel. Close the breakers to the panel and recheck the motor direction to be sure it's correct.

3. When the startup checklist is completed satisfactorily, review the safety warnings at the beginning of this manual and then start up the pump. To protect your investment, please complete the STARTUP AND CERTIFICATION CHECK-LIST and send or FAX a copy of it to Vaughan Engineering so we can verify that the pump is properly matched to your system.

SECTION 6: NORMAL OPERATION

A. NOISE

Most Vaughan pumps operate at either 1170 or 1750 RPM. At these speeds, the pump is normally quiet running, and the major source of noise is the electric motor. (Higher horsepower, higher head pumps, of course, are noisier.) Sometimes at startup a tank may be full of debris, and the pump will be fairly noisy due to chopping it. This noise should dissipate as the debris is broken up and/or pumped out.

Note that 3510 RPM pumps will be somewhat noisier. At this speed, the normal operating noise will be fairly high (85-90 dbA). Much of this noise will be from the motor fan, but there will be some hydraulic noise. Pay particular attention to the pump casing noise on all pumps. If there are any crackling noises coming from the pump casing, (as if pumping marbles) this could be evidence of cavitation. If these noises persist, please call Vaughan Company to discuss. Cavitation can damage a pump in a very short time period.

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 an unbalance and vibration. This condition is generally short-lived, and the chopping action of the pump normally clears the obstruction in a short time.

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 less than 0.1 ounce/inches per second of imbalance. The pump shaft is fully machined to be straight and tightly held by ball 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.

SECTION 7: SHUTDOWN INSTRUCTIONS

A. MANUAL SHUTDOWN

DANGER
Be sure to turn off electrical power by opening the breaker at the control panel and by following all plant safety procedures before working on the pump!

In the manual mode of operation, a Vaughan pump is shut down by pushing the "off" button or turning the auto/man/off switch to the "off" position on the front 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.

B. AUTOMATIC SHUTDOWN

Automatic operation will normally shut the pump down, usually on low pit level. If the pump does not shut down when the pit is empty, the pump may be shut down manually, but you should troubleshoot your level control system to find out why the automatic operation is not working properly. Continued operation of the pump during "snoring" will damage the pump. "Snoring" is a condition where the pump is operating while alternately drawing water and air. The differing loads on the impeller shaft cause high stresses and vibrations that can quickly result in damage.

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 shut down, operate the manual off switch or push-button 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. Be sure to tag the breaker so everyone will know not to turn it back on.

SECTION 8: MAINTENANCE

A. ROUTINE MAINTENANCE

MONTHLY:

1. Check amperage draw to the pump motor and compare to amperage measured at startup. Make sure that amp draw does not exceed allowable amperage to the motor at full load.
2. Check for seal or packing leakage at the stuffing box area. Adjust packing leakage to 6-10 drops per minute, if applicable. If seal leakage is evident, the seal faces can be cleaned (Non-Vaughan seal only). Isolate the pump hydraulically and electrically, (See all warnings at front of manual!) drain intake manifold, remove the 2 bolts on the seal gland, and pull the gland back on the shaft to clean the seal faces. Use isopropyl alcohol or oven cleaner. If cleaning the seal faces does not stop severe leakage, consult the Vaughan Overhaul Manual for instructions on how to replace the mechanical seal.

QUARTERLY:

1. Motor: Inspect electric motor. Make sure that motor drain is not plugged with debris. Clean cooling fins so that dirt buildup will not affect cooling ability of motor. Check for loose or corroded hardware and damaged wiring or conduit.
2. Pump: Inspect pump for loose hardware. Make sure that pump is operating smoothly and without vibration or cavitation.
3. Check bearing housing oil level. It should be located at the center of the sight glass.

SEMIANNUALLY:

1. Grease motor bearings with bearing grease as specified by the manufacturer.
2. Perform all quarterly inspections as shown above.

ANNUALLY:

1. **Check the clearances between the impeller and cutting surfaces.**

Isolate the pump electrically (open & tag breakers) to make sure that the motor can't start accidentally and adjust the clearance between impeller and cutting surfaces. This can be done without any pump disassembly. Remove a motor stool cover and rotate the coupling by hand. Feel for bearing roughness or cutter contact. If the bearings are rough consider overhauling the pump to change bearings.

There are two sets of external adjusters, one set for the impeller/cutterbar gap, and one for the impeller/upper cutter gap. (Refer to the photo that fits your pump on page 16)

Impeller-Upper Cutter Adjustment

Adjust the clearance between the back side of the impeller and the upper cutter before adjusting impeller to cutter bar clearance. HE pumps with a skinny bearing housing don't have external upper cutter adjustments. If you have this model, skip this step. Please follow the following procedures closely. It is important to note that if the adjustment sleeves are turned the wrong way, interference will be felt as described but it will be interference on the front side of the impeller instead of the back. This will cause a confusing problem during the next step when the front clearances are adjusted.

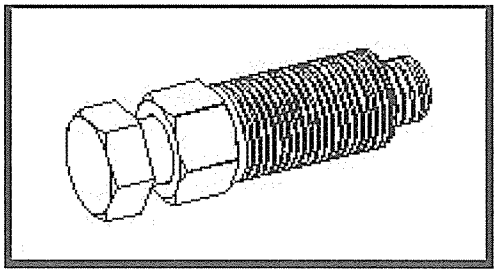
a. Loosen the bolts holding the bearing housing to the baseplate. The motor feet are not bolted to the baseplate. *Don't change the motor feet adjustment!*
b. The upper cutter adjustment is done by adjusting the thrust bearings at the motor end of the bearing housing. Loosen each of the four clamp bolts on the bearing housing cap about ½ turn.
c. To move the impeller closer to the upper cutter, (normal maintenance) rotate each of the adjustment sleeves one flat clockwise (it is important to turn them exactly the same amount to keep everything parallel), and then tighten the clamp bolts onto them. Repeat this step until you feel interference (by turning the coupling by hand) between the impeller and the upper cutter. Once interference is felt, move the impeller back only until it is free. To move the impeller away from the upper cutter, loosen the clamp bolts, rotate the adjustment sleeves *counter clockwise* and then retighten the clamp bolts.

Impeller-Cutter Bar Plate Adjustment

Once the upper cutter adjustment is complete, the cutter gaps on the front of the impeller can be adjusted. The clearance can be adjusted externally by modifying the position of the rotating assembly. To make this adjustment you will be moving the entire rotating assembly, including the impeller, backplate, bearing housing and motor in or out of the casing.

To begin, loosen and back off all of the nuts on the adjustment sleeve clamping bolts between the casing and the casing backplate. Back all adjusting sleeves away from the casing (counter clockwise) except for three approximately equally spaced sleeves that you will use for making the adjustments.

Adjusting Sleeve & Clamp Bolt



a. Adjustment is accomplished by rotating each of the three equally spaced adjusting sleeves counter clockwise by an equal amount, then tightening the clamping bolts onto them and checking for contact by rotating the shaft again. This step may have to be repeated a couple of times if the pump has some wear on it. Each flat of rotation of the adjustment sleeve hex nut is worth .010" to .012" of cutter movement. Typically the pump won't have more than .020" to .050" of wear.

b. After achieving light contact, find a piece of key stock or other shim material that is slightly larger than the gap now present between the backplate and casing flanges. This will probably be about 3/16" to ¼". Turn the (3) adjustment sleeves clockwise and adjust the gap to the chosen shim stock until the gap is exactly equal at each adjusting sleeve with the clamping bolts tight. This step ensures that the impeller and cutter bar are parallel and the gap is even.

c. Now that the impeller and cutter bar are parallel, repeat step "a" except be more careful to turn the adjustment sleeves evenly to keep the cutters exactly parallel. Close up the gap to find light contact with the clamp bolts tight.

d. When you have the cutters lightly touching, and you think that the contact is fairly uniform, (backplate and casing parallel), unclamp the adjustment sleeves once again and carefully rotate them one flat clockwise. This will give the cutters .010" to .012" clearance. Don't make this clearance tighter than this, because as the pump warms up, the shaft will grow slightly and close this gap.

e. Snug the five unused adjusting sleeves against the casing. Make sure that the adjusting sleeves bottom on the iron, and are not tightening on anything that will crush when the clamp bolts are tightened. Lock all the adjusters down with the clamping bolts, and tighten the bolts that you loosened on the baseplate.

f. After all bolts have been securely tightened, check for smooth shaft rotation by rotating the pump shaft again by hand.

If the proper clearance cannot be achieved, or if other damage requires it, the impeller and cutter bar may need to be replaced. If this becomes necessary, refer to the overhaul manual for the proper procedures for this operation.

2. Check oil in Vaughan cartridge seal.
The only maintenance required of the Vaughan Cartridge Seal is a routine check of the oil condition. There are two 1/8" pipe plugs located on the outboard end of the seal. The upper plug is for filling and the lower plug is for draining. If you find oil that is contaminated or dirty, it can be easily changed. Simply drain the oil and refill. Use 2 oz. of oil (i.e. ISO 46 Turbine oil) for 3-6" pumps to refill, 6 oz. for 8"-12" pumps.

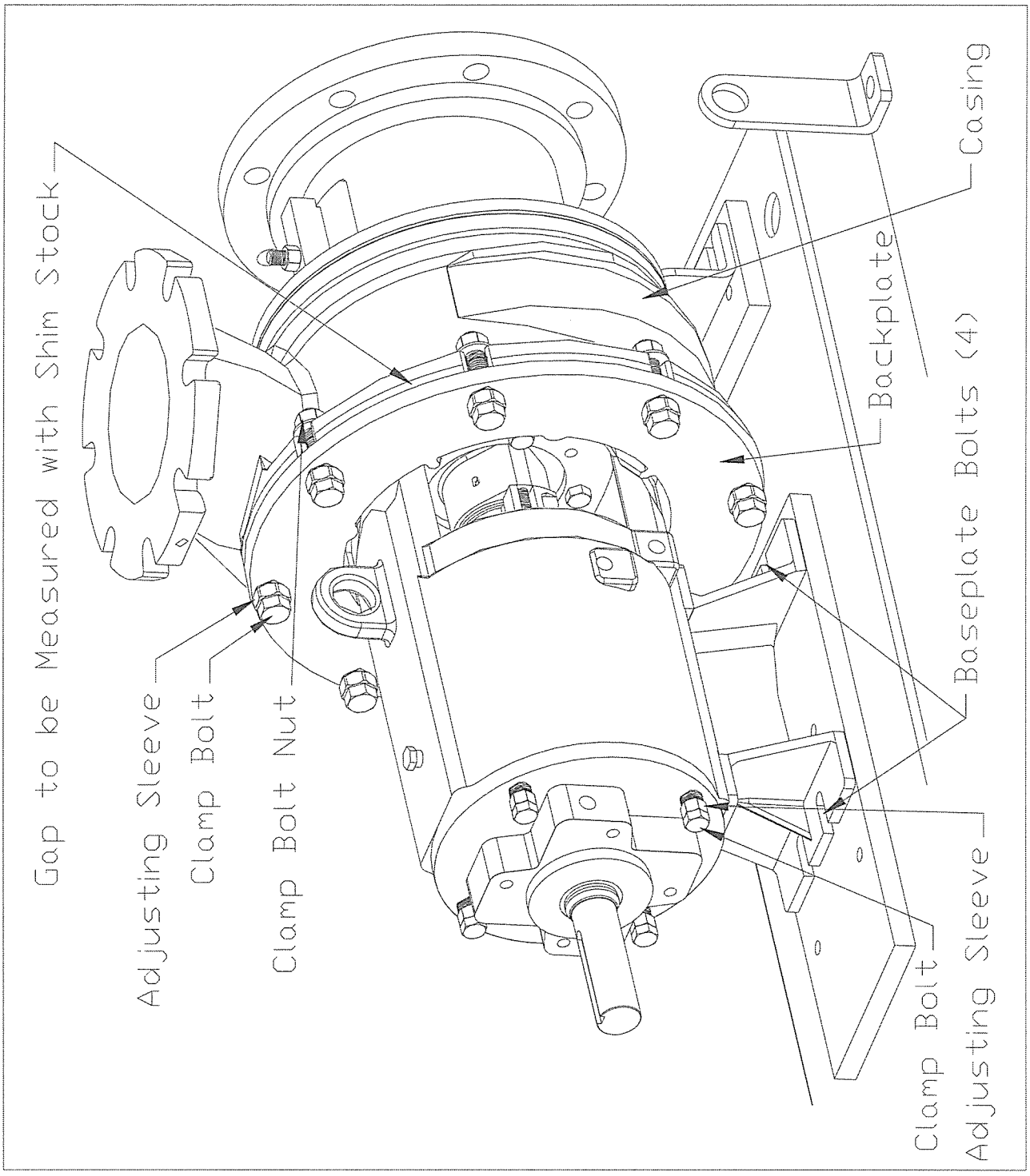
DANGER
Pressure may buildup in the standard mechanical seals used in Vaughan Horizontal or Pedestal pumps. Whenever checking or maintaining the oil in the Vaughan Cartridge Seal, or the Eagle welded metal bellows seal with seal oil chamber, make sure the pump and seal are cool to the touch and use care when removing the oil chamber plugs, in case any residual pressure exists. If pressure exists, plug could become a projectile and/or contaminated oil could spray.

B. CORRECTIVE MAINTENANCE

The Overhaul Instructions for Vaughan Chopper Pumps are listed in a separate manual. Please do not try to overhaul or repair the pump without the overhaul manual and exploded parts assembly breakdown. The overhaul manual was sent with your pump from the factory, but if you do not have a copy of this manual, please call Vaughan Co. Engineering and we will make sure you get proper instructions by overnight delivery, email, or by FAX. A repair video is also available at nominal cost. Vaughan Company's contact numbers are on the front cover of this manual.

HE PUMPS ADJUSTMENT

IMAGE AT S:\ENGR\MANUALS\IMAGES\CBH ADJUSTERS



SECTION 10: TROUBLESHOOTING

The Vaughan Horizontal End-Suction Chopper pump is more susceptible to system problems than Vaughan Wet-Well or Submersible pumps because piping is attached to the pump suction. Piping problems can cause "starving" of the pump before material has a chance to get into the pump. While Vaughan's End-Suction design has obvious advantages over other types of horizontal pumps, problems still can occur.

