TRANSMITTAL MEMO
OPERATION & MAINTENANCE

DATE: July 13, 2018

TO: Columbia Pulp
c/o: Allnorth Consultants LTD

Attn: Marge Branchi-Project Administrator
Email: mbrachi@allnorth.com

FROM: Cindy Newell, Engineering Department

SUBJECT: Transmittal of Installation, Operation, and Maintenance Instructions; STHE8N10CS-160 - Horizontal Pump

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Marge Brachi:

This memo documents our EMAIL transmittal of the Installation, Operation, Maintenance information and documentation. If you require hard copies, please let me know how many and I will send them to you.

Since we have received approval for manufacturing, this order has been placed into production.

If I can help with any questions please let me know.

Sincerely,

Cindy Newell,
Engineering Assistant

Cc: job file #140267

VAUGHAN COMPANY, INC.

INSTALLATION, OPERATION AND MAINTENANCE MANUAL
COLUMBIA PULP
HORIZONTAL PUMP

LYONS FERRY-STRAW PULP PLANT
2 EACH VAUGHAN MODEL: STHE8N10CS-160
WITH 60 HP, 1185 RPM BALDOR MOTOR
SERIAL NO.: 140267 A&B-05/18

DATE: July 13, 2018
Prepared by: Cindy Newell
Vaughan Engineering Department

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

PROJECT INFORMATION

CUSTOMER
COLUMBIA PULP
LYONS FERRY
STRAW PULP PLANT

EQUIPMENT
(2) STHE8N10CS-160

TAG #:
330-PM-3325 MIX TANK A PUMP
330-PM-3329 MIX TANK B PUMP

VAUGHAN COMPANY REPRESENTATIVE
PUMPTECH INC.
209 HAMILTON ROAD
MOSES LAKE, WA 98837
PHONE: (509) 766-6330

MANUFACTURER
VAUGHAN COMPANY INC.
364 MONTE-ELMA ROAD
MONTESANO, WA 98563
PHONE: 360-249-4042/ FAX: 360-249-6155
WEBSITE: WWW.CHOPPERPUMPS.COM

VAUGHAN CONTACT:
Regional Manager: BRYAN DIERICK
Phone: (360) 249-4042 Ext: 730

VAUGHAN COMPANY SERIAL NUMBER:
140267

TABLE OF CONTENTS
INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS
COLUMBIA PULP
HORIZONTAL PUMPS

MAINTENANCE SUMMARY FORM
CUSTOMER: COLUMBIA PULP
HORIZONTAL PUMPS

1. EQUIPMENT ITEMS:

(2) Vaughan Model STHE8N10CS-160
Lyons Ferry-Straw Pulp Plant
Horizontal Chopper Pumps

2. MANUFACTURER:

Vaughan Co., Inc.
364 Monte-Elma Rd.
Montesano, WA 98563
(360) 249-4042
(360) 249-6155 FAX

3. EQUIPMENT IDENTIFICATION NUMBERS:

TAG #:
330-PM-3325 MIX TANK A PUMP
330-PM-3329 MIX TANK B PUMP

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 LBS.):

STHE8N10CS-160 Pump Weight:	1750 lbs.
60 HP BALDOR Motor Weight:	582 lbs.
Total Weight:	2332 lbs.

5. NAMEPLATE DATA:

Serial No.:	140267
Performance:	1875 GPM @ 56 FT TDH
Model No.:	STHE8N10CS-160
Impeller Dia.:	16.0"
Pump Speed:	1185 RPM
Motor HP:	60 HP
Motor Speed:	1185 RPM
Voltage:	460V/3-PH/60HZ

6. MANUFACTURER'S LOCAL REP. FOR PARTS, SALES AND SERVICE:

PUMPTECH INC.
Industrial and Municipal Sales - Eastern WA
209 S Hamilton Rd SE
Moses Lake, WA 98837
(509)766-6330
(509)766-6331 fax

7. MAINTENANCE REQUIREMENTS:

Operation	Frequency	Lubricant	Comments
1) Check amperage draw to motor. Compare to amperage measured at start-up.	Monthly		Make sure amp draw does not exceed full load amps on nameplate.
2) Motor Greasing	6 months	Polyrex EM Grease	Do not mix greases unless compatibility has been checked and verified.
3) Add oil to pump bearing housing	Only as needed	ISO 100 hydraulic oil	
4) Check oil in Vaughan Seal	Monthly	**Fyrquel** (Phosphate Ester type hydraulic oil)	If leakage is observed at the pressure relief valve change the oil. Replace seal if new oil is quickly contaminated.
5) Check cutter clearance	Annually		

8. LUBRICANT LIST:

BALDOR MOTOR

Ref.	Symbol	Exxon	Chevron
2.	#2 Brg Grease	Polyrex EM (Standard)	SRI No.2 (Compatible w/ Polyrex EM)

VAUGHAN HORIZONTAL CHOPPER PUMP

Ref.	Symbol	Chevron	Shell	Texaco	Exxon
3.	ISO 100 Hydraulic Oil	Rando HD-100	Turbo 100	Regal 100	Teressic 100

VAUGHAN SEAL

Ref.	Fyrquel (or equivalent)
4.	(Phosphate Ester type hydraulic oil)

9. SPARE PARTS:

No spare parts are being supplied with this order.

LIST OF EQUIPMENT TO BE SUPPLIED
LOCATION: COLUMBIA PULP
HORIZONTAL PUMPS
LYONS FERRY / STRAW PULP PLANT

2 **EA** VAUGHAN MODEL **STHE8N10CS-160** (16.00" Impeller) STAINLESS STEEL HORIZONTAL END SUCTION CHOPPER PUMPS.
PUMP PERFORMANCE: 1875 GPM @ 56 FT. TDH @ 910 RPM &
1875 GPM @ 73 FT. TDH @ 1015 RPM