Following is a troubleshooting chart that will help you get some idea of what problems could be causing your symptoms. If you would like troubleshooting help, please call Vaughan Co. We'll be glad to offer assistance.

POSSIBLE PROBLEMS	SYMPTOMS	Low Discharge Pressure	Loss of Prime	Excessive Power Required	Stuffing Box Leakage	Short Packing or Seal Life	Abnormally High Vibration	Short Bearing Life	Pump Casing Overheating	High Brg. Temp	Low Flow
SUCTION PROBLEMS	Air Pockets in Suction Line		■				■				■
	Pump Not Primed	■	■								■
	Insufficient NPSH	■	■			■	■	■			■
	Suction Line Air Leaks		■				■				■
	Packing Air Leaks		■								■
	Vortexing in Pit at Inlet	■	■			■	■				■
	Intake Openings Plugged	■	■			■	■		■		■
SYSTEM PROBLEMS	Pump Speed Too High		■			■	■	■			
	Pump Speed Too Low	■					■				■
	Pump Rotation Incorrect	■	■	■		■	■				■
	System Head Too High					■	■	■	■		■
	System Head Too Low	■	■	■		■	■	■			
	Specific Gravity Higher than			■							
	Viscosity Higher than Expected	■		■							■
	Operation at Low Capacity					■	■	■	■		
	Improper Parallel Operation of Pumps	■				■	■		■		■
	Improper Series Operation of Pumps					■					
MECHANICAL PROBLEMS	Pump Discharge Blocked					■	■	■	■	■	■
	Misalignment of Pump/Driver			■	■	■	■	■		■	
	Foundation not Rigid					■	■	■			
	Worn Bearings			■	■	■	■			■	
	Bent Shaft				■	■	■	■			
	Rotating Mbr Contacts Stationary					■	■	■	■		
	Cutter Bar or Impeller Worn	■	■	■			■				■
	Impeller Damaged	■	■	■		■	■				■
	Shaft Running Off Center						■	■	■	■	
	Loss of Fresh Water to Stuffing Box		■		■	■			■		
	Lack of Lubrication			■			■	■		■	
	Improper Repair/Installation of Bushings			■		■	■	■		■	
	Dirt in Bearings					■	■	■		■	
	Shaft Sleeve Worn or Scored		■			■					
	Packing Improperly Installed		■			■					
	Improper Packing Material for Application					■					
	Packing Gland Too Tight			■		■			■		
	Dirt or Grit in Sealing Fluid				■	■					
	Overfill of Bearing Housing							■		■	

VAUGHAN CO., INC. PRODUCT WARRANTY

Vaughan Co., Inc. warrants to the original purchaser/end user all pumps and pump parts manufactured by Vaughan Co. to be free from defects in workmanship or material for a period of one (1) year from date of startup or eighteen (18) months from the date of shipment from Vaughan Co., whichever occurs sooner. 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, 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 labor for 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 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, its 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's printed instructions or damaged due to a defective power supply, improper electrical protection or faulty installation, maintenance, or repair. Wear caused by pumping abrasive or corrosive fluids or by cavitation is not covered under this 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, which warranty, if appropriate, will be assigned by Vaughan Co. to the purchaser/end user.

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.

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.

BELT TENSIONING PROCEDURE

Your belts have been de-tensioned after testing and will need to be tightened after the pump is installed, plumbed, and bolted down into final position.

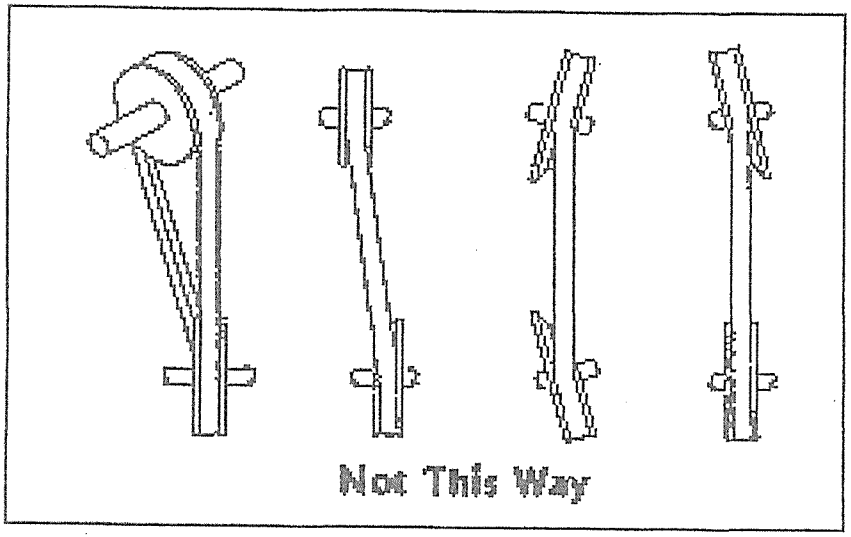
The procedure is as follows:

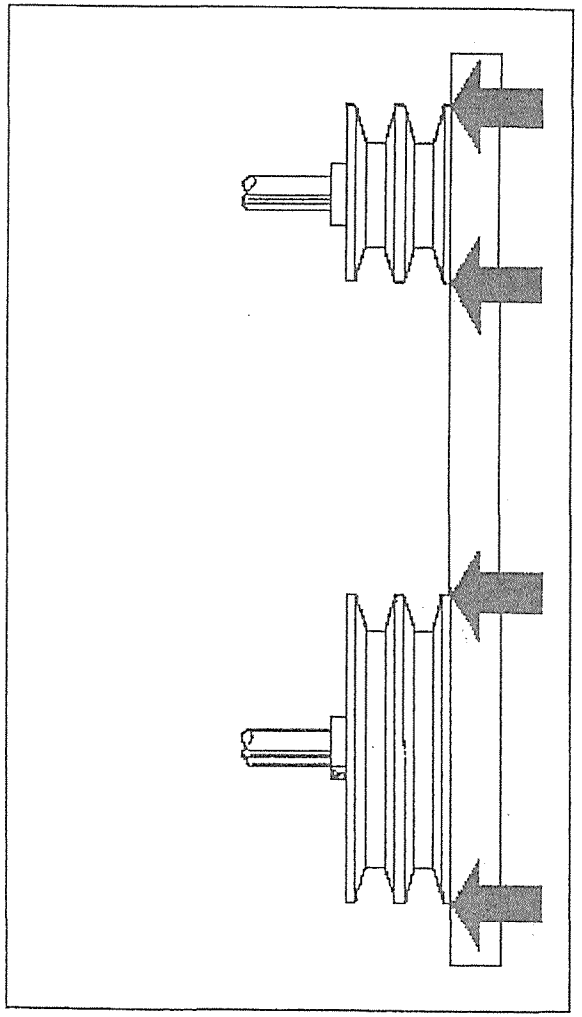
1. Remove the belt guard outer cover and set it aside.
2. Loosen the motor hold down bolts and turn the belt tensioning bolts under motor until belts are tight and can be depressed approximately ½" in the center of one belt by hand.
3. Place a steel straight edge across the two belt sheave's centers, passing directly over the center of the shafts. If the two sheaves are in alignment, the straight edge will touch each edge of each sheave. If a straight edge is not available, the edge of the belt guard cover that you removed can be used. This can't be placed exactly across the centers of the sheaves, but it will work if a straight edge is not available.
4. If the straight edge doesn't touch in four places, move the motor with the adjusting screws (and perhaps axially if necessary) to obtain a perfect four point match. Close is not acceptable. Even a small misalignment can cause vibration and premature belt/sheave wear. You may need to push on the back side of the motor with the adjusting screw. The screw will push if it is threaded out about ¾".
5. Once the sheaves are in proper alignment, the belt tension must be set. During tensioning, move the motor carefully so you don't change the sheave alignment. To check the tension, press in the center of one belt length with a special belt tensioning spring tool such as Dodge part # 109082. This tool is available at most industrial supply houses for about $30. A spring scale and a tape measure can be used if the special tool is not available, but it is very important to set the tension correctly because incorrect tension can cause rapid belt, sheave, and bearing wear.

. The correct tension for your belt drive system is when 20 to 22 lbs of pressure deflects the belt by .54 inches in the center of the span of one belt..

6. The alignment/tensioning may have to be repeated until both tension and alignment are correct, as setting one changes the other. These also can change when the motor hold down bolts are tightened. Once the tension and alignment are correct with all bolts tight, reinstall the belt cover.

Align Sheaves

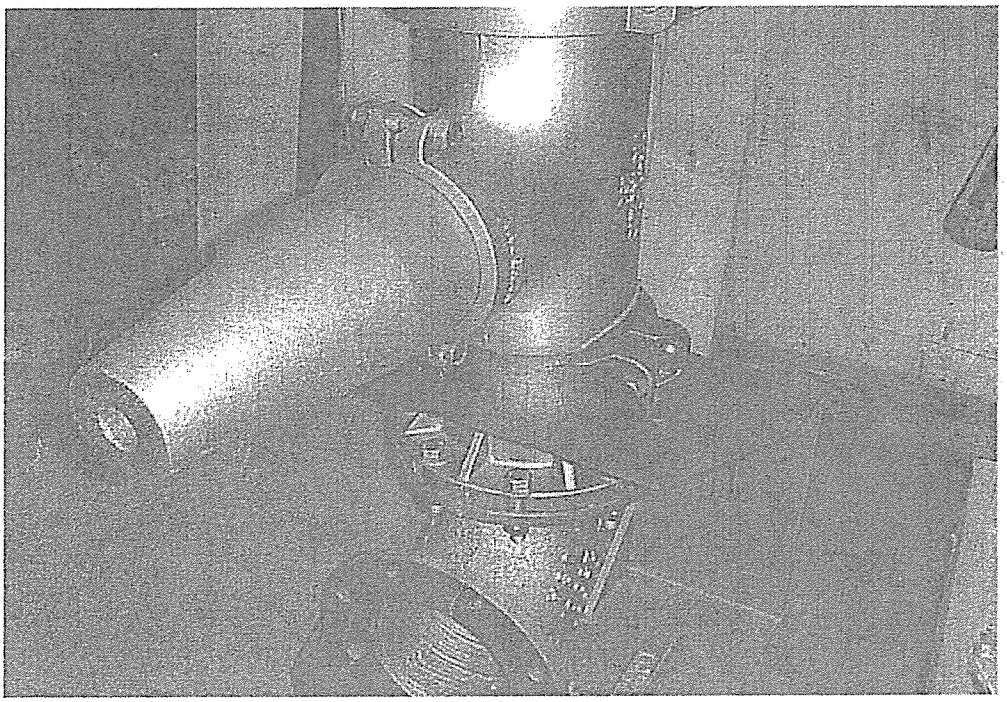




ROTAMIX NOZZLE AIMING

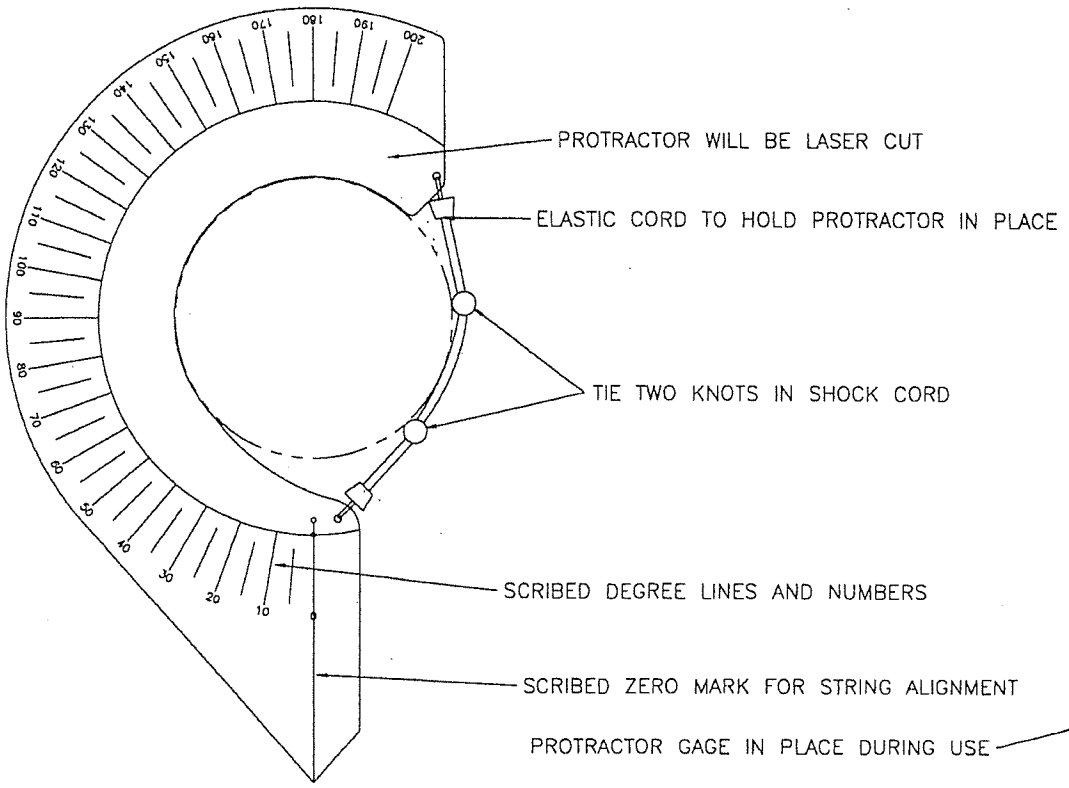
WITH VAUGHAN SUPPLIED PROTRACTOR

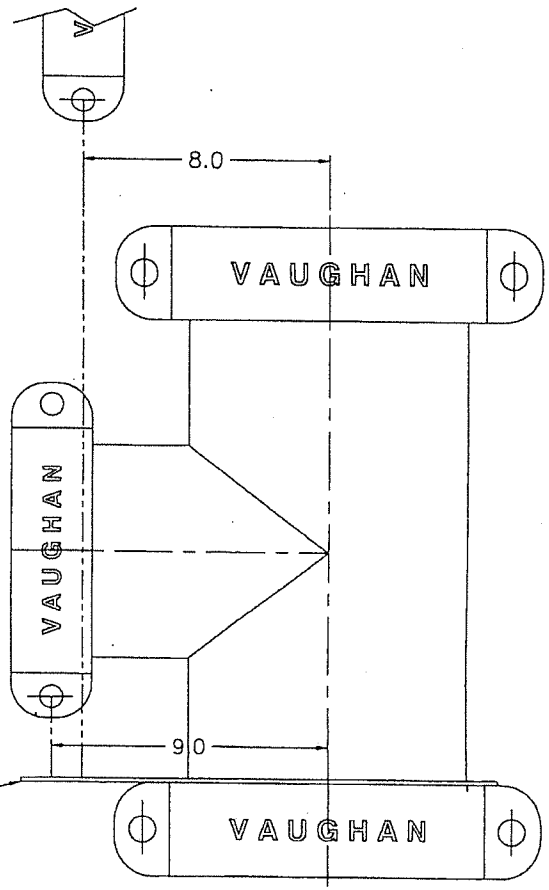
TO BE DONE BEFORE FILLING THE TANK



To perform this procedure, you will need Vaughan nozzle aiming kit, part # V108-205.
This kit includes the aiming protractor, mounting bungee, and plumb bob.
You will also need (2) 1 1/8" wrenches and a ladder tall enough to reach the top nozzle.