TAG#: 330-PM-3325 MIX TANK A PUMP
330-PM-3329 MIX TANK B PUMP

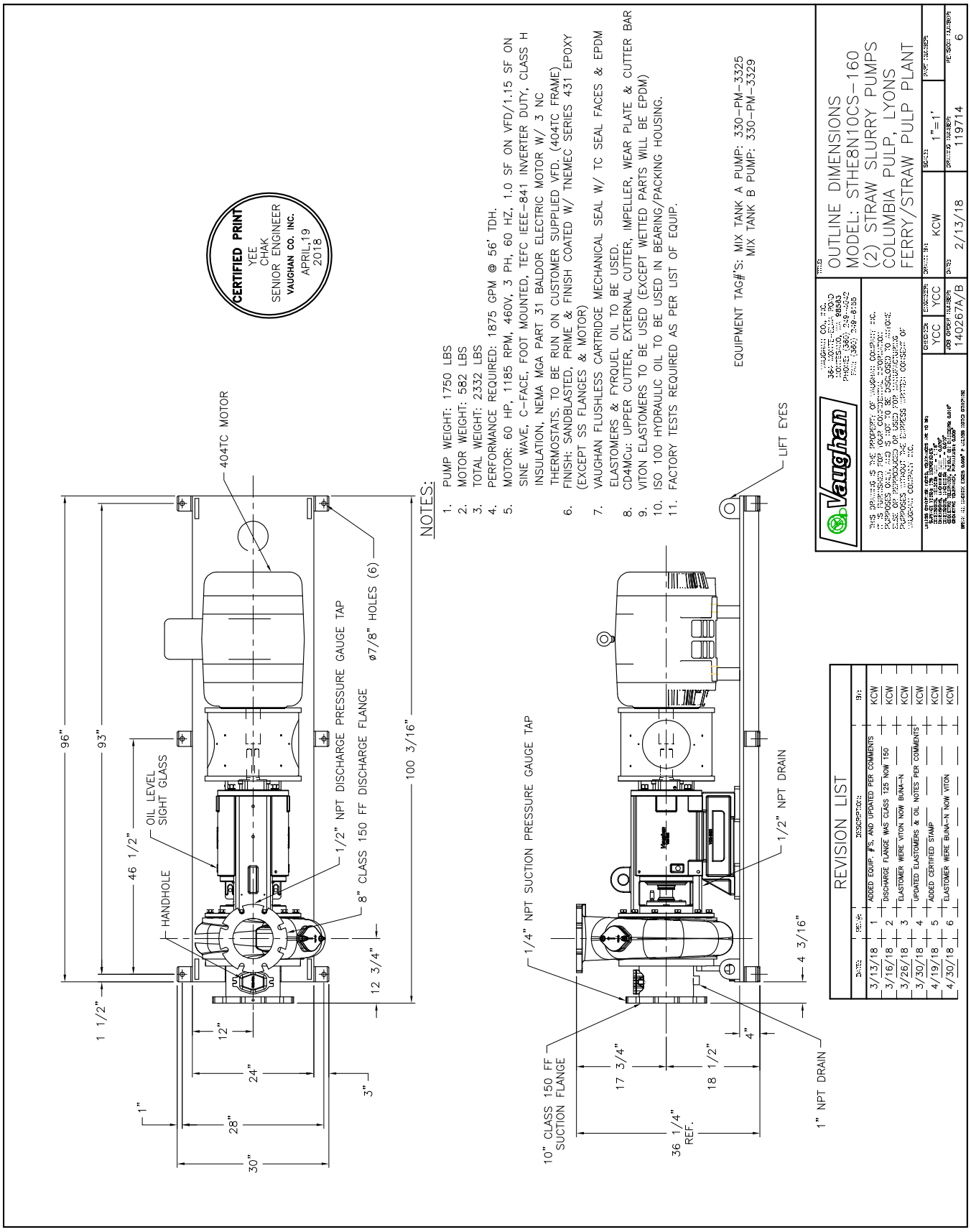
CONSISTING OF:
CASING, CF8M**.**
BACK PULL-OUT PLATE, cast CD4MCu.
UPPER CUTTER, EXTERNAL CUTTER, **IMPELLER AND CUTTER BAR & WEAR PLATE**, cast CD4MCu. Impeller dynamically balanced.
SHAFT, 316 stainless steel.
BEARINGS, ball type thrust and radial bearings, oil lubricated.
BEARING/PACKING HOUSING, cast ductile iron with sight glass **(ISO 100 Hydraulic oil to be used).**
FLUSHLESS MECHANICAL SEAL, 316 stainless steel cartridge type with Tungsten Carbide (TC) faces and integral shaft sleeve, as manufactured by Vaughan **WITH EPDM ELASTOMERS and FYRQUEL (Phosphate Ester type Hydraulic oil to be used).**
ELASTOMERS, Viton; **except wetted parts which will be EPDM.**
FLANGES, 8" discharge (Class 150) & 10" inlet 150 LB ANSI rated.
COUPLING, elastomeric type by TB Woods.
MOTOR MOUNT, 1018 steel, piloted for "C" flanged mounted motor.
BASE, fabricated 1018 steel.
FACTORY TESTING, Non-witness Factory Performance Test and Hydrostatic Testing.
DRIVE, 60 HP, 1185 RPM, 460/3/60, 1.0 SF on VFD/ 1.15 SF on Sine Wave, "C" flanged, TEFC, IEEE-841 inverter duty, Class H insulation, NEMA MG1 Part 31 BALDOR electric motor with 3 NC Thermostats.
FINISH: Sandblasted and a prime coat of Tnemec Perma-Shield PL Series 431 Epoxy and a finish coat of Tnemec Perma-Shield PL Series 431 Epoxy (for a total minimum thickness of 30 MDFT). (Except Motor & SS Flanges).

NOTE:

THE ITEMS CONTAINED IN THIS SUBMITTAL ARE THE ONLY ITEMS BEING SUPPLIED BY VAUGHAN COMPANY, THE PUMP MANUFACTURER. OTHER SPECIFIC ITEMS WHICH MAY BE REQUIRED, INCLUDING, BUT NOT LIMITED TO THE ITEMS LISTED BELOW, MUST BE FURNISHED BY OTHERS:

GAUGES, SWITCHES, VALVES AND OTHER SPECIALTIES NOT SPECIFICALLY CALLED OUT HEREIN.
SPECIAL COATINGS OTHER THAN THOSE QUOTED.
EQUIPMENT, LABOR, MATERIAL AND PERSONNEL REQUIRED TO PERFORM FIELD TESTING OF PUMPS.
SPECIAL MOTOR SPECIFICATIONS INCLUDING MILL AND CHEM DUTY, EXPLOSION PROOF, INTERNAL SPACE HEATERS, ETC.
FACTORY MOTOR TESTS.
INTRINSICALLY SAFE FEATURES.
LEVEL CONTROLS, VARIABLE FREQUENCY DRIVES, AND CONTROL PANELS.
ADDITIONAL LUBRICANTS OTHER THAN THOSE CONTAINED WITHIN THE PUMP.
ANCHOR BOLTS.
SEAL WATER SYSTEMS.
VFD.
TRAINING AND/OR STARTUP ACTIVITIES.

OUTLINE DRAWING 119714-6



SPEC SHEET - STHE8N10CS-160 HORIZONTAL PUMP

SPECIFICATIONS, 8" – 10" HE-SERIES HORIZONTAL CHOPPER PUMPS

The horizontal chopper pump shall be specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications. Pump shall be manufactured by Vaughan Co., Inc.

DETAILS OF CONSTRUCTION

A. **Casing and Back Pull-Out Plate, Wear Plate,** The pump casing shall be of volute design, spiraling outward to the Class 150 flanged centerline discharge. A 1/2" NPT pressure tap shall be included on or near the discharge flange Back pull-out plate shall allow for removal of pump components from outboard of the casing, and allow external adjustment of impeller-to-cutter bar clearance. Casing shall be CF8M and back pull-out plate shall be CD4MCu with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. The back pull-out wear plate shall be CD4MCu. Backplate will include a replaceable steel wear plate with adjustability to maintain 0.030-0.050" clearance to cut against the rotating impeller pumpout vanes for removing fiber and debris.

B. **Impeller**: Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a maximum set clearance between the impeller and cutter bar of 0.015" - 0.025". Impeller shall be CD4MCu and dynamically balanced. The impeller shall be threaded to the shaft and shall have no axial adjustments and no set screws.

C. **Cutter Bar Plate:** Shall be recessed into the pump bowl and contain at least 2 shear bars extending diametrically across the intake opening to within 0.025” - 0.050” of the rotating external cutter tooth, for the purpose of preventing debris from wrapping and blocking the intake opening. Cutter bar shall be CD4MCu. Chopper pumps utilizing individually mounted shear bars, and which do not have a rotating external cutter extending through to the opposite side of the shear bar, shall not be acceptable.

D. **Upper Cutter:** Shall be bolted into the back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be CD4MCu. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.6 or less.

E. **External Cutter:** The external cutter shall be used to eliminate binding or build-up of stringy materials at the pump inlet. The external cutter shall consist of opposing cutter wings which shear against the outside surface of the shear bars and the anvil, an integral cast tooth which shears against the adjacent surface of the shear bars, and a hex head sufficiently sized for ease of removal. The external cutter shall be CD4MCu.

F. **Pump Shafting:** The pump shaft and impeller shall be supported by rolling element bearings. All shafting shall be 316 stainless steel.

G. **Bearings:** Shaft thrust in both directions shall be taken up by two back-to-back mounted single-row angular contact ball bearings, or two face-to-face mounted tapered roller bearings, mounted in an adjustable position thrust bearing cartridge to permit upper cutter to impeller adjustment. A single spherical roller radial bearing shall also be provided. L10 bearing life shall be minimum 100,000 hours.