VAUGHAN COMPANY INC
364 MONTE-ELMA RD
MONTESANO WA 98563
360-249-4042
360-249-6155 FAX





KIT V108-205 INCLUDES:

1. PROTRACTOR.
2. PLUMB BOB, MMC# 2161A11
3. SHOCK CORD MMC# 8835T21

VAUGHAN CO., INC.
364 MONTE-ELMA ROAD
MONTESANO, WA 98563
PHONE: (360) 249-4042
FAX: (360) 249-6155

UNLESS OTHERWISE NOTED, TOLERANCES ARE TO BE:
SURFACE FINISH: 125 MICROINCHES
DIMENSIONS, WELDING: X.XX = 1/16"
DIMENSIONS, MACHINING: X.XX = 0.020"
DIMENSIONS, MACHINING: X.XXX = 0.010"
GEOMETRIC TOLERANCE, RUNOUT ON CYLINDERS: 0.010"
GEOMETRIC TOLERANCE, PARALLELISM: 0.000"
BREAK ALL MACHINE EDGES 0.005" R UNLESS NOTED OTHERWISE

CHECKED:	ENGINEER:	DRAWN BY:	SCALE:	PART NUMBER:
DGM	DGM	DGM	1:4	V108-205
JOB ORDER NUMBER:		DATE: 11/26/01	DRAWING NUMBER: 108205	REVISION NUMBER: 0

TITLE:
PROTRACTOR GAGE
ROAMIX AIMING

Date:_____

by

STARTUP AND CERTIFICATION CHECKLIST

Project Name / Rep:_____ RQ#: _____
Pump Serial No. _____ Assy Serial No. _____ Customer Tag Number: _____
Startup performed by (Agent & Telephone):_____
Customer Contact / Telephone #: _____

PUMP CHECKLIST

Pump shaft turns freely by hand?	Yes	☐	No	☐
All guards are in place?	Yes	☐	No	☐
All piping attached to pump is being independently supported? (not by the pump)	Yes	☐	No	☐
Is the pump casing vented and filled with liquid?	Yes	☐	No	☐
Has vent line been installed at top of volute?	Yes	☐	No	☐
Pump is turning clockwise as viewed from the motor end?	Yes	☐	No	☐
Are expansion joints installed on pump discharge piping?	Yes	☐	No	☐
If yes, is piping anchored between expansion joint and pump discharge, per H.I. Standards?	Yes	☐	No	☐
Perform general check of contractor supplied piping to verify connections, supports & sizing	Yes	☐	No	☐

ELECTRICAL DATA:

Motor Brand: _____ Model: _____ HP: _____ RPM: _____
Nameplate Voltage: _____ Nameplate Full Load Amperage: _____ Service Factor:_____

SYSTEM DATA:

Tank Geometry: _____ Type of process being mixed: _____ % Solids: _____
Tank Type: New ____ Retrofit: ____ If Retrofit, previous system? _____
Sloped Floor: Yes ☐ No ☐ If sloped, slope = _____ degrees.
Required Flow / Head: _____ GPM @ _____ FT TDH Measured Differential Head _____ FT TDH
Required Flow / Head: _____ M3/Hr @ _____ M TDH Measured Differential Head _____ M TDH

STARTUP MEASUREMENTS & OBSERVATIONS:

Measured Differential Head: _____
Operating Voltage: L1-L2: _____ L2-L3: _____ L1-L3: _____
Operating Amperage: L1: _____ L2: _____ L3: _____
Pump Operation: Quiet: ☐ Noisy: ☐ Measured @: _____
Vibration: Acceptable: ☐ Excessive: ☐ Measured @: _____

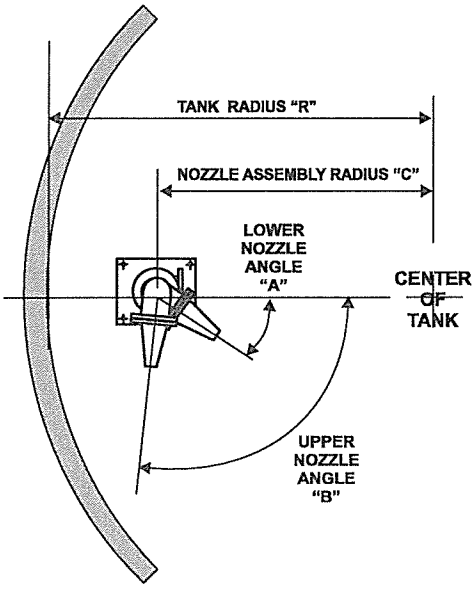
Comments:

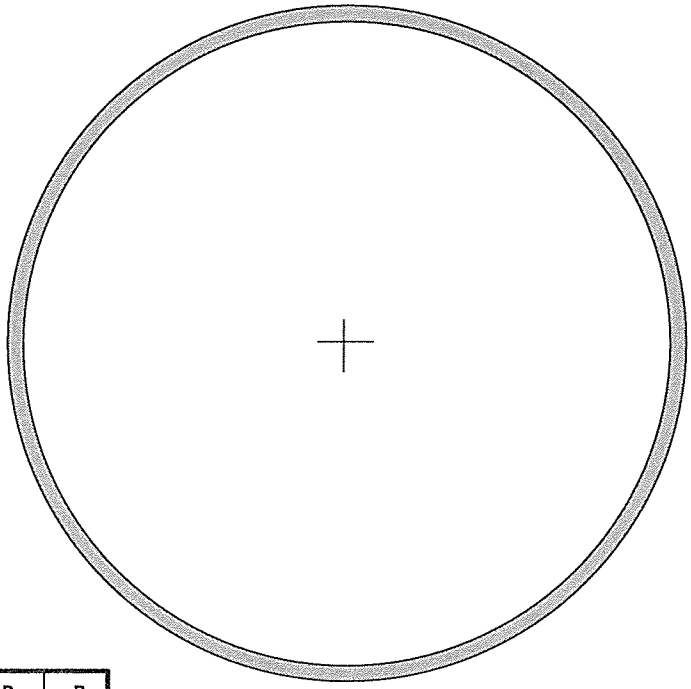
_____

_____

NOZZLE ASSEMBLY DATA

Is Contractor's piping properly installed and bolted to assembly?	Yes	☐	No	☐
All coupling have been checked and tightened after field nozzle adjustment.	Yes	☐	No	☐
Anchor Bolts Installed?	Yes	☐	No	☐
Grouting complete and Assembly Base set level?	Yes	☐	No	☐
Pictures enclosed with this report.	Yes	☐	No	☐



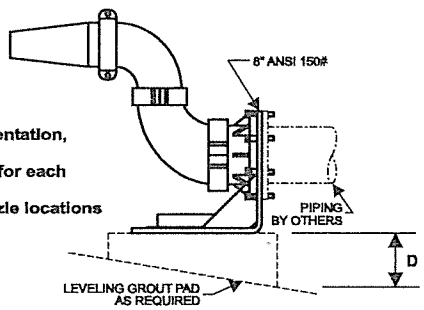


SHOW PIPING LAYOUT AND NOZZLE ASSEMBLY LOCATIONS

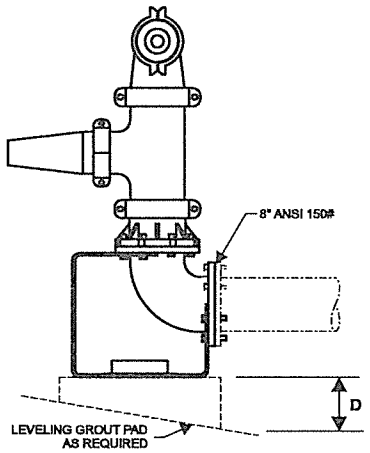
NOZZLE	SINGLE NOZZLE	DOUBLE NOZZLE	A	B	C	D	R
1							
2							
3							
4							
5							
6							
7							
8							

DIRECTIONS:

1. Measure each nozzle for orientation, elevation and location.
2. Fill out chart for Items A - R for each nozzle 1 - 8.
3. Show piping layout and nozzle locations on top right diagram.



SINGLE NOZZLE ASSEMBLY



DOUBLE NOZZLE ASSEMBLY

5/2005

ROTAMIX AIMING INSTRUCTIONS

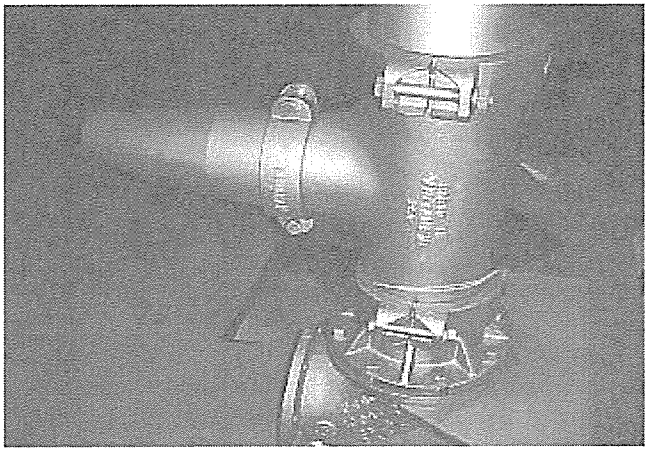
STEP 1

Check nozzle assembly location against the Vaughan supplied layout drawing. Check both the radial and tangential measurements.

To aim the nozzles, loosen the clamp on the vertical pipe just below the lower nozzle and spread it so that it will allow the pipe to rotate without being so loose that it will allow the nozzle assembly to fall.

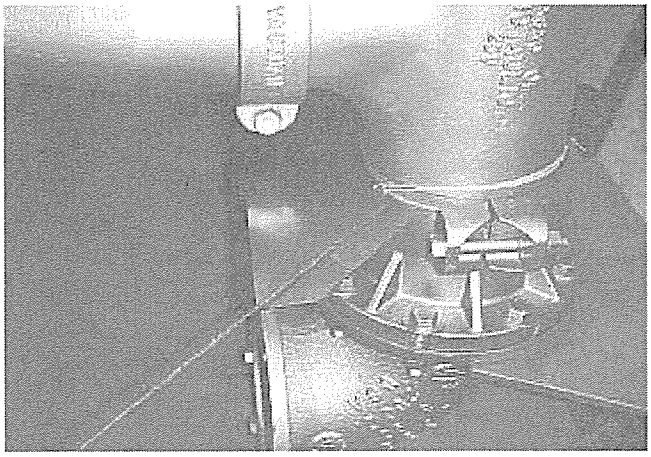
Once the clamp is loose, place the Vaughan supplied protractor on top of it.

There is provision for an elastic tie around the back side of the protractor to hold it in place.



STEP 2

Tie a string to the protractor at the zero point hole, and attach the other end of this string to the center of the tank in some manner. This will align the protractor so that the nozzles can be properly aimed relative to the center of the tank.



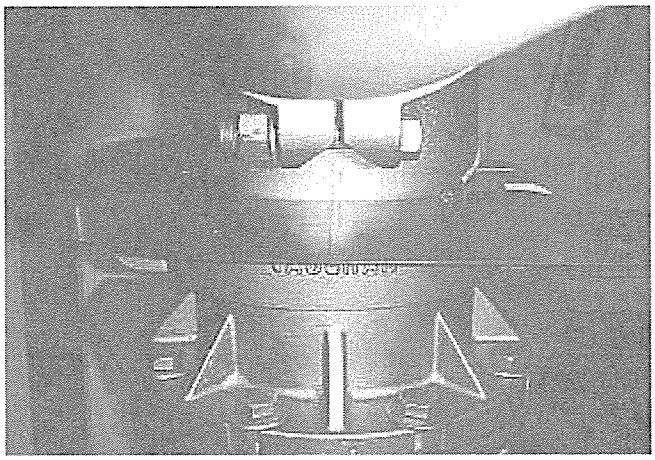
STEP 3

Once the protractor is properly aligned with the tank, you can proceed to aim the nozzles.

Aim the lower nozzle by aligning the center of the lower nozzle clamp with the specified degree mark on the protractor.

See your Nozzle Layout drawing for the proper angles to set your nozzles.

Moving the lower nozzle will tend to move the protractor also. Be sure to recheck the zero point before tightening the lower nozzle clamp.



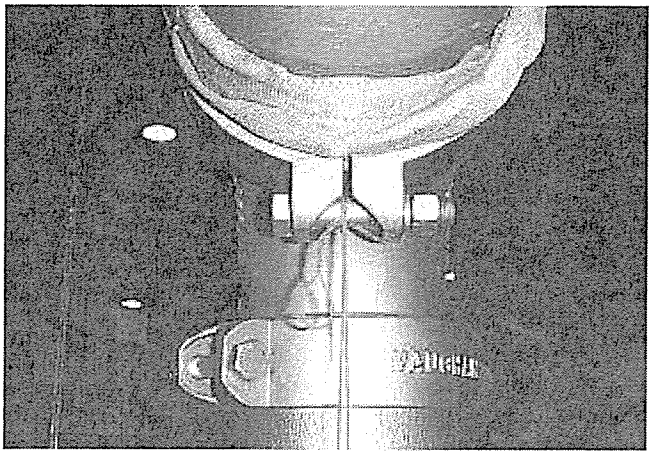
ROTAMIX AIMING INSTRUCTIONS

STEP 4

To aim the upper nozzle, tie the plumb bob string to the bolt on the nozzle clamp as shown. Make sure that it hangs from the the center of the nozzle.

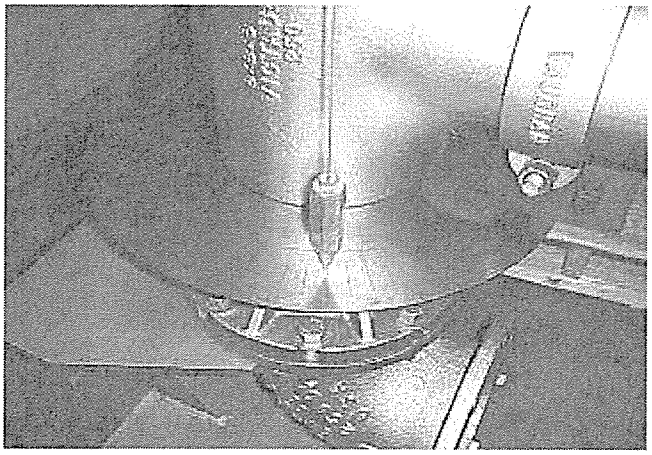
Loosen the clamp on the vertical pipe below the nozzle, and spread it slightly so that the elbow can rotate, but not so much that the nozzle could fall.

The picture shows a sling holding the nozzle for security. If a crane is not available, just make sure that the nozzle can't fall.



STEP 5

The plumb bob will hang directly over the protractor scale. Rotate the upper nozzle until the bob hangs over the degree mark specified for the upper nozzles on your nozzle location plan view drawing.



STEP 6

Tighten all clamps, remove the plumb bob and the protractor, and the job is complete.

VAUGHAN ROTAMIX™ SYSTEM INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

Form V372, Rev. 8, January, 2011

DESCRIPTION:

The Vaughan Rotamix™ system is a proprietary (patent 7,025,492) mixing system designed to mix cylindrical, egg-shaped, or rectangular sludge storage tanks or digesters with greater mixing efficiency and lower power requirements than some other systems that have been traditionally used.

The Rotamix™ system consists of one or more Vaughan chopper pumps pumping through a customer-supplied piping system to one or more Vaughan-supplied nozzle assemblies.

The glass-lined ductile iron nozzle assemblies are typically floor-mounted, dual-nozzle systems, but can also be single nozzle systems (generally in rectangular tanks), or roof-mounted nozzle systems (where floor-mounted nozzles cannot be installed). In a cylindrical storage tank and with dual nozzle assemblies, the lower nozzle is aimed more toward the center of of the tank, while the upper nozzle is aimed to create more tangential rotation. *Nozzle aiming must be done per Vaughan instructions once nozzle assembly installation is complete but before the storage tank is closed up*. Please contact your local representative for aiming the nozzles. Nozzles normally cannot be aimed remotely on floor-mounted systems.

A layout drawing of the Rotamix™ system (showing nozzle location and nozzle angles within the tank) is included in your custom Installation, Operation and Maintenance Manual package for your particular project.

RECEIPT INSPECTION:

Description of pump receipt inspection is described in the I,O&M Manual for the Vaughan chopper pump. You should also inspect the nozzle assemblies received for the Rotamix™ system to make sure they have arrived undamaged.

Your best indication of potential shipping damage to equipment is the condition of the crating. If the crating is damaged, look for cracked fittings and clamps or damaged paint.

Report damage to your carrier. Vaughan Co. can also work with you to provide replacement fittings as needed.

STORAGE:

The nozzle assembly epoxy paint are susceptible to damage from prolonged UV exposure. If nozzle assemblies are to be stored for more than two weeks prior to installation they must be either stored indoors or covered. If nozzle assemblies will be exposed to sunlight for more than two weeks after installation they should be covered.

INSTALLATION:

The Vaughan chopper pump is to be installed as described in the pump I,O&M Manual. Note however, that the Rotamix™ system reason for being is to achieve improved efficiency over your previous mixing systems. Therefore the Rotamix™ system piping design should minimize friction losses through the suction and discharge piping. This means using large suction and discharge piping.

For best results choose piping size so that velocity is around 3-5 ft/sec. for suction piping and no more than 8 ft/sec for discharge piping. This is fast enough to avoid particle settling in the piping, but slow enough to minimize friction losses. Vaughan Co. will help you with your system design. Please consult us to be sure your system works as intended.

Use of smaller diameter piping than recommended, results in higher velocities, increased friction loss, and in less effective tank mixing. Also, smaller diameter piping may lead to troublesome gas-binding problems in the mix pump because of decreased pressure at the pump suction that tends to liberate volatile gases from the pumped fluid. Gas binding in the pump can result in complete loss of flow and the necessity to stop the pump and vent all the trapped gas out of the pump casing before restarting the pump.

WARNING!! Follow all confined space entry procedures for entering an enclosed tank. See Vaughan pump I,O&M Manual for other warnings.

Total Rotamix™ flow is determined in consultation with Vaughan Co. Sales Engineering. The total flow is calculated based on your storage tank (or digester) volume and consideration of your tank geometry. Once you know total system flow, you can determine best sizing for suction and discharge piping. Vaughan Co. will help you with piping sizing recommendations.

Nozzle sizing for the nozzle assemblies is also determined at the beginning of the Rotamix™ project in consultation with Vaughan Co. Proper sizing for the nozzles is critically important in making the system work efficiently.

Nozzle aiming is performed once nozzle assembly installation is complete but before the storage or digester tank is closed up. Proper nozzle aiming is critically important and is performed by your Vaughan Co. representative. Please contact him to schedule this very important operation before closing the digester or storage tank.

For roof-mounted nozzles, an arrow will be located on the deckplate which, when mounted in your digester, should point at the center of the tank. This

assures that the nozzles are aiming in the correct direction within your tank to achieve proper mixing.

Finally, location of the nozzle assemblies within the digester is determined in consultation with Vaughan Co. In a cylindrical tank (such as a digester) the floor-mounted nozzles are typically mounted on a circle whose diameter is defined by Vaughan Co. based on the diameter of your storage tank. Also, the nozzle angles are determined by Vaughan Co. The positioning and angles of the nozzles in your digester or storage tank are defined on a Rotamix Nozzle Location Plan drawing specific to your project. This drawing will always be included in the custom Installation, Operation and Maintenance Manual for your particular Rotamix system.

A note on the Vaughan Foambuster: The Vaughan Foambuster is a patented nozzle and splashplate combination that sprays sludge droplets over a large area at the upper surface of a digester to break down and control foam. In some cases, digester mixing systems are purchased with the addition of the Foambuster because of the risk of foaming, particularly in activated sludge plants. The Foambuster nozzle must be mounted above liquid level. Only a few inches of distance is enough to allow the Foambuster to work. Also, the Foambuster needs about 4 ft. of headroom above the height of the nozzle to allow the spray to cover as much of the tank surface as possible. The Foambuster works best with a fixed cover. Finally, the Foambuster is designed to be aimed radially inward toward the center if the Foambuster if located near the outer walls, or aimed radially outward toward the outer walls if the Foambuster is located at the tank center. When the Foambuster is used with the Rotamix system, Rotamix rotates the liquid in the tank below the Foambuster. In this way, one Foambuster can cover all the surface area of the tank as it rotates below the Foambuster.

Vaughan Co. recommends that the Foambuster operates whenever the Rotamix system operates. By taking this approach, if foaming should occur, the Foambuster will always be operating to keep the level of foam broken down and under control. If foaming is allowed to take place when the Foambuster is not operating, foam may adhere to the tank walls, preventing the surface from rotating. If the upper surface does not rotate, the Foambuster will not be effective at controlling foam over the entire upper surface.

A note on system venting:

WARNING!! Explosions can kill or injure! Mixing may liberate gases of decomposition which are highly flammable or explosive. Do not use an open flame or non-explosion-proof equipment in areas where gas is present. Follow all plant safety procedures for hazardous areas.

Sludge pumping systems are likely to generate gases of decomposition and these gases are likely to collect in either the suction piping or in the chopper pump casing. Should this occur, the pump would not work properly when started, since the impeller, when rotating, will collect gas and not be able to fill with the sludge to be

pumped. So gas buildup in the system may keep your pump and Rotamix system from working properly. This can be particularly troublesome if your system is to be operating intermittently. Gas binding is also much more common if your pump has other than a top discharge on the pump casing. That is, side-discharge orientations of the pump casing flange tend to trap more gas in the pump casing. Gas binding problems can keep your mixing system from working properly so this issue must be addressed.

To avoid gas binding problems, you should consider designing in an automatic venting system. Failure to properly vent the pump before each startup can result in a mixing system that doesn't work. *Note that you cannot vent the pump of gas or air when the pump is running.* (The pump casing can be vented through the 1/2"-NPT pressure tap on the casing flange if the pump has a top discharge, or through the ½"-NPT vent on the side of the casing if the pump uses a side discharge configuration.)

There are several ways to successfully vent the pump:

1. You can install an automatic venting system to the pump casing vent in a couple of ways:
   A. You can use a suitable automatic air release valve (ARV) of 2" size available from various manufacturers. (Vaughan Co. has available an air release valve from Val-Matic.) Run the discharge piping to either a drain or back to the digester or tank to be mixed. An automatic air release valve will continually and automatically vent gas or air from the pump casing any time the valve senses that the presence of gas or air at the valve. We feel the ARV is the best approach.
   B. You can use a solenoid-controlled valve (2" is best) controlled by a timer in your control panel, which would open this valve prior to each startup of the pump. Based on experimentation, you can determine how long it takes to vent the gas from the system to completely fill the pump casing before the pump starts. You can then set the timer to this setting. Again, run the piping either to a drain back to the tank you are mixing.

Note also that pumps and piping located outdoors and exposed to the sun are more likely to cause more gas generation in an idle pump and system. Shading the system from the sun using plywood or fiberglass panels can be very helpful to minimizing gas problems.

Roof-Mounted Nozzles:

Roof-mounted nozzles are made of gusseted, heavy-wall pipe and are often long, sometimes reaching lengths of 35' long and longer, and they are often heavy. While these units are designed to be strong enough to withstand the weight and reaction forces of the nozzles, ***you will need to evaluate what impact these forces and moments may have on your cover and support systems***. The weight and total imposed moment at the mixing nozzle assembly deckplate will be listed on the outline dimension drawing for the assembly.

The reaction forces that the nozzle assembly will impose on your cover and onto your mounting flange can be calculated by assuming that each nozzle will have a reaction force of about 80 lbs. The total moment (ft-lbs) imposed onto your digester and mounting flange will be the distance from the deckplate (in feet) to each of the nozzles, multiplied times 80 lbs. The calculated moment for each nozzle must be

summed together to determine the entire moment. For example, a roof-mounted, dual-nozzle assembly with the lower nozzle located 20 ft. below the deckplate and an upper nozzle located at 10 ft. below the deckplate will have a total moment of (20' x 80 lbs) + (10' x 80 lbs.) = 2,400 ft-lbs.

STARTUP:

See the pump I,O&M Manual and all warnings for pump startup and operating instructions.

Before starting the Rotamix™ system, check all piping connections to be sure they are tight and are not stressing up the pump or other equipment. Proper piping alignment and support is critically important to good equipment life. Also, as discussed above, venting all air from the system at initial and all startups is critical to allowing the mixing system to work to its normal capacity. Poor gas venting can often result in poor mixing.

OPERATION:

Operation of the Rotamix™ system involves operation of the Vaughan pump(s). The objective in Rotamix™ operation is achieving effective mixing in your storage tank or digester. This may or may not require operation of the Rotamix™ system on a 100% duty cycle. Many times this system may be operated on a timer, on a duty cycle less than 100%. As a general rule, a Rotamix system requires 30-60 minutes to reach steady state mixing, and it may require several days of mixing after that to achieve a homogeneous slurry in the tank. Note however, that if the Rotamix™ system is operated intermittently, there may be more of a challenge in properly venting the pump of gas prior to each pump startup, and so an automatic venting system should be considered during design. This gas venting issue is discussed above in the Installation section.

Digester mixing:

Experience has shown that the majority of gas generation in a digester occurs while new sludge is being added, and so the Rotamix system should be run during this time. Therefore, if intermittent mixing is going to be used, the Rotamix system should be started about 30 minutes before adding new sludge and should be shut down about 30 minutes after stopping the addition of new sludge. This mode of operation generally amounts to about a 35% to 50% duty cycle and saves a considerable amount of electricity. Vaughan Co. encourages experimentation so that you get the best possible mixing using the lowest possible energy requirements for your system. Generally, the mixing system should be run for at least 2 hours at a time (3 or 4 hours may be better), then perhaps the pump can be shut off for an equal amount of time, say 3 hours on, 3 hours off. Operation of the mixing for short periods of time, such as 15-30 minutes will not provide any useful mixing. Again, most tanks must be run for 30 minutes just to reach full mixing velocity in the tank; active digester mixing occurs *only* after reaching full mixing velocity.

Sludge tank mixing:

Lime stabilized sludge if left unmixed in a sludge storage tank for more than a couple of weeks must be mixed continuously for at least 7 continuous days to get the sludge mixed again. Occasional mixing of lime stabilized sludge will help to get this material to mix easier later. This type of sludge tends to set up like concrete and be unmixable.

For other types of sludges, it is wise to run the mixing system at regular intervals to homogenize the sludge. If sludge has been allowed to sit for any significant period of time, the mixing system will very likely require at least two days (and often more) of continuous operation to thoroughly mix and homogenize the sludge.

Blend tank mixing:

Blend tanks may be mixing polymer thickened sludges (like TWAS) with primary sludges, scum and grease. Because the viscosity of TWAS can be 30 times thicker than primary sludges, mixing systems must often be oversized to provide adequate mixing flow and power, particularly with a maximum level blend tank. Even with oversized mixing systems, in some cases with very viscous TWAS at full level, upper surface mixing will not be evident until tank levels are lowered, perhaps to half full. Nevertheless, mixing is still occurring under the surface in the lower portions of the tank. Anytime thickened sludge can be added low in the tank, at the level of the nozzles, mixing will be more effective. Dumping thickened sludge on the top of the tank where the lowest mixing velocities occurs should be avoided whenever possible since TWAS tends to float and build up a scum layer.