H. **Bearing Housing:** Shall be ductile cast iron, machined with piloted bearing fits for concentricity of all components, and shall include a side-mounted site glass. Bronze non-contacting labyrinth style, O-ring mount bearing isolators shall be provided at each end of the bearing housing to prevent egress of oil and ingress of contaminants.

I. **Seal:** Mechanical Seal system specifically designed to require no seal flush: The mechanical seal shall be located immediately behind the impeller hub to eliminate the stuffing box and maximize the flushing available from the impeller pumpout vanes. The seal shall be cartridge-type mechanical seal with **EPDM** O-rings and tungsten carbide faces. This cartridge seal shall be a pre-assembled, and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and ductile iron seal housing.

J. **Inlet Manifold:** The pump assembly shall be mounted horizontally with a Class 150 standard inlet flange, cleanout, 1/2" NPT suction pressure tap, drain connection and mounting feet.

K. **Shaft Coupling:** Bearing housing and motor stool design is to provide accurate, self-aligning mounting for a C-flanged electric motor. Pump and motor coupling shall be T.B. Woods Sureflex elastomeric type.

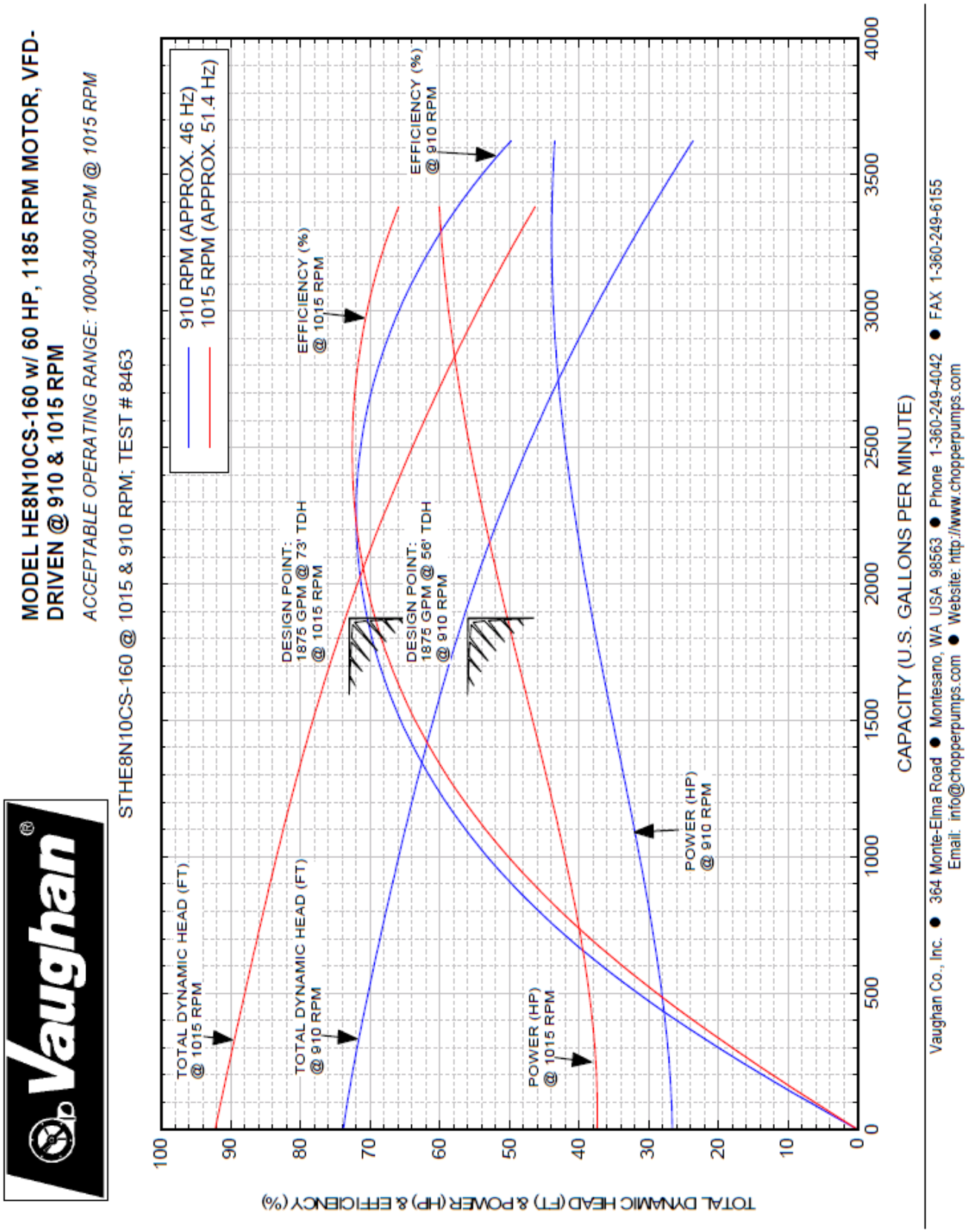
L. **Stainless Steel Nameplate:** Shall be attached to the pump giving the manufacturer’s model and serial number, rated capacity, head, speed and all pertinent data.

M. **Drive motor:** Shall be 60 HP, 1185 RPM, 460 volts, 3 phase, 60 hertz, 1.0 SF on VFD/1.15 SF on Sine Wave, C-flange mounted, 404T Frame, TEFC enclosure IEEE-841 inverter duty, Class H insulation, NEMA MG1 Part 31 BALDOR motor with 3 NC Thermostats.

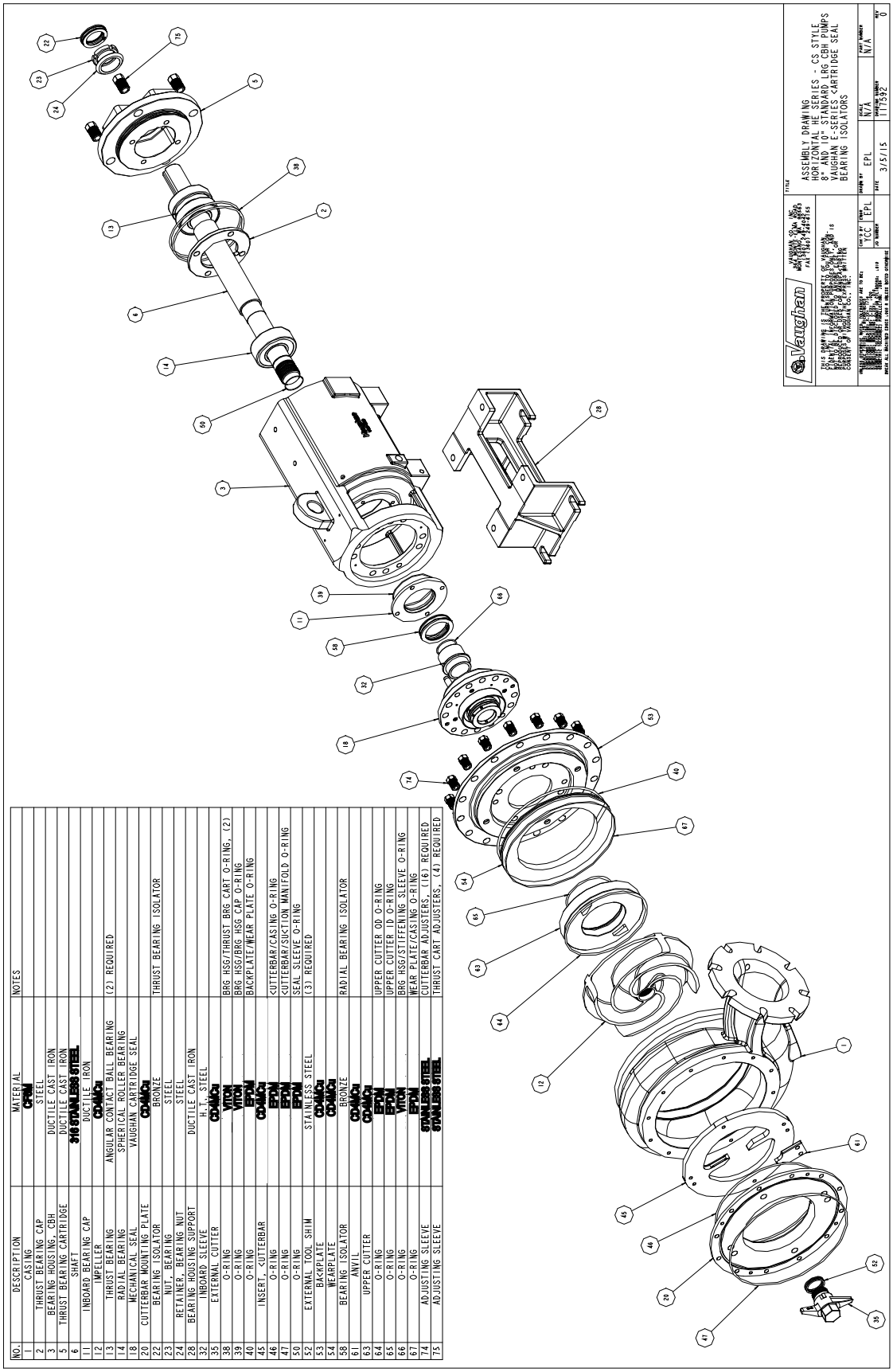
N. **Surface Preparation**: SSPC-SP6 commercial sandblast (except motor), a prime coat of Tnemec 431 epoxy and a finish coat of Tnemec 431 epoxy for total finish of 30 MDFT minimum (except motor & SS Flanges).