SHUTDOWN:

Shutdown of the Rotamix™ system involves stopping the pump(s). Again, see the pump I,O&M Manual.

Note also that if you are mixing a sludge storage tank that heavy, lime-stabilized sludge should not be permitted to sit stagnant in the system piping. The piping should be flushed with light sludge or water before securing the system. Especially with an open-top storage tank where the sun can heat the piping, the sludge can dry out and ultimately cause plugging of the mixing nozzle(s).

ROUTINE MAINTENANCE:

Roof-mounted nozzle assemblies should be removed from the tank or digester and inspected every 5 years (or sooner in abrasive or corrosive applications). More frequent inspection would be indicated by a decrease in main pump pressure over time, indicating that wear is taking place at the discharge nozzle(s), permitting more flow to exit the nozzle(s). Failure to inspect the nozzle assembly before severe wear takes place could result in mechanical failure of the assembly and the dropping of nozzle components into your mix tank. This would be evident from a sudden decrease in pump discharge pressure, possibly even by the sudden appearance of high-flow pump cavitation noise at the pump.

No routine maintenance is required for Rotamix™ floor-mounted nozzle assemblies as these units have a standard 10-year warranty, are made of ductile cast iron and are completely glass-lined. If you have occasion to enter your digester or storage tank, you will want to inspect the nozzle assemblies and piping to make sure the equipment is in good working order and that the nozzles are still properly aimed. Whenever you check the nozzle system, inspect the nozzle opening to make sure that the glass coating is still intact. If the glass coating is worn away, replace the nozzle. For polyurethane nozzles, measure the discharge diameter to make sure that it is no more than 15 % larger than it was when new. (For example, a new 2.00" dia. nozzle should not be larger than 2.3". If it is larger than 2.3", replace it.) Nozzle exit diameters are defined in the PARTS section of your custom Installation, Operation and Maintenance Manual for your Rotamix system.

Venting systems may require yearly inspections to make sure they are working properly and staying clear of debris. Vaughan always supplies the flushing option with the air release valves we supply.

CORRECTIVE MAINTENANCE:

Replacement of any Rotamix™ nozzle assembly components is self-explanatory. Fittings are attached to each other on the assembly by clamps. Contact Vaughan Co. for pricing on replacement components. The parts list for the nozzle assembly is included in your Rotamix™ system I,O&M Manual Parts Section.

TROUBLESHOOTING:

See the associated Vaughan pump I,O&M manual for the troubleshooting chart. Typical problems that could be encountered in a Rotamix™ system might be:

- A plugged nozzle. This may show up as reduced mixing within your digester or storage tank. Other symptoms of nozzle plugging would be reduced pump electric motor power requirements (lower amps), and higher pump discharge pressure than normal (which should be about 15-17 psi differential pressure across the pump). Because Vaughan chopper pumps are used in this system, nozzle plugging would not be expected until severe wear has taken place in the pump so that effective chopping might be compromised. Pump cutting parts are designed for long life (3-5 years of continuous use), so that such an event should not occur on a new system unless construction debris has gotten into the system piping. Annual inspection of the pump as required in our pump I,O&M manual should help prevent nozzle plugging because of loss of chopping ability.
- A worn nozzle. This would show up as increased mixing within your digester or storage tank. Other symptoms of a worn nozzle would be higher than normal pump electric motor power requirements (higher amps), and lower pump discharge pressure (less than 15-17 psi differential pressure across the pump). You may also hear pump cavitation noise, a crackling sound, similar to pumping gravel. Many people incorrectly interpret cavitation as a pump bearing problem. Nozzles on Vaughan Rotamix™ systems are made of glass-lined ductile cast iron (and sometimes made of abrasion-resistant polyurethane). So nozzle wear should take many years to achieve.

- Pump cavitation from the Rotamix™ system when pumping with your tank at abnormally low levels. Mixing at very lower levels can cause vortexing in your tank, which results in drawing large amounts of air into the pump. Low-liquid-level mixing can also cause the nozzle to discharge above liquid level, a situation that can cause aeration of the fluid in the tank. Either of these situations can cause pump cavitation and vibration, which if allowed to continue, will shorten the life of your pump(s). To stop vortexing, Variable Frequency Drive (VFD) motor control systems can be used. By using a VFD, you can slow the pump (and pump motor) down as tank level decreases and thus reduce pumping power going into the system, thereby avoiding some types of vortexing and cavitation problems. However, Vaughan Co. recommends that the slowest VFD speed used by no slower than 75% of normal pump speed. For example, if 100% speed is at 60 Hz. on your VFD, do not run the VFD at less than 45 Hz. Too slow of a speed reduces pump and system pressure and can result in nozzle plugging.
- Pump cavitation noise could also indicate a mechanical failure in a roof-mounted nozzle assembly. Such a failure could take place after relatively long periods of operational time if the unit is not regularly inspected for wear and if components are not replaced over time. The cavitation noise is caused by high-flow cavitation in the pump because the nozzle flow-restriction against the pump may no longer be present, especially if the nozzle or other parts of the assembly have fallen down into your mix tank.
- Poor mixing performance from the Rotamix™ system may be caused by air or gas binding in the pump(s) or by plugged nozzle(s). Proper venting and filling of the pump casing at each startup is required for the pump to work to its normal capacity. If the pump is partially full of air, it will not generate normal pressure or flow, and therefore the flow through the nozzles will be inadequate. Operating VFD's at speeds slower than 75% of full speed has also resulted in plugged nozzles.

BALDOR • RELIANCE

Integral Horsepower
AC Induction Motors
ODP, WPI Enclosures
TENV, TEAO, TEFC Enclosure
Explosion Proof

Installation & Operating Manual

8/12 MN408

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Section 1
General Information

Overview This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the **Warning and Caution** statements.
A **Warning** statement indicates a possible unsafe condition that can cause harm to personnel.
A **Caution** statement indicates a condition that can cause damage to equipment.

Important: **This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.**

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- IEC 34–1 Electrical and IEC72–1 Mechanical specifications
- ANSI C51.5, the National Electrical Code (NEC) and local codes and practices.

Limited Warranty

www.baldor.com/support/warranty_standard.asp

Safety Notice: This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

Be sure that you are completely familiar with NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING: **Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.**

WARNING: **Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.**

WARNING: **Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes must be carefully followed.**

WARNING: **Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.**

WARNING: **Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. When installing, protection should be provided by the user to protect against accidental contact with hot surfaces. Failure to observe this precaution could result in bodily injury.**

WARNING: **This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.**

WARNING: **Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.**

WARNING: **Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.**

WARNING: **Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.**

WARNING: **UL Listed motors must only be serviced by UL Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.**

WARNING: **Thermostat contacts automatically reset when the motor has slightly cooled down. To prevent injury or damage, the control circuit should be designed so that automatic starting of the motor is not possible when the thermostat resets.**

Safety Notice Continued

WARNING: **Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.**

WARNING: **Pacemaker danger – Magnetic and electromagnetic fields in the vicinity of current carrying carrying conductors and permanent magnet motors can result result in a serious health hazard to persons with cardiac pacemakers, metal implants, and hearing aids. To avoid risk, stay way from the area surrounding a permanent magnet motor.**

WARNING: **Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.**

WARNING: **Do not use non UL/CSA listed explosion proof motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.**

WARNING: **Motors that are to be used in flammable and/or explosive atmospheres must display the UL label on the nameplate along with CSA listed logo. Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.**

WARNING: **Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.**

Caution: **To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.**

Caution: **Do not over tension belts. Excess tension may damage the motor or driven equipment.**

Caution: **Do not over–lubricate motor as this may cause premature bearing failure.**

Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.**

Caution: **If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.**

Caution: **To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.**

Caution: **If a HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG1 and MG2 standards to avoid equipment damage.**

Caution: **The space heaters are designed to operate at or below the maximum surface temperature stated on the nameplate. If the marked ambient and/or voltage are exceeded this maximum surface temperature can be exceeded and can damage the motor windings. If applied in a division 2 or zone 2 environment this excessive temperature may cause ignition of hazardous materials.**

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Section 3.**

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.

Receiving

Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.

Handling

The motor should be lifted using the lifting lugs or eye bolts provided.

Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.**

1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft or the hood of a WPII motor.

2. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
3. When lifting a WPII (Weather Proof Type 2) motor, do not lift the motor by inserting lifting lugs into holes on top of the cooling hood. These lugs are to be used for hood removal only. A spreader bar should be used to lift the motor by the cast lifting lugs located on the motor frame.
4. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted as an assembly for installation.

   Do not lift the assembly using the motor lugs or eye bolts provided. Lugs or eye bolts are designed to lift motor only. If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting. If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

Storage

Storage requirements for motors and generators that will not be placed in service for at least six months from date of shipment.

Improper motor storage will result in seriously reduced reliability and failure. An electric motor that does not experience regular usage while being exposed to normally humid atmospheric conditions is likely to develop rust in the bearings or rust particles from surrounding surfaces may contaminate the bearings. The electrical insulation may absorb an excessive amount of moisture leading to the motor winding failure.

A wooden crate "shell" should be constructed to secure the motor during storage. This is similar to an export box but the sides & top must be secured to the wooden base with lag bolts (not nailed as export boxes are) to allow opening and reclosing many times without damage to the "shell".

Minimum resistance of motor winding insulation is 5 Meg ohms or the calculated minimum, which ever is greater. Minimum resistance is calculated as follows: **Rm = kV + 1**

where: (Rm is minimum resistance to ground in Meg–Ohms and
kV is rated nameplate voltage defined as Kilo–Volts.)

Example: For a 480VAC rated motor Rm =1.48 meg–ohms (use 5 MΩ).
For a 4160VAC rated motor Rm = 5.16 meg–ohms.

Preparation for Storage

1. Some motors have a shipping brace attached to the shaft to prevent damage during transportation. The shipping brace, if provided, must be removed and stored for future use. The brace must be reinstalled to hold the shaft firmly in place against the bearing before the motor is moved.
2. Store in a clean, dry, protected warehouse where control is maintained as follows:
   a. Shock or vibration must not exceed 2 mils maximum at 60 hertz, to prevent the bearings from brinelling. If shock or vibration exceeds this limit vibration isolation pads must be used.
   b. Storage temperatures of 10°C (50°F) to 49°C (120°F) must be maintained.
   c. Relative humidity must not exceed 60%.
   d. Motor space heaters (when present) are to be connected and energized whenever there is a possibility that the storage ambient conditions will reach the dew point. Space heaters are optional.

   Note: Remove motor from containers when heaters are energized, reprotect if necessary.
3. Measure and record the resistance of the winding insulation (dielectric withstand) every 30 days of storage.
   a. If motor insulation resistance decreases below the minimum resistance, contact your Baldor District office.
   b. Place new desiccant inside the vapor bag and re–seal by taping it closed.
   c. If a zipper–closing type bag is used instead of the heat–sealed type bag, zip the bag closed instead of taping it. Be sure to place new desiccant inside bag after each monthly inspection.
   d. Place the shell over the motor and secure with lag bolts.
4. Where motors are mounted to machinery, the mounting must be such that the drains and breathers are fully operable and are at the lowest point of the motor. Vertical motors must be stored in the vertical position. Storage environment must be maintained as stated in step 2.

5. Motors with anti–friction bearings are to be greased at the time of going into extended storage with periodic service as follows:
   a. Motors marked "Do Not Lubricate" on the nameplate do not need to be greased before or during storage.
   b. Ball and roller bearing (anti–friction) motor shafts are to be rotated manually every 3 months and greased every 6 months in accordance with the Maintenance section of this manual.
   c. Sleeve bearing (oil lube) motors are drained of oil prior to shipment. The oil reservoirs must be refilled to the indicated level with the specified lubricant, (see Maintenance). The shaft should be rotated monthly by hand at least 10 to 15 revolutions to distribute oil to bearing surfaces.
   d. "Provisions for oil mist lubrication" – These motors are packed with grease. Storage procedures are the same as paragraph 5b.
   e. "Oil Mist Lubricated" – These bearings are protected for temporary storage by a corrosion inhibitor. If stored for greater than 3 months or outdoor storage is anticipated, connected to the oil mist system while in storage. If this is not possible, add the amount of grease indicated under "Standard Condition" in Section 3, then rotate the shaft 15 times by hand.
6. All breather drains are to be fully operable while in storage (drain plugs removed). The motors must be stored so that the drain is at the lowest point. All breathers and automatic "T" drains must be operable to allow breathing and draining at points other than through the bearings around the shaft. Vertical motors should be stored in a safe stable vertical position.
7. Coat all external machined surfaces with a rust preventing material. An acceptable product for this purpose is Exxon Rust Ban # 392.
8. Carbon brushes should be lifted and held in place in the holders, above the commutator, by the brush holder fingers. The commutator should be wrapped with a suitable material such as cardboard paper as a mechanical protection against damage.

Non–Regreaseable Motors

Non–regreasable motors with "Do Not Lubricate" on the nameplate should have the motor shaft rotated 15 times to redistribute the grease within the bearing every 3 months or more often.

All Other Motor Types

Before storage, the following procedure must be performed.

1. Remove the grease drain plug, if supplied, (opposite the grease fitting) on the bottom of each bracket prior to lubricating the motor.
2. The motor with regreasable bearing must be greased as instructed in Section 3 of this manual.
3. Replace the grease drain plug after greasing.
4. The motor shaft must be rotated a minimum of 15 times after greasing.
5. Motor Shafts are to be rotated at least 15 revolutions manually every 3 months and additional grease added every nine months (see Section 3) to each bearing.
6. Bearings are to be greased at the time of removal from storage.

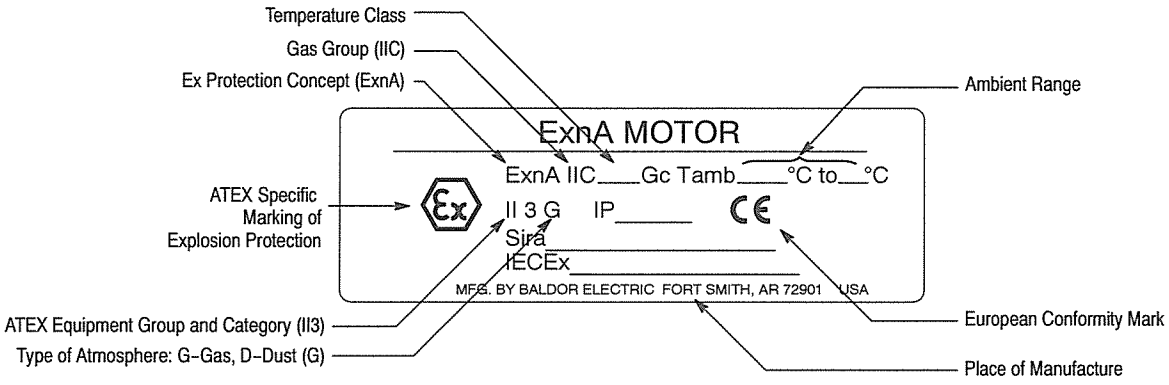
Removal From Storage

1. Remove all packing material.
2. Measure and record the electrical resistance of the winding insulation resistance meter at the time of removal from storage. The insulation resistance must not be less than 50% from the initial reading recorded when the motor was placed into storage. A decrease in resistance indicates moisture in the windings and necessitates electrical or mechanical drying before the motor can be placed into service. If resistance is low, contact your Baldor District office.
3. Regrease the bearings as instructed in Section 3 of this manual.
4. Reinstall the original shipping brace if motor is to be moved. This will hold the shaft firmly against the bearing and prevent damage during movement.

Equipment Marking for IEC Certified Product

IEC certified products have special markings that identify the protection concept and environment requirements. An example is shown in Figure 3-1.

Figure 3-1 IEC Certified Product Markings



Specific Conditions of Use:
If the motor certificate number is followed by the symbol "X", this indicates that the motor has specific conditions of use which are indicated on the certificate. It is necessary to review the product certification certificate in conjunction with this instruction manual.

Operation On Frequency Converters:
If the motor is evaluated for operation with an adjustable speed drive, the type of converter (for example PWM for Pulse Width Modulated) and safe speed ranges (for example 0–120Hz) will be specified in the certification documents or on motor nameplates. It is necessary to consult the adjustable speed drive manual for proper set up. IECEx Certificates are available online at www.iecex.com

Section 2
Installation & Operation

Overview

Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

Location

It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.

Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

1. **Open Drip–Proof/WPI** motors are intended for use indoors where atmosphere is relatively clean, dry, well ventilated and non–corrosive.
2. **Totally Enclosed and WPII** motors may be installed where dirt, moisture or dust are present and in outdoor locations.

Severe Duty, IEEE 841 and Washdown Duty enclosed motors are designed for installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material, unless specifically designed for this type of service.

IEEE841 motors are suitable for application in Class I Division 2 and Class I Zone 2 areas on sine wave power in accordance with the applicable codes and standards.

Hazardous Locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers, or flyings. Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code.

EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2004/108/EC . These motors are commercial in design and not intended for residential use.

Mounting

Location

The motor should be installed in a location compatible with the motor enclosure and specific ambient. To allow adequate air flow, the following clearances must be maintained between the motor and any obstruction:

Table 2–1 Enclosure Clearance

TEFC / TENV (IC0141) Enclosures	
Fan Cover Air Intake	180 – 210T Frame 1″□(25mm)
Fan Cover Air Intake	250 – 449T Frame 4″□(100mm)
	IEC 112 – 132 1″□(25mm)
	IEC 160 – 280 4″□(100mm)
Exhaust	Envelope equal to the P Dimension on the motor dimension sheet
OPEN/Protected Enclosures	
Bracket Intake	Same as TEFC
Frame Exhaust	Exhaust out the sides envelope A minimum of the P dimension plus 2″ (50mm) Exhaust out the end same as intake.

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

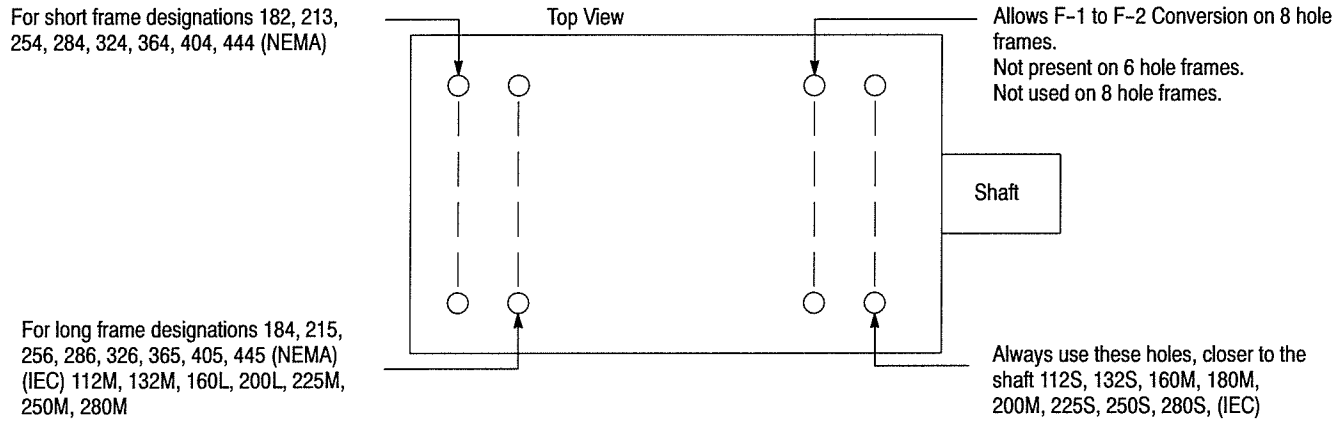
When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

Frame Mounting Holes

Some motors have standardized frames containing 6 or 8 mounting holes. 6 hole frames are not suitable for field reversal of mounting from F–1 to F–2, etc. Figure 2-2 indicates the proper mounting holes to use.

Figure 2-2 6 & 8 Hole Motor Frame Mounting



Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.**

In the case of assemblies on a common base, any lifting means provided on the motor should not be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. Assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

Alignment Accurate alignment of the motor with the driven equipment is extremely important. The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. It is recommended to heat the pulley, sprocket, or gear before installing on the motor shaft. Forcibly driving a unit on the motor shaft will damage the bearings.

1. **Direct Coupling**
   For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.
2. **End-Play Adjustment**
   The axial position of the motor frame with respect to its load is also extremely important. The standard motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.
3. **Pulley Ratio**
   The best practice is to not exceed an 8:1 pulley ratio.

Caution: **Do not over tension belts. Excess tension may damage the motor or driven equipment.**

4. **Belt Drive**
   Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

Doweling & Bolting After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor•Reliance motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet in the locations provided.
2. Drill corresponding holes in the foundation.
3. Ream all holes.
4. Install proper fitting dowels.
5. Mounting bolts must be carefully tightened to prevent changes in alignment. Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure. Flanged nuts or bolts may be used as an alternative to washers.

WARNING: Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.

Guarding Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions. This is particularly important where the parts have surface irregularities such as keys, key ways or set screws. Some satisfactory methods of guarding are:

1. Covering the machine and associated rotating parts with structural or decorative parts of the driven equipment.
2. Providing covers for the rotating parts. Covers should be sufficiently rigid to maintain adequate guarding during normal service.

Power Connection Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices.

For ExnA hazardous location motors, it is a specific condition of use that all terminations in a conduit box be fully insulated. Fully insulated and lugged terminations must be bolted and provided with lock washer to prevent rotation. Flying leads must be insulated with two full wraps of electrical grade insulating tape or heat shrink tubing.

Grounding In the USA consult the National Electrical Code, Article 430 for information on grounding of motors and generators, and Article 250 for general information on grounding. In making the ground connection, the installer should make certain that there is a solid and permanent metallic connection between the ground point, the motor or generator terminal housing, and the motor or generator frame. In non–USA locations consult the appropriate national or local code applicable.

Motors with resilient cushion rings usually must be provided with a bonding conductor across the resilient member. Some motors are supplied with the bonding conductor on the concealed side of the cushion ring to protect the bond from damage. Motors with bonded cushion rings should usually be grounded at the time of installation in accordance with the above recommendations for making ground connections. When motors with bonded cushion rings are used in multimotor installations employing group fusing or group protection, the bonding of the cushion ring should be checked to determine that it is adequate for the rating of the branch circuit over current protective device being used.

There are applications where grounding the exterior parts of a motor or generator may result in greater hazard by increasing the possibility of a person in the area simultaneously contacting ground and some other nearby live electrical parts of other ungrounded electrical equipment. In portable equipment it is difficult to be sure that a positive ground connection is maintained as the equipment is moved, and providing a grounding conductor may lead to a false sense of security.

Select a motor starter and over current protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or other applicable local codes.

For motors installed in compliance with IEC requirements, the following minimum cross sectional area of the protective conductors should be used:

Cross-sectional area of phase conductors, S	Minimum cross-sectional area of the corresponding protective conductor, S_p
mm^2	mm^2
$S < 16$	S
$16 < S \leq 35$	16
$S > 35$	$0{,}5\,S$

Equipotential bonding connection shall made using a conductor with a cross-sectional area of at least 4 mm^2.

Conduit Box For ease of making connections, an oversize conduit box is provided. Most conduit boxes can be rotated 360° in 90° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

AC Power Motors with flying lead construction must be properly terminated and insulated.
Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within ±10% of rated voltage with rated frequency. (See motor name plate for ratings).
   OR
2. AC power is within ±5% of rated frequency with rated voltage.
   OR
3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-4.

Figure 2-3 Accessory Connections

HEATERS H1 —∿∿— H2 H1 —∿∿— H2	One heater is installed in each end of motor. Leads for each heater are labeled H1 & H2. (Like numbers should be tied together).
THERMISTORS TD1 —∿∿— TD2	Three thermistors are installed in windings and tied in series. Leads are labeled TD1 & TD2.
WINDING RTDS RED RED WHITE	Winding RTDs are installed in windings (2) per phase. Each set of leads is labeled 1TD1, 1TD2, 1TD3, 2TD1, 2TD2, 2TD3 etc.
BEARING RTD RED RED WHITE	* One bearing RTD is installed in Drive endplate (PUEP), leads are labeled RTDDE. * One bearing RTD is installed in Opposite Drive endplate (FREP), leads are labeled RTDODE. * Note RTD may have 2–Red/1–White leads; or 2–White/1–Red Lead.

Rotation All three phase motors are reversible. To reverse the direction of rotation, disconnect and lock out power and interchange any two of the three line leads for three phase motors. For single phase motors, check the connection diagram to determine if the motor is reversible and follow the connection instructions for lead numbers to be interchanged. Not all single phase motors are reversible.

Adjustable Frequency Power Inverters used to supply adjustable frequency power to induction motors produce wave forms with lower order harmonics with voltage spikes superimposed. Turn–to–turn, phase–to–phase, and ground insulation of stator windings are subject to the resulting dielectric stresses. Suitable precautions should be taken in the design of these drive systems to minimize the magnitude of these voltage spikes. Consult the drive instructions for maximum acceptable motor lead lengths, and proper grounding.

Note: Main power leads for CE Marked Motors may be marked U,V,W – for standard configurations, please consult connection diagrams.

Caution: **The space heaters are designed to operate at or below the maximum surface temperature stated on the nameplate. If the marked ambient and/or voltage are exceeded this maximum surface temperature can be exceeded and can damage the motor windings. If applied in a division 2 or zone 2 environment this excessive temperature may cause ignition of hazardous materials.**

Connection Diagrams

AC Motor Connection Diagram

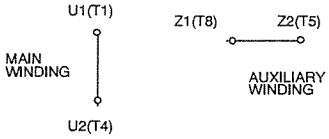
IEC VERSUS NEMA LEAD MARKING

EXAMPLE COMPARISIONS OF IEC AND NEMA LEADING MARKINGS FOR COMMON CONNECTION TYPES ARE SHOWN BELOW.

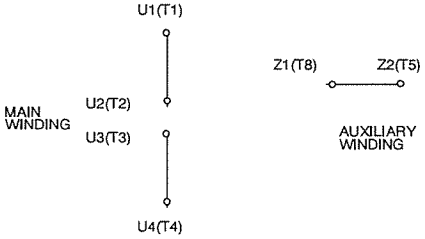
SINGLE PHASE MOTORS

SINGLE VOLTAGE NON REVERSIBLE

SINGLE VOLTAGE REVERSIBLE



DUAL VOLTAGE REVERSIBLE



AC Motor Connection Diagram

THREE PHASE

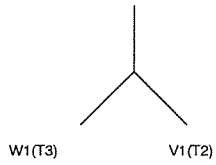
FOR SINGLE WINDING 3 PHASE MOTORS, LEAD MARKINGS CAN BE DIRECTLY TRANSLATED BETWEEN IEC AND NEMA DESIGNATIONS. FOR THESE MOTORS, THE LEAD MARKINGS ARE EQUIVALENT AS FOLLOWS:

U1=T1	U2=T4	U5=T7	U6=T10
V1=T2	V2=T5	V5=T8	V6=T11
W1=T3	W2=T6	W5=T9	W6=T12

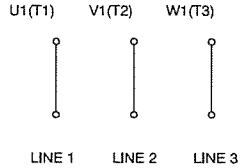
EXAMPLES OF COMMON CONNECTIONS ARE GIVEN BELOW.