FORM V399-REV5-ECN3623

PERFORMANCE CURVE - STHE8N10CS-160



EXPLODED ASSEMBLY - STHE8N10CS-160



NO.	DESCRIPTION	MATERIAL	NOTES
1	CASING	CI/W	
2	THRUST BEARING CAP	STEEL	
3	BEARING HOUSING, CBH	DUCTILE CAST IRON	
5	THRUST BEARING CARTRIDGE	DUCTILE CAST IRON	
6	SHAFT	316 STAINLESS STEEL	
11	INBOARD BEARING CAP	DUCTILE IRON	
12	IMPELLER	CD4MCu	
13	THRUST BEARING	ANGULAR CONTACT BALL BEARING	(2) REQUIRED
14	RADIAL BEARING	SPHERICAL ROLLER BEARING	
18	MECHANICAL SEAL	VAUGHAN CARTRIDGE SEAL	
20	CUTTERBAR MOUNTING PLATE	CD4MCu	
22	BEARING ISOLATOR	BRONZE	THRUST BEARING ISOLATOR
23	NUT, BEARING	STEEL	
24	RETAINER, BEARING NUT	STEEL	
28	BEARING HOUSING SUPPORT	DUCTILE CAST IRON	
32	INBOARD SLEEVE	H.T. STEEL	
35	EXTERNAL CUTTER	CD4MCu	
38	O-RING	VITON	BRG HSG/THRUST BRG CART O-RING, (2)
39	O-RING	VITON	BRG HSG/BRG HSG CAP O-RING
40	O-RING	EPDM	BACKPLATE/WEAR PLATE O-RING
45	INSERT, CUTTERBAR	CD4MCu	
46	O-RING	EPDM	CUTTERBAR/CASING O-RING
47	O-RING	EPDM	CUTTERBAR/SUCTION MANIFOLD O-RING
50	O-RING	EPDM	SEAL SLEEVE O-RING
52	EXTERNAL TOOL SHIM	STAINLESS STEEL	(3) REQUIRED
53	BACKPLATE	CD4MCu	
54	WEARPLATE	CD4MCu	
58	BEARING ISOLATOR	BRONZE	RADIAL BEARING ISOLATOR
61	ANVIL	CD4MCu	
63	UPPER CUTTER	CD4MCu	
64	O-RING	EPDM	UPPER CUTTER OD O-RING
65	O-RING	EPDM	UPPER CUTTER ID O-RING
66	O-RING	VITON	BRG HSG/STIFFENING SLEEVE O-RING
67	O-RING	EPDM	WEAR PLATE/CASING O-RING
74	ADJUSTING SLEEVE	416 STAINLESS STEEL	CUTTERBAR ADJUSTERS, (16) REQUIRED
75	ADJUSTING SLEEVE	416 STAINLESS STEEL	THRUST CART ADJUSTERS, (4) REQUIRED

REL. S.O.	FRAME	HP	TYPE	PHASE/ HERTZ	RPM	VOLTS
	404TC	60	P	3/60	1185	460

AMPS	DUTY	AMB °C/ INSUL.	S.F.	NEMA DESIGN	CODE LETTER	ENCL.
69	CONT	40/F	1.15	B	G	TEFC

E/S	ROTOR	TEST S.O.	TEST DATE	STATOR RES.@25 °C OHMS (BETWEEN LINES)
595761	418142-71EE	---	---	.108

PERFORMANCE

LOAD	HP	AMPERES	RPM	% POWER FACTOR	% EFFICIENCY
NO LOAD	0	19.9	1200	5.36	0
1/4	15.0	25.9	1197	58.9	92.3
2/4	30.0	37.7	1194	78.5	94.9
3/4	45.0	52.5	1191	84.2	95.2
4/4	60.0	69.0	1187	85.8	95.0
5/4	75.0	86.3	1184	86.2	94.4

SPEED TORQUE

	RPM	TORQUE % FULL LOAD	TORQUE LB.-FT.	AMPERES
LOCKED ROTOR	0	159	422	425
PULL UP	240	145	385	411
BREAKDOWN	1133	247	655	243
FULL LOAD	1187	100	265	69.0

AMPERES SHOWN FOR 460. VOLT CONNECTION. IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE

REMARKS: TYPICAL DATA
XE MOTOR-NEMA NOM. EFF. 95.0 %
GUARANTEED MIN. EFF. 94.5%

BALDOR
A MEMBER OF THE ABB GROUP

DR. BY R.R. PENDLEY
CK. BY D.M. BYRD
APP. BY D.M. BYRD
DATE 02/06/92

A-C MOTOR PERFORMANCE DATA
A40WG0115-R001
ISSUE DATE 06/16/20

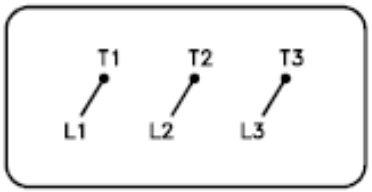
Printed on 6/16/11 8:52 @ ragsun

BALDOR · RELIANCE

BALDOR · RELIANCE

416820-036

A-C MOTOR
CONNECTION DIAGRAM
STANDARD 3 LEAD CONNECTED



(N.P. 1575-BA)

416820-036

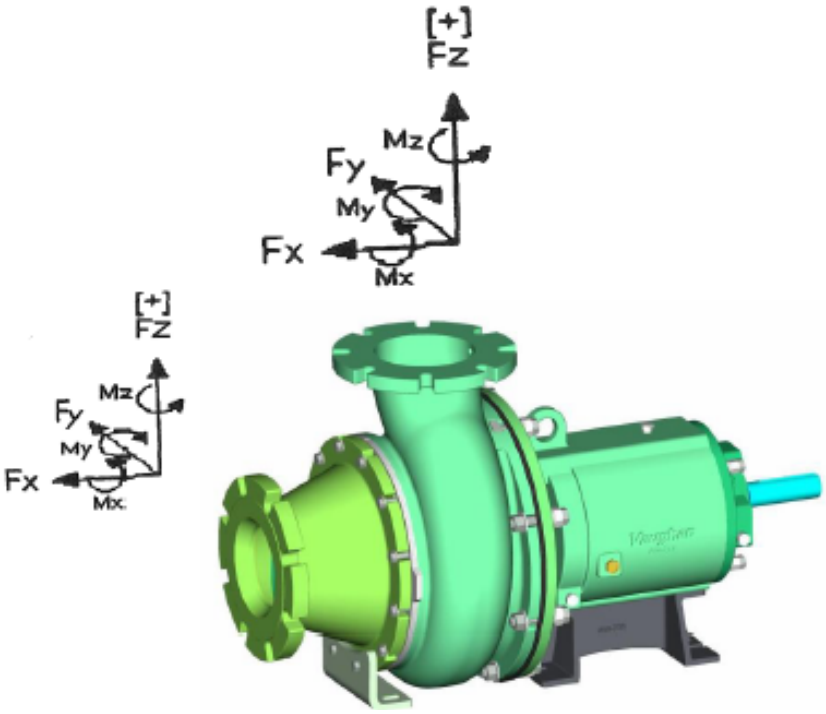
REV. DESC: LOADED TO BUS, C/R 335225			BALDOR
REV. LTR: -	VERSION: 00	TDR: 000000538207	
FILE: \MGA\00000\682		REVISED: 11:54:06 04/30/2010	CONN DIAG - STANDARD 3 LEAD
MTL: -		BY: RAGRA	SH 1 of 1

BALDOR
A MEMBER OF THE ABB GROUP

Vaughan Horizontal Pump Maximum Nozzle Loading Summary

	SUCTION						DISCHARGE					
	Forces (lbs)			Moments (ft-lbs)			Forces (lbs)			Moments (ft-lbs)		
Model	F_{xs}	F_{ys}	F_{zs}	M_{xs}	M_{ys}	M_{zs}	F_{xd}	F_{yd}	F_{zd}	M_{xd}	M_{yd}	M_{zd}
HE3F/HE3G	775	775	1500	1300	350	350	775	775	3250	1200	1460	591
HE3L/HE3M	775	775	1500	1300	350	350	775	775	3250	1200	1460	575
HE3V/HE3W	775	775	1500	1300	350	350	775	775	3250	1200	1460	567
HE3P	775	775	1500	1300	310	310	775	775	3250	1200	1460	565
HE4K/HE4L	775	775	1500	1300	1100	1100	775	775	3250	1200	1500	602
HE4S/HE4T	775	775	1500	1300	1300	1100	775	775	3250	1200	1500	608
HE4V	775	775	2000	1500	1130	1130	775	775	3500	1250	2840	616
HE6W/HE6X	775	775	2000	1500	1170	1030	775	775	3500	1250	2840	567
HE8K	775	775	2000	1500	2000	1253	775	775	3500	1250	2840	677
HE8M/HE8N	775	775	2000	1500	1130	1130	775	775	3500	1250	2840	809
HE8P	775	775	2000	1500	1130	1130	775	775	3500	1250	2840	787
HE10P/HE10R	1034	1034	2000	1500	1130	1130	1034	1034	3500	1250	2840	719
HE12U/HE12W	1034	1034	2000	1500	1130	1130	1034	1034	3500	1250	716	935
HE16W	1034	1034	2000	1500	1130	1130	1034	1034	3500	1250	501	995

Orientation of forces and moments on suction and discharge flanges.



PROTECTIVE MEASURES TO BE TAKEN BY VAUGHAN CO. AND VAUGHAN'S LONG-TERM STORAGE INSTRUCTIONS
HORIZONTAL PUMP

OFF LOADING AND INSPECTION INSTRUCTIONS:

Prior to shipment Vaughan pumps are carefully crated and inspected to ensure arrival at your site in good condition. On receiving your pump, examine it carefully to assure that no damaged crating 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.

STORAGE REQUIREMENTS TO BE UNDERTAKEN BY CONTRACTOR:

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 **1-¼ 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.

TNEMEC

PERMA-SHIELD® PL SERIES 431

PRODUCT DATA SHEET

PRODUCT PROFILE

GENERIC DESCRIPTION Modified Polyamine Ceramic Epoxy

COMMON USAGE A 100% solids, abrasion-resistant lining specifically designed for wastewater immersion and fume environments. Provides low permeation to H_2S gas, protects against MIC and provides chemical resistance to steel, ductile iron pipe and fittings for severe wastewater. A coal-tar free, resin-rich formulation with low pigment volume concentration (PVC) for maximum performance.

COLORS 5024 Sewer Pipe Green. **Note:** Epoxies chalk with extended exposure to sunlight.

FINISH Gloss

SPECIAL QUALIFICATIONS Contains 20% ceramic microspheres for increased abrasion resistance. Compatible with high-velocity jet sewer cleaning (hydrocleaning) with 0-degree tips (Reference Technical Bulletin No. 11-86).
Meets the performance requirements of AWWA C 210 (not for potable water contact).

COATING SYSTEM

PRIMERS Self-priming, Series N69 or Series N140. **Note:** Series 431 must be applied to Series N69 or N140 within 7 days. Scarify the surface with fine abrasive before topcoating if exceeding this maximum recoat window.

SURFACE PREPARATION

Prepare surfaces by method suitable for exposure and service.

STEEL SSPC-SP5/NACE 1/ISO Sa 3 White Metal Blast Cleaning with a minimum angular anchor profile of 3.0 mils (76.2 microns)

DUCTILE IRON All internal surfaces of ductile iron pipe and fittings shall be delivered to the application facility without asphalt or any other protective lining on the interior surface. All oils, small deposits of asphalt paint, grease, and soluble deposits shall be removed in accordance with NAPF 500-03-01 Solvent Cleaning prior to abrasive blasting.
Pipe: Uniformly rotary-abrasive blast using angular abrasive to a NAPF 500-03-04: Internal Pipe Surface condition, full removal of annealing oxide layer. When viewed without magnification, the interior surfaces shall be free of all visible dirt, dust, annealing oxide, rust, mold coating and other foreign matter. Any area where rust reappears before application shall be reblasted. The surface shall contain a minimum angular anchor profile of 3.0 mils (76.2 microns) (Reference NACE RP0287 or ASTM D 4417, Method C).
Fittings: Uniformly abrasive blast using angular abrasive to a NAPF 500-03-05: Fitting Blast Clean #1 condition, no staining. When viewed without magnification, the interior surfaces shall be free of all visible dirt, dust, annealing oxide, rust, mold coating and other foreign matter. Any area where rust reappears before application shall be reblasted. The surface shall contain a minimum angular anchor profile of 3.0 mils (76.2 microns) (Reference NACE RP0287 or ASTM D 4417, Method C).

ALL SURFACES Must be clean, dry and free of oil, grease and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS 100% (mixed)

RECOMMENDED DFT **Carbon Steel:** 30.0 to 50.0 mils (762 to 1270 microns) in one or more coats.
Ductile Iron: 40 mils (1015 microns) (nominal) in one or more coats.
Note: Number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME

Temperature	Set to Touch	Max. Recoat	To Place in Service
90°F (32°C)	1-2 hours	7 days	24 hours
75°F (24°C)	2-3 hours	7 days	2 days
55°F (13°C)	8-9 hours	7 days	3 days

Note: If more than 7 days have elapsed between coats, the Series 431 coated surface must be mechanically abraded (scarified) before topcoating. Curing time will vary with surface temperature, air movement, humidity and film thickness.

VOLATILE ORGANIC COMPOUNDS EPA Method 24: 0.19 lbs/gallon (23 grams/litre)

HAPS 0.00 lbs/gal solids

THEORETICAL COVERAGE 1,604 mil sq ft/gal (39.4 m²/L at 25 microns). See APPLICATION section for coverage rates.