THREE LEADS

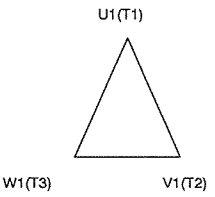
WYE CONNECT



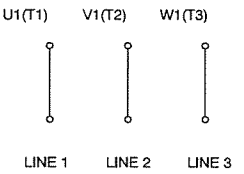
WIRING DIAGRAM



DELTA CONNECT



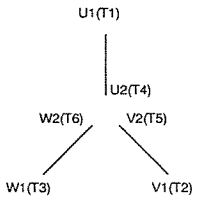
WIRING DIAGRAM



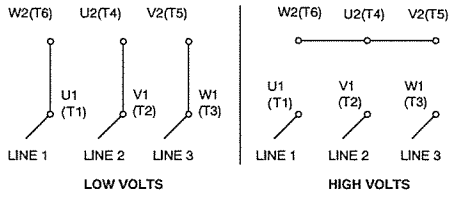
AC Motor Connection Diagram

SIX LEADS

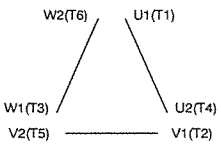
DELTA-WYE CONNECT



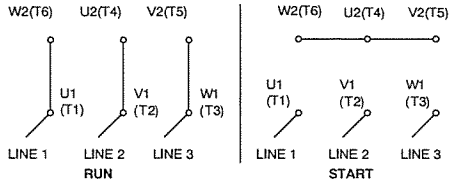
DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 1.73:1



WYE-DELTA CONNECT



WYE START-DELTA RUN SINGLE VOLTAGE

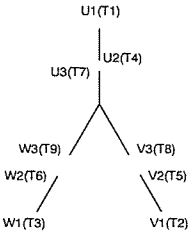


AC Motor Connection Diagram

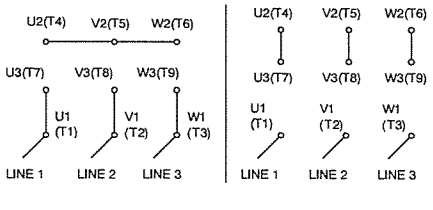
NINE LEADS

DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 2:1

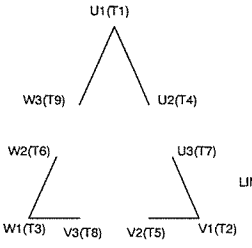
WYE CONNECT



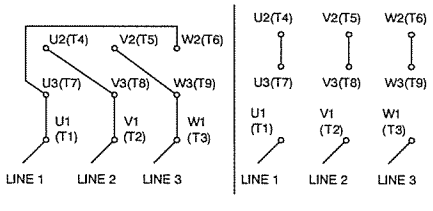
WIRING DIAGRAM



DELTA CONNECT



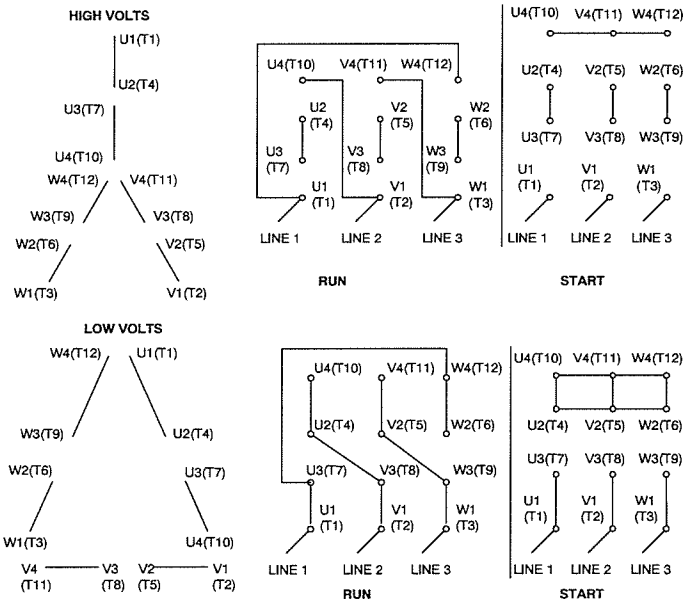
WIRING DIAGRAM



AC Motor Connection Diagram

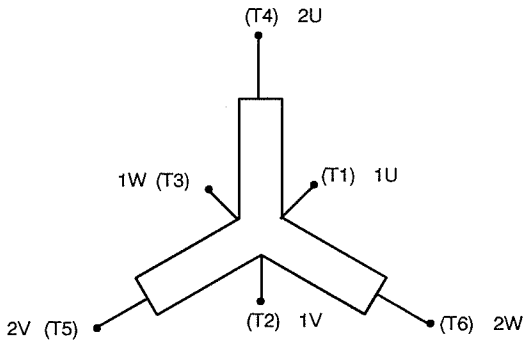
TWELVE LEADS

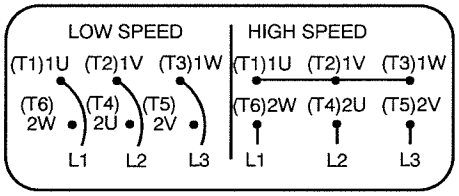
DUAL VOLTAGE WYE START - DELTA - RUN



AC Motor Connection Diagram

SINGLE WINDING MULTI-SPEEDS CONSTANT TORQUE

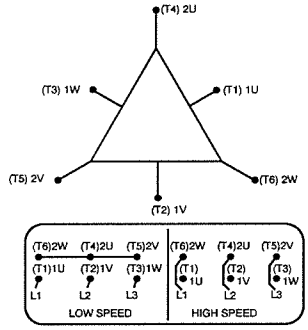




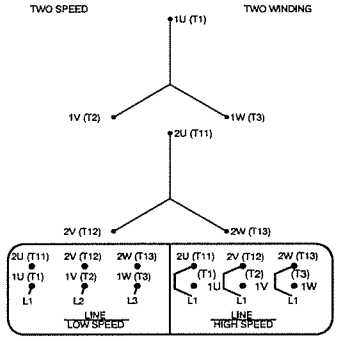
(N.P. 1634-DE)

AC Motor Connection Diagram

SINGLE WINDING MULTI-SPEEDS CONSTANT HP.

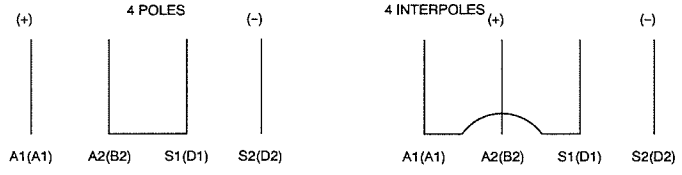


TWO SPEED TWO WINDING



DC Motor Connection Diagram

WIRING DIAGRAM TYPE "T" MOTOR



COUNTERCLOCKWISE ROTATION CLOCKWISE ROTATION

ROTATION - FACING COMMUTATOR END

COMPARISON OF IEC AND NEMA LEAD MARKINGS
FOR DIRECT CURRENT MOTORS

A1--A1
A2--B2
S1--D1

S2--D2

MOTOR WINDING THERMOSTATS		
CONTACTS _____ @ _____ °C		
FIGURE NUMBER _____		
CONTACT RATING		
VOLTS	CONTINUOUS AMPERES	INRUSH AMPERES
110 - 120	3.0	30
220 - 240	1.5	15
440 - 480	0.75	7.5
550 - 600	0.60	6.0

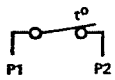
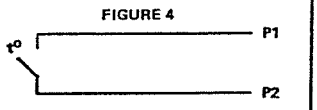
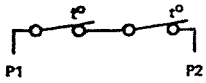
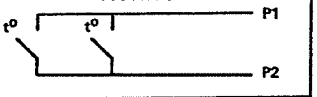
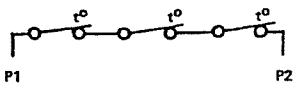
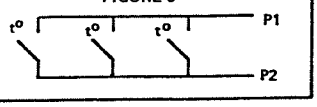
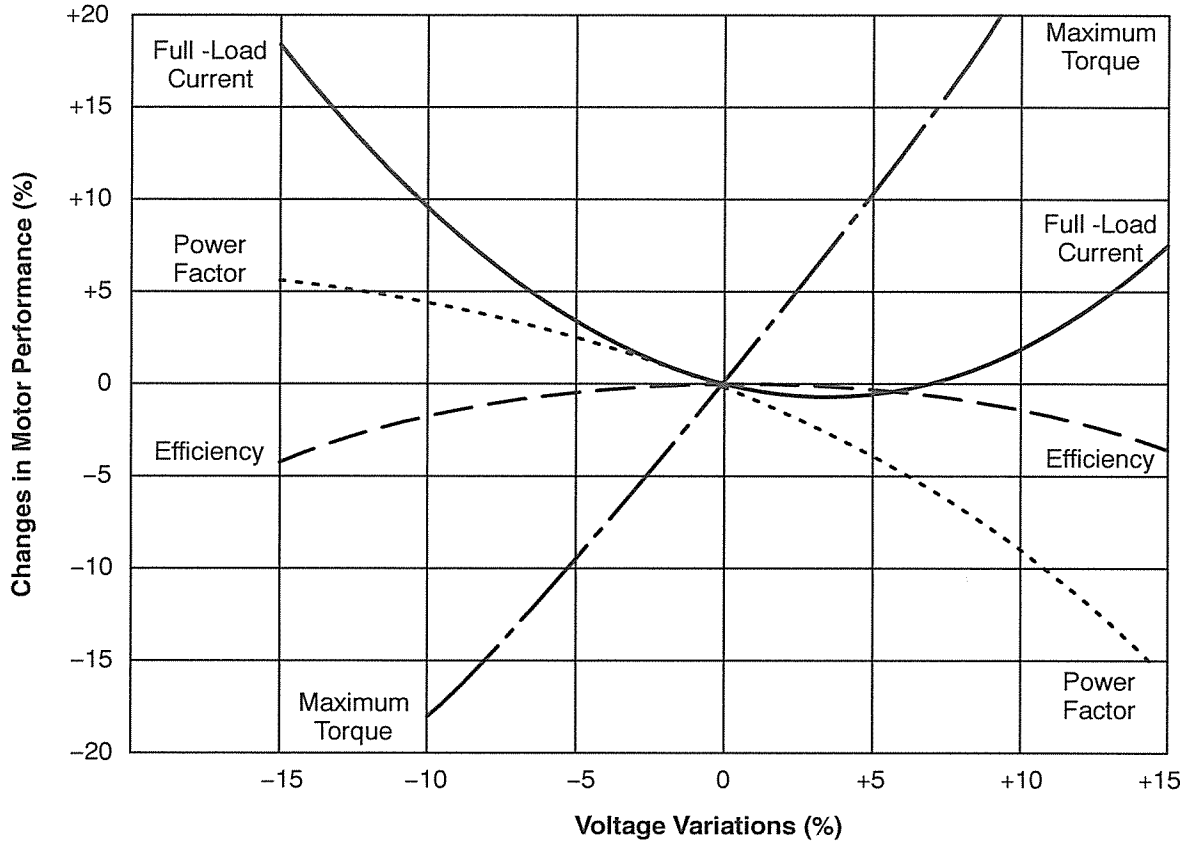
THERMOSTATS	
NORMALLY CLOSED	NORMALLY OPEN
FIGURE 1 	FIGURE 4 
FIGURE 2 	FIGURE 5 
FIGURE 3 	FIGURE 6 

Figure 2-4 Typical Motor Performance VS Voltage Variations



Initial Lubrication Baldor•Reliance motors are shipped from the factory with the bearings properly packed with grease and ready to operate. Where the unit has been subjected to extended storage (6 months or more) the bearings should be relubricated (regreasable type) prior to starting. When motors are equipped for oil mist lubrication refer to the instruction manual for installation, operation, and maintenance of oil mist lubrication systems.

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Section 3.**

First Time Start Up Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.
10. After 1 hour of operation, disconnect power and connect the load to the motor shaft. Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.
11. If motor is totally enclosed fan–cooled or non–ventilated it is recommended that condensation drain plugs, if present, be removed. These are located in the lower portion of the end–shields. Totally enclosed fan–cooled "XT" motors are normally equipped with automatic drains which may be left in place as received.

Coupled Start Up This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
2. Check that the coupling is properly aligned and not binding.
3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor though the coupling or the foundation. Vibration should be at an acceptable level.
4. Run for approximately 1 hour with the driven equipment in an unloaded condition.

The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

Jogging and Repeated Starts Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

Hazardous Locations

Hazardous locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers or flyings.

Selection Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code. In international hazardous location areas, guidance for gas / vapor / mist classification is given in IEC60079–14, or for dust in IEC61241–14. This classification process lets the installer know what equipment is suitable for installation in that environment, and identifies what the maximum safe temperature or temperature class is required. It is the customer or users responsibility to determine the area classification and select proper equipment.

Areas are classified with respect to risk and exposure to the hazard. In the US market, areas are typically classified as follows Class, Division, Group and Temperature Class. In some newer installations in the US and in most international markets, areas are classified in Zones.

Protection Concepts

Class I Division 1 / Zone 1 [Equipment Group I (mining) or II (surface), Equipment Protection Level (EPL) Gb, Mb]

Baldor offers a range of motors suitable for installation in a Division 1 or Zone 1 environment. These motors are known as explosion proof or flameproof.

Motors that are explosion proof or flameproof use specially machined flameproof joints between the end bell or bracket and the frame, as well as along the rotating shaft and at connection box covers and entries. The fit of these flameproof joints are designed to contain the combustion or quench the flame of an explosive gas atmosphere prior to it exiting the motor. These flameproof joints have lengths and widths selected and tested based on the gas group present in the atmosphere. Baldor•Reliance motors are typically designed to meet Class I (Division 1) Group C and D (explosion proof) or Ex d IIB (flameproof).

An application note regarding equipment applied in accordance with the US National Electric Code (NFPA 70–2008) – according to Article 500.8(C) Marking, sub clause (2) in the fine print note, it is noted that Equipment not marked to indicate a division is suitable for both Division 1 and Division 2 locations. These motors are not gas tight. To the contrary, this protection concept assumes that due to the normal heating and cooling cycle of motor operation that any gas present will be drawn into the motor. Since flameproof or explosion proof motors are designed to contain the combustion and extinguish any flame transmission, for this protection concept, only external surface temperatures are of concern. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions.

If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device. The ATEX directive requires that motor shutdown on thermal trip be accomplished without an intermediate software command. Where intermediate circuitry is involved the circuit shall fall within the scope of a safety, controlling and regulating device as defined in article 1(2) of European Directive 94/9/EC, and shall be covered by an appropriate EC Type Examination Certificate.

Flameproof motors, internationally referred to as Ex d use a protection concept similar to that used in Class I Division 1 motors, with minor differences in the flameproof joints and cable entry designs. Flameproof and explosion proof motors are both type tested. Representative motors are connected to a reference gas and ignited in laboratory conditions to verify that the flame is not transmitted outside the motor enclosure and to determine the maximum internal pressure encountered.

Explosion proof and Flame proof motors shipped without a conduit box require use of a certified box of suitable dimensions and that is appropriate for the classification. Openings in connection boxes must be closed with suitably certified and dimensioned device.