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy)

MIXING RATIO By volume: One (Part A) to one (Part B)

PACKAGING

	PART A (partially filled)	PART B (partially filled)	When Mixed
Drum Sets †	55 gallon drum	55 gallon drum	100 gallons
Large Kit †	5 gallon pail	5 gallon pail	8 gallons (30.28 L)
Small Kit	1 gallon pail	1 gallon pail	1 gallon (3.78L)
Touch-Up Kit †† (1 tube)	4 ounces	4 ounces	8 ounces (236 mL)

† Plural Component application only.
†† Touch-Up Kit consists of six (6) tubes along with twelve (12) disposable static mixers.

NET WEIGHT PER GALLON 9.48 ± 0.25 lbs (4.3 ± .11 kg) (mixed)

STORAGE TEMPERATURE Minimum 25°F (-4°C) Maximum 110°F (43°C)
For optimal handling and application characteristics both material components should be conditioned to a minimum of 80°F (27°C) or higher 48 hours prior to use.

TEMPERATURE RESISTANCE (Dry) Continuous 275°F (135°C) Intermittent 300°F (149°C) (Wet) Intermittent 150°F (65°C)

PERMA-SHIELD® PL | SERIES 431

SHELF LIFE 24 months at recommended storage temperature.

FLASH POINT - SETA Part A: N/A Part B: 200°F (93°C)

HEALTH & SAFETY This product contains chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product.
Keep out of the reach of children.

APPLICATION

COVERAGE RATES Before commencing, obtain and thoroughly read the Series 431 Surface Preparation and Application Guide.

Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
30.0 (762)	30.0 (762)	53 (4.9)
40.0 (1016)	40.0 (1016)	40 (3.7)
50.0 (1270)	50.0 (1270)	32 (3.0)

Note: Recommended DFT will depend on substrate condition and system design. Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance.

MIXING **Drum Set:** For Plural Component Application. Place band heaters on drums. Remove the lid and insert the mixing blade shaft through the center two-inch bung; reinstall the lid. Mixing blade should be adequately sized to fully agitate material. The material should be 80°F-90°F (27°C-32°C) before the mixing blade is turned on. Insert 5:1 feed pumps into the outside two-inch bung. Place the recirculation line in the 3/4 inch outside bung. Recirculate the material through the primary heaters and heated hose bundle back into the containers. Continue recirculation under agitation until Component A reaches 110°F-120°F (43°C-49°C) and Component B reaches 100°F-110°F (38°C-43°C). Do not exceed 120°F (49°C) for either component. Consult Technical Services for specific details.

Large Kit: For Plural Component Application. Agitate Parts A & B separately making sure no pigment or solids remain on the bottom of the can. **DO NOT MIX PART A WITH PART B.** Use a 1 (Part A amine) to 1 (Part B epoxy) mix ratio heated plural component airless spray unit. **Note:** Product component A (amine) must be heated to 110°F to 120°F (43°C to 49°C) and component B (epoxy) must be heated to 100°F to 110°F (38°C to 43°C) prior to and during plural component application. Do not exceed 120°F (49°C) for either component. Keep containers tightly sealed prior to use. Consult Technical Services for specific details.

Small Kit: Agitate Parts A & B separately ensuring no pigment or solids remain on the bottom of the can. Scrape all of the Part B into Part A can using a flexible spatula. Use a variable speed drill with a PS Jiffy blade ad mix the blended components for a minimum of two minutes. During the mixing process, scrape the sides and bottom of the container to ensure complete blending of materials. Apply the mixed material within 15 to 20 minutes, or before the material reaches 100°F following agitation. **Note:** A large volume of material will gel quickly if not applied or reduced in volume.

Touch-Up Kit: Equipment: A dispensing gun with a thrust ratio of 26:1 is required (F100-TKAP). Material tube must be used in conjunction with provided disposable static mixer in order to ensure proper mixing.
Usage: Unscrew retaining ring and remove plug. Save plug in case entire tube is not used. Install static mixing element, replace retaining screw ring, and install tube in gun. Point assembly up and slowly pull the trigger to de-air the mixer. Dispense approximately 1 fluid ounce (29.8 mL) of material to waste and continue to pump until material is of uniform color with the Part A completely blended with the Part B. Use a putty knife, brush or spatula to ensure adequate coverage and repair.

For complete instructions on application, please refer to the Series 431 *Surface Preparation & Application Guide*.

THINNING **DO NOT THIN**

APPLICATION EQUIPMENT **PLURAL COMPONENT AIRLESS EQUIPMENT.** The preferred application method for Series 431 Perma-Shield PL is using plural component equipment. Plural component equipment reduces material waste, solvent consumption and reduces material viscosity. Contact Tnemec Technical Service for complete Series 431 Plural Component Recommendations.

Airless:

Pump Size	Rotary Gun †	Mat'l Hose ID	Manifold Filter
45:1 or 56:1	Model 712-216	3/8" (9.5mm)	30 Mesh

† **Rotary Spray Gun:** Series 431 shall be applied to the interior surfaces of pipe or fittings using a rotary coater pistol spray gun. Spray-Quip (Houston, TX), Model 712-216, or similar rotary lance, to produce a monolithic and level film. Contact Tnemec Technical Services for additional information.

Note: Pump assembly should include a moisture trap and oiler, air regulator with gauge and fluid outlet drain valve and outfitted with a gravity fed material hopper (material will not feed through a suction tube).

Brush: Recommended for bell sockets, spigot ends, and small repairs.

SURFACE TEMPERATURE Minimum of 50°F (10°C) Maximum of 130°F (54°C).
The surface temperature should be dry and at least 5°F (3°C) above the dew point. The coating will not cure properly below minimum surface temperature.

HOLIDAY TESTING High Voltage Discontinuity (spark) testing shall be performed in accordance with ASTM D 5162, 100 to 125 V/mil voltage setting.

CLEANUP Flush and clean all equipment immediately after use with Tnemec's No. 4 Thinner or MEK.

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 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.

VAUGHAN SERIAL NO.: 140267A-05/18 & 140267B-05/18
2 EACH, VAUGHAN MODEL STHE8N10CS-160 (CBH, V-SEAL)
MOTOR: 60 HP, 1185 RPM, 404TC FRAME, TEFC
Vaughan Drawing #119714-6
CUSTOMER: COLUMBIA PULP, WA
Exploded Parts Drawing 117592, V421 (IOM Manual), V509 (User Guide), V492 (Seal Manual) & V434 (Overhaul Manual)

NOTE: CBH VERSION & VAUGHAN SEAL

1. *Use only SS pop rivets for attaching ID plate and warnings*
2. *Stainless Vaughan seal with fyrquel oil, TC faces and EPDM elastomers required*
3. *EPDM elastomers will be used on wetted end, rest of pump uses Viton elastomers*
4. *Sandblasted, prime and finish coated with Tnemec Perma-Shield PL Series 431 Epoxy (a minimum of 30 MDFT), except motor and SS flanges*
5. *Fasteners and adjusters must be masked before sandblasting*
6. *ISO 100 Hydraulic oil to be used in bearing housing*
7. *Factory non-witness performance test and hydrostatic tests*
8. *Performance: 1875 GPM at 73' TDH at 1015 RPM and 1875 GPM at 56' TDH at 910 RPM via VFD by others*
9. *CD4MCu impeller, cutter bar, external cutter, upper cutter, backplate, wearplate and anvil to be used*
10. *Reinforcing sleeve and bearing isolators to be used*
11. *Tag pumps and Stamp on ID Plates: 330-PM-3325 MIX TANK A PUMP and 330-PM-3329 MIX TANK B PUMP*

REF.#:	DESCRIPTION:	PART #:	DWG.#:
1	Casing, 8"	SSV113-021	113021
	with Casing discharge pointing straight up (std., 12 o'clock)		
2	Thrust Bearing Cartridge Cap	V108-197	108197
3	Bearing Housing, 8-12" CBH	V108-185	108185
3A	Baffle Vent, LDI, AV53	V801-632	N/A
4	**Suction Manifold (w/weld-on cleanout)**	**SSV114-278**	**114278**
	Suction Manifold Cleanout Cover	**SSV111-214**	**111214**
	Cleanout Cover Gasket	**V111-215**	**111215**
5	Cartridge, Thrust Bearing, includes:	V108-187	108187
5A	Thrust Bearing, Body	V108-187A	108187
5B	Thrust Bearing, Cap	V108-187B	108187
5C	O-ring, Thrust Cartridge, Viton	V850-357V	N/A
6	Shaft, for Standard Seal	SSV112-298	112298
11	Bearing Cap	V116-445	116445
12*	Impeller, 8N, 16.0" Dia.	CDV109-457-160	109457
13*	Thrust Bearings (2)	V801-729	N/A
14*	Radial Bearing	V801-783	N/A
18*	**Mechanical Seal, Fyrquel Oil, EPDM, TC faces**	**SSV801-315HEFE/TC**	**115535**
20	Cutter Bar Mounting Plate, For 9" suction opening	SSV108-474	108474
22	Bearing Isolator, Outboard	V801-204	116366
	Includes: Oil Containment Cup V116-817E		
23*	Nut, Bearing	V801-730	N/A
24*	Retainer, Bearing Nut	V801-731	N/A
27	Motor Stool 404TC-405TC	V900-202	108846C

YCC

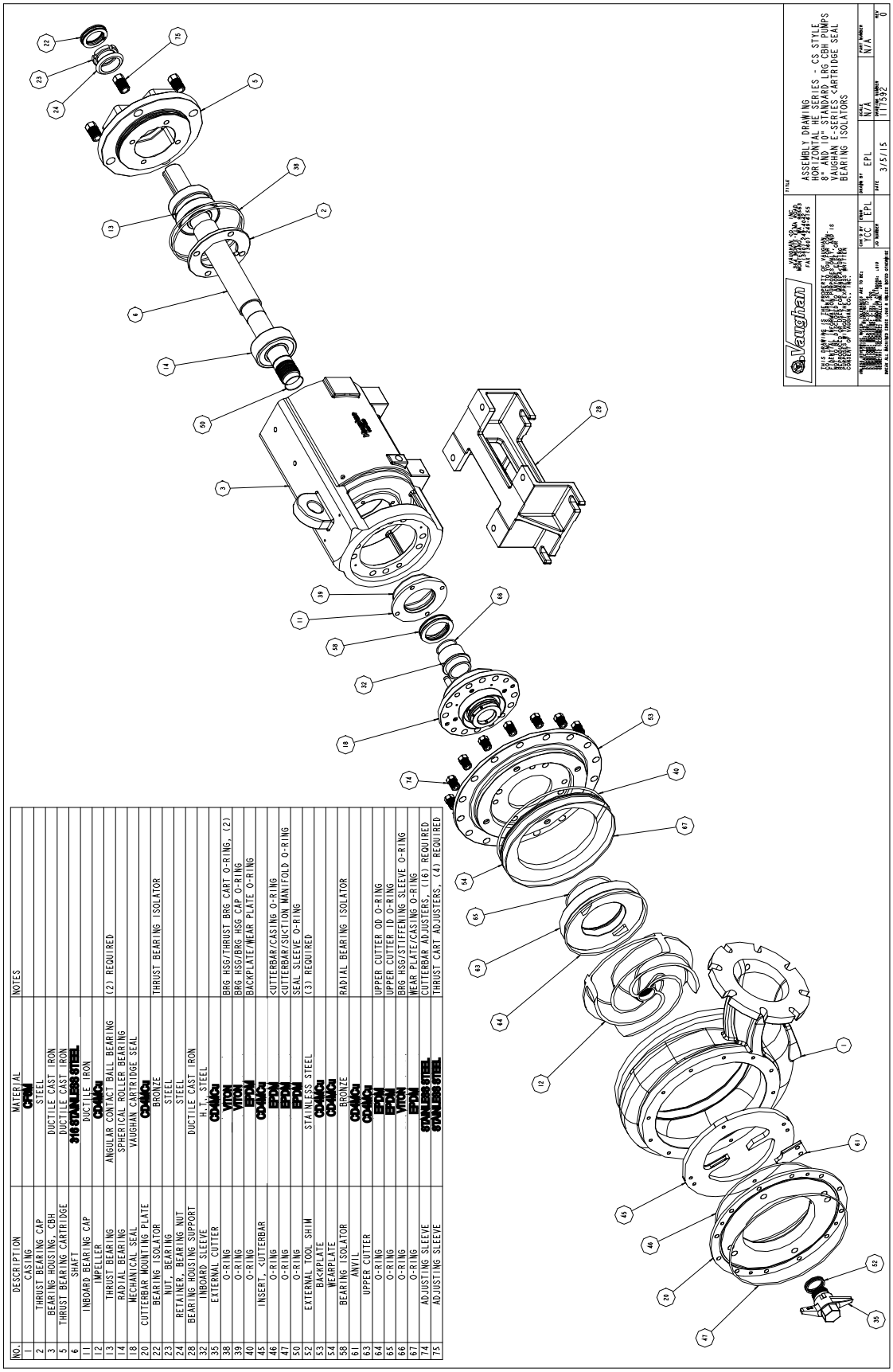
VAUGHAN SERIAL NO.: 140267A-05/18 & 140267B-05/18
2 EACH, VAUGHAN MODEL STHE8N10CS-160 (CBH, V-SEAL)
MOTOR: 60 HP, 1185 RPM, 404TC FRAME, TEFC
Vaughan Drawing #119714-6
CUSTOMER: COLUMBIA PULP, WA
Exploded Parts Drawing 117592, V421 (IOM Manual), V509 (User Guide), V492 (Seal Manual) & V434 (Overhaul Manual)

REF.#:	DESCRIPTION:	PART #:	DWG.#:
27A	Motor Stool Cover (2 req'd)	V110-961	110961
28	Bearing Housing Support, CBH 8"	V108-189	108189
29	Motor Adjusters, 4, 404TC	V1100-102	104488C
32*	Reinforcing Sleeve, Inboard	V116-444	116444
34	Coupling, Motor		
	60 HP/1200, Woods 11S-2 7/8, Motor Flange	11S278	N/A
	Woods 11E Sleeve	11E	N/A
	Woods 11S-2 7/16"Pump Flange	11S2716	N/A
35*	External Cutter, 8N, 10R	CDV109-511	109511
37	Oil Sight Glass	V801-789	N/A
38*	O-ring, Bearing Housing/ Thrust Bearing Cartridge, (2 req'd)		
	Viton	V850-375V	N/A
39*	O-ring, Bearing Housing/ Bearing Cap, Viton	V850-161V	N/A
40*	**O-ring, Backplate/Wearplate, EPDM**	**V850-460E**	**N/A**
43	Guard, Packing Housing (2 req'd)	V107-157	107157
45	Cutter Bar Insert, 8N, 9" suction opening	CDV109-509	109509
46*	**O-ring, Cutter bar/ Casing, EPDM**	**V850-384E**	**N/A**
47*	**O-ring, Cutter Bar/ Suction Manifold, EPDM**	**V850-385E**	**N/A**
50*	**O-ring, Seal Sleeve, EPDM**	**V850-036E**	**N/A**
52*	Shim, Ext. Cutter, 8N, 10R	V109-838	109838
53	Backplate, W/O Stiffener Can	CDV109-679	109679
54	Wearplate, Backplate	CDV107-803	107803
58	Bearing Isolator, Inboard	V801-203	116365
	Includes: Oil Containment Cup V116-817D		
61*	Anvil	CDV105-737	105737
62	Suction Support Assembly, HE8/HSC8	V108-385	108385
63	Cutter, Upper	CDV106-765	106765
64	**O-Ring, Upper Cutter, OD, EPDM**	**V850-379E**	**N/A**
65	**O-Ring, Upper Cutter, ID, EPDM**	**V850-361E**	**N/A**
66	O-Ring, inboard bearing sleeve, Viton	V850-230V	N/A
67*	**O-ring, Wearplate/Case, EPDM**	**V850-281E**	**N/A**
74	Adjusters, Backplate (12 required)	SSV107-894	107894
75	Adjusters, Thrust Bearing Cartridge (4 required)	SSV107-247	107247
--	Decal Placement Kit (Direct Drive)	118370KIT	118370
--	Base, Direct Drive, HE8/HSC8	V107-801	107801