Class I Division 2 / Zone 2 Ex nA, [Equipment Protection Level (EPL) Gc]

This protection concept relies on having no sources of ignition present such as arcing parts or hot surfaces. For this protection concept, internal temperatures as well as external temperatures are considered. In many cases, the internal temperatures are higher than the external temperatures and therefore become the limiting factor in determination of temperature code designation. In these applications, it is very important to use a motor that has been evaluated thermally for use with an inverter or converter, if variable speed operation is desired. Thermostats used for Class I Division 2 and Ex nA motors are used to protect the motor only. For motors using flying lead construction, it is important to use connection lugs and insulate with heat shrink tubing or a double wrap of insulation grade electrical tape to avoid the risk of spark or ignition.

Class II Division 1 / Zone 21 [Equipment Group III, Equipment Protection Level (EPL) Db]

This area classification is one where the risk of ignitable concentrations of dust is present at all or some of the time. The protection concepts used for Class II Division 1 is similar to flamepath, except with additional dust exclusion paths designed for the rotating shaft. In the international designations, this concept is referred to as dust ignition proof or Ex tD. External surface temperature remains the limiting factor. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions. If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device.

Note: In the North American area classification system, Class III exists for fibers and flyings. In the IEC designation, both dusts and flyings are absorbed into Group III.

Class II Division 2 / Zone 22 [Equipment Group III, Equipment Protection Level (EPL) Dc]

This area classification is one where the risk of exposure to ignitable concentrations of dust are not likely to occur under normal operating conditions and relies heavily on the housekeeping practices within the installation.

Sine Wave Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22 Hazardous Location.

These motors are designed to operate at or below the maximum surface temperature (or T–Code) stated on the nameplate. Failure to operate the motor properly can cause this maximum surface temperature to be exceeded. If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperatures above nameplate value
3. Voltages above or below nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Altitude above 3300 feet / 1000 meters
7. Severe duty cycles of repeated starts
8. Motor stall
9. Motor reversing
10. Single phase operation of polyphase equipment
11. Variable frequency operation

Variable Frequency Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22 Hazardous Location (motors with maximum surface temperature listed on the nameplate).

Only motors with nameplates marked for use on inverter (variable frequency) power, and labeled for specific hazardous areas may be used in those hazardous areas on inverter power. The motor is designed to operate at or below the maximum surface temperature (or T–Code) stated on the nameplate. Failure to operate the motor properly can cause this maximum surface temperature to be exceeded.

If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperature above nameplate value
3. Voltage (at each operating frequency) above or below rated nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Operation outside of the nameplate speed / frequency range
7. Altitudes above 3300 feet / 1000 meters
8. Single phase operation of polyphase equipment
9. Unstable current wave forms
10. Lower than name plate minimum carrier frequency

Thermal Limiting

Thermal limiting devices are temperature sensing control components installed inside the motor to limit the internal temperature of the motor frame by interrupting the circuit of the holding coil of the magnetic switch or contactor. They are required for most Division 1 and Zone 1 applications. For Division 2 or Zone 2 applications, motors should be selected that preclude running temperatures from exceeding the ignition temperatures for the designated hazardous material. In Division 2 or Zone 2 classified locations, thermal limiting devices should only be used for winding protection and not considered for limiting all internal motor temperatures to specific ignition temperatures.

Equipotential Bonding and Shaft Current Reduction

Larger motors (ie WP construction) may require proper bonding between motor enclosures and covers to avoid the risk of stray currents during start up. Fastening methods and bonding straps must not be modified.

Bearing currents can exist in some motors for both line–fed and inverter–fed applications. Larger line–fed motors may require at least one insulated bearing to prevent a flow of current through the bearings. Do not defeat such insulation whether the motor is line–fed or inverter–fed applications. Inverter–fed motors may require additional bearing insulation or even a shaft brush. Do not defeat such features. When the motor and the coupled load are not on a common conductive baseplate, it may also be necessary to electrically bond together the stationary parts of the motor and the coupled equipment.

Repair of Motors used in Hazardous Locations

Repair of hazardous certified motors requires additional information, skill, and care. It is the customer's responsibility to select service shops with proper qualifications to repair hazardous location motors. Contact the manufacture for additional repair details. Use only original manufacturer's parts.

Repair of Explosion Proof or Flame Proof Motors Class I Division 1 and Zone 1

In the North American market, recertification programs are offered by Underwriters Laboratories and Canadian Standards Association which allow authorized service shops to mark the rebuilt motors as certified. In the international markets using IEC based requirements, repair should be undertaken only after consulting IEC60079–19 Explosive Atmospheres–Part 19 Equipment repair, overhaul and reclamation. If use of a certified repair facility is desired, consult the IECEX Repair Scheme at

http://www.iecex.com/service_facilities.htm

Explosion proof and flameproof motors achieve their safety based on the mechanical construction – flameproof joints and bearing clearance, and the electrical design including any thermal limiting devices. If it is necessary to repair a flameproof or explosion proof motor, it is critical that the mechanical flameproof joints be maintained. Consult Baldor Electric Company for flameproof joint construction details. Use only Baldor•Reliance supplied parts. Baldor does not recommend reclamation of parts. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present.

Repair of Dust Ignition Proof Motors – Class II Division 1 and 2, Zone 21 and 22.

For Dust Ignition Proof, proper sealing is required. Do not modify the motor construction to add any additional opening, and ensure that proper sealing is maintained in the connection box and at the shaft seal. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present

Repair of Class I Division 2 and Zone 2 motors

For Division 2 and Zone 2, the internal and external temperatures are of concern. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present. Use only Baldor replacement thermostats, if provided.

Section 3
Maintenance & Troubleshooting

WARNING: **UL and EX Listed motors must only be serviced by UL or EX Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.**

General Inspection Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING: **Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.**

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Perform a dielectric with stand test periodically to ensure that the integrity of the winding insulation has been maintained. Record the readings. Immediately investigate any significant decrease in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Relubrication & Bearings Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease A high grade ball or roller bearing grease should be used. Recommended grease for standard service conditions is **Polyrex EM (Exxon Mobil)**. Do not mix greases unless compatibility has been checked and verified.

Ball Bearing Motors

Operating Temperature –25°C (–15°F) to 50°C (120°F)

EXXON	POLYREX EM (Standard on Baldor motors)
EXXON	UNIREX N2
EXXON	BEACON 325
CHEVRON OIL	SRI NO. 2 (Compatible with Polyrex EM)
CHEVRON OIL	BLACK PEARL
TEXACO, INC.	PREMIUM RB
TEXACO, INC.	POLYSTAR
AMOCO	RYKON # 2
PENNZOIL	PENNZLUBE EM–2
DARMEX	DARMEX 707
DARMEX	DARMEX 711
PETRO–CANADA	PEERLESS LLG
SHELL OIL	DOLIUM BRB

Minimum Starting Temperature –60°C (–76°F)

SHELL OIL CO.	AEROSHELL 7 (Standard on Baldor motors)
MOBIL	MOBIL 28
MOBIL	MOBILITH SHC 100 (Low Temperature – Arctic Duty)

Roller Bearing Motors

Operating Temperature –25°C (–15°F) to 50°C (120°F)

TEXACO, INC.	PREMIUM RB
MOBIL	MOBILITH SHC 220 (Standard on Baldor motors)
CHEVRON OIL	BLACK PEARL

Relubrication Intervals Recommended relubrication intervals are shown in Table 3-2. It is important to realize that the recommended intervals of Table 3-2 are based on average use.

Refer to additional information contained in Tables 3-3, 3-4 and 3-5.

Table 3-2 Relubrication Intervals *

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)		**	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 449 incl. (315)		**	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

* Relubrication intervals are for ball bearings.
For vertically mounted motors and roller bearings, divide the relubrication interval by 2.

** For motors operating at speeds greater than 3600 RPM, contact Baldor for relubrication recommendations.

Table 3-3 Service Conditions

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40° C	Clean, Little Corrosion
Severe	16 Plus	50° C	Moderate dirt, Corrosion
Extreme	16 Plus	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration
Low Temperature		<–29° C **	

* Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.

** Special low temperature grease is recommended (Aeroshell 7).

Table 3-4 Relubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Some motor designs use different bearings on each motor end. This is normally indicated on the motor nameplate. In this case, the larger bearing is installed on the motor Drive endplate. For best relubrication results, only use the appropriate amount of grease for each bearing size (not the same for both).

Table 3-5 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)			
	Bearing	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
			in^3	teaspoon
56 to 140 (90)	6203	0.08 (2.4)	0.15	0.5
140 (90)	6205	0.15 (3.9)	0.2	0.8
180 (100–112)	6206	0.19 (5.0)	0.3	1.0
210 (132)	6307	0.30 (8.4)	0.6	2.0
250 (160)	6309	0.47 (12.5)	0.7	2.5
280 (180)	6311	0.61 (17)	1.2	3.9
320 (200)	6312	0.76 (20.1)	1.2	4.0
360 (225)	6313	0.81 (23)	1.5	5.2
400 (250)	6316	1.25 (33)	2.0	6.6
440 (280)	6318	1.52(40)	2.5	8.2
440 (280)	6319	2.12 (60)	4.1	13.4
5000 to 5800 (315–355)	6328	4.70 (130)	9.2	30.0
5000 to 5800 (315–355)	NU328	4.70 (130)	9.2	30.0
360 to 449 (225–280)	NU319	2.12 (60)	4.1	13.4
AC Induction Servo				
76 Frame 180 (112)	6207	0.22 (6.1)	0.44	1.4
77 Frame 210 (132)	6210	0.32 (9.0)	0.64	2.1
80 Frame 250(160)	6213	0.49 (14.0)	0.99	3.3

* Weight in grams = .005 DB of grease to be added

Note: Not all bearing sizes are listed.
For intermediate bearing sizes, use the grease volume for the next larger size bearing.

Caution: To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.

Relubrication Procedure Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

Caution: Do not over–lubricate motor as this may cause premature bearing failure.

With Grease Outlet Plug

1. With the motor stopped, clean all grease fittings with a clean cloth.
2. Remove grease outlet plug.

Caution: Over–lubricating can cause excessive bearing temperatures, premature lubrication breakdown and bearing failure.

3. Add the recommended amount of grease.
4. Operate the motor for 15 minutes with grease plug removed. This allows excess grease to purge.
5. Re-install grease outlet plug.

Without Grease Provisions

Note: Only a Baldor authorized and UL or CSA certified service center can disassemble a UL/CSA listed explosion proof motor to maintain it's UL/CSA listing.

1. Disassemble the motor.
2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)
3. Assemble the motor.

Sample Relubrication Determination

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 3-2 list 9500 hours for standard conditions.
2. Table 3-3 classifies severity of service as "Severe".
3. Table 3-5 shows that 1.2 in^3 or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

Shaker Duty Motors only

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Table 3-6.**

Lubrication should be performed before Start Up and at regular maintenance intervals. Follow these recommendations to ensure proper lubrication.

Recommended Lubricant

For ambient temperatures between –15°F to 120°F the following lubricants are recommended:
Mobil PolyrexEM, Texaco Premium RB, Exxon Unirex N–2.
Do not mix greases unless compatibility has been checked and verified.

Table 3-6 Lubrication Volume

NEMA Frame Size	Volume in Cubic Inches					
	Normal Duty		Severe Duty		Extreme Duty	
	Start Up	Relub	Start Up	Relub	Start Up	Relub
184TY	1.4	0.5	1.4	0.5	2.7	0.5
215TY	1.6	0.5	1.6	0.5	4.5	1
256TY	7	1			11	2
286TY	9	1			15	3

Lubrication Frequency

Normal Duty 8 hours per day (16 hours per day in a clean environment). Lubricate every 2 months.

Severe Duty 16 hours per day or more in a dirty environment (corrosive atmosphere, chemical fumes, acids, alkalies or extreme high humidity). Lubricate every month or 700 hours of operation.

Extreme Duty operation in extremely dirty or dusty environments and high ambient temperatures exceeding 104°F (40°C). Lubricate twice a month or 350 hours of operation.

Lubrication Procedure

1. Locate the grease inlet and outlet. Clean the areas.
2. Remove the plug(s) and install a grease fitting in the inlet if grease fitting is not already installed.
3. Add the recommended amount of lubricant.
4. Run the motor for two hours with the outlet plug removed.
5. Install outlet plug.

Note: To loosen hardened grease it may be necessary to insert a rod or wire into the grease inlet and outlet holes.

Table 3-7 Troubleshooting Chart

Symptom	Possible Causes	Possible Solutions
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage.	Check input line connections.
	Eccentric air gap.	Have motor serviced at local Baldor service center.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings.
		Tighten "Thru Bolts".
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to motor lead connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately $^3/_4$ filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately $^3/_4$ filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately $^3/_4$ filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked are repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately $^3/_4$ filled.

Suggested bearing and winding RTD setting guidelines for Non–Hazardous Locations ONLY

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80°C) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

Winding RTDs – Temperature Limit In °C (40°C Maximum Ambient)

Motor Load	Class B Temp Rise ≤ 80°C (Typical Design)		Class F Temp Rise ≤ 105°C		Class H Temp Rise ≤ 125°C	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note: • Winding RTDs are factory production installed, not from Mod–Express.
• When Class H temperatures are used, consider bearing temperatures and relubrication requirements.

Bearing RTDs – Temperature Limit In °C (40°C Maximum Ambient)

Bearing Type Oil or Grease	Anti–Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Note: * Bearing temperature limits are for standard design motors operating at Class B temperature rise.
** High temperature lubricants include some special synthetic oils and greases.

Greases that may be substituted that are compatible with Polyrex EM (but considered as "standard" lubricants) include the following:

- Texaco Polystar
- Rykon Premium #2
- Chevron SRI #2
- Mobilith SHC–100
- Pennzoil Pennzlube EM–2
- Chevron Black Pearl
- Darmex 707
- Darmex 711
- Petro–Canada Peerless LLG

See the motor nameplate for replacement grease or oil recommendation.
Contact Baldor application engineering for special lubricants or further clarifications.

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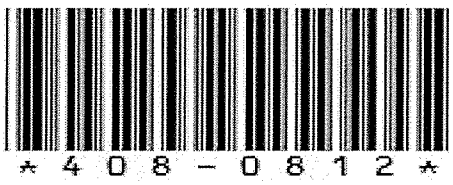

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