■ MOTOR: 60 HP, 1185 RPM, 404TC frame, 460/3/60, 1.0 SF on VFD/ 1.15 SF on Sine Wave, "C" flanged, TEFC, IEEE-841 inverter duty, Class H insulation, NEMA MG1 Part 31 BALDOR electric motor with 3 NC Thermostats (Quote attached)

YCC

EXPLODED ASSEMBLY - STHE8N10CS-160



NO.	DESCRIPTION	MATERIAL	NOTES
1	CASING	CI/W	
2	THRUST BEARING CAP	STEEL	
3	BEARING HOUSING, CBH	DUCTILE CAST IRON	
5	THRUST BEARING CARTRIDGE	DUCTILE CAST IRON	
6	SHAFT	316 STAINLESS STEEL	
11	INBOARD BEARING CAP	DUCTILE IRON	
12	IMPELLER	CD4MCu	
13	THRUST BEARING	ANGULAR CONTACT BALL BEARING	(2) REQUIRED
14	RADIAL BEARING	SPHERICAL ROLLER BEARING	
18	MECHANICAL SEAL	VAUGHAN CARTRIDGE SEAL	
20	CUTTERBAR MOUNTING PLATE	CD4MCu	
22	BEARING ISOLATOR	BRONZE	THRUST BEARING ISOLATOR
23	NUT, BEARING	STEEL	
24	RETAINER, BEARING NUT	STEEL	
28	BEARING HOUSING SUPPORT	DUCTILE CAST IRON	
32	INBOARD SLEEVE	H.T. STEEL	
35	EXTERNAL CUTTER	CD4MCu	
38	O-RING	VITON	BRG HSG/THRUST BRG CART O-RING, (2)
39	O-RING	VITON	BRG HSG/BRG HSG CAP O-RING
40	O-RING	EPDM	BACKPLATE/WEAR PLATE O-RING
45	INSERT, CUTTERBAR	CD4MCu	
46	O-RING	EPDM	CUTTERBAR/CASING O-RING
47	O-RING	EPDM	CUTTERBAR/SUCTION MANIFOLD O-RING
50	O-RING	EPDM	SEAL SLEEVE O-RING
52	EXTERNAL TOOL SHIM	STAINLESS STEEL	(3) REQUIRED
53	BACKPLATE	CD4MCu	
54	WEARPLATE	CD4MCu	
58	BEARING ISOLATOR	BRONZE	RADIAL BEARING ISOLATOR
61	ANVIL	CD4MCu	
63	UPPER CUTTER	CD4MCu	
64	O-RING	EPDM	UPPER CUTTER OD O-RING
65	O-RING	EPDM	UPPER CUTTER ID O-RING
66	O-RING	VITON	BRG HSG/STIFFENING SLEEVE O-RING
67	O-RING	EPDM	WEAR PLATE/CASING O-RING
74	ADJUSTING SLEEVE	416 STAINLESS STEEL	CUTTERBAR ADJUSTERS, (16) REQUIRED
75	ADJUSTING SLEEVE	416 STAINLESS STEEL	THRUST CART ADJUSTERS, (4) REQUIRED

Vaughan

ASSEMBLY DRAWING
HORIZONTAL HE SERIES - CS STYLE
8" AND 10" STANDARD LRG CBH PUMPS
VAUGHAN ES&S CARTRIDGE SEAL
BEARING ISOLATORS

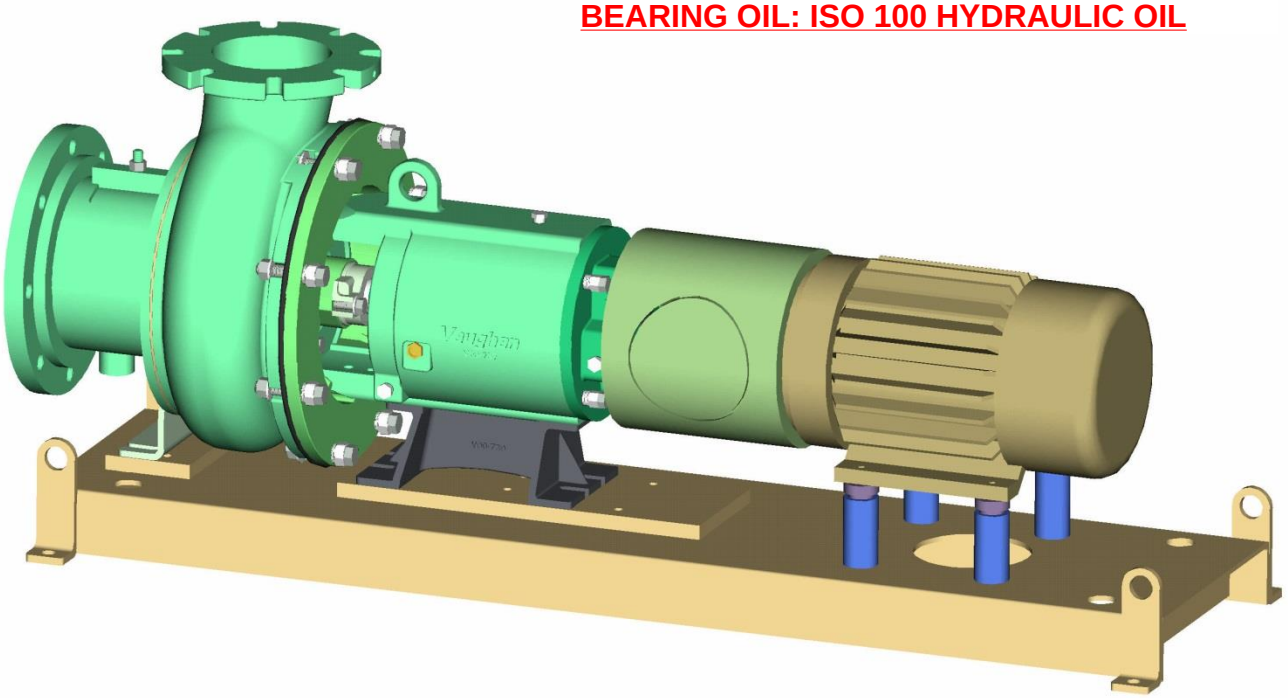
DRAWN BY: EPL
DATE: 3/5/15
SIZE: A4
PART NUMBER: N/A
REV: 0

Unmatched Reliability

Vaughan®

HE SERIES HORIZONTAL CHOPPER PUMPS

***NOTE:**
SEAL OIL: FYRQUEL (PHOSPHATE ESTER TYPE HYDRAULIC OIL
BEARING OIL: ISO 100 HYDRAULIC OIL



INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

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

Pump Model: _____

Serial Number:_____

Installation Date: _____

TABLE OF CONTENTS

INSTALLATION, OPERATION, & MAINTENANCE INSTRUCTIONS

SECTION 1: IMPORTANT SAFETY INFORMATION

IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

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

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

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

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

NOTICE Indicates special operation or maintenance information.

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

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

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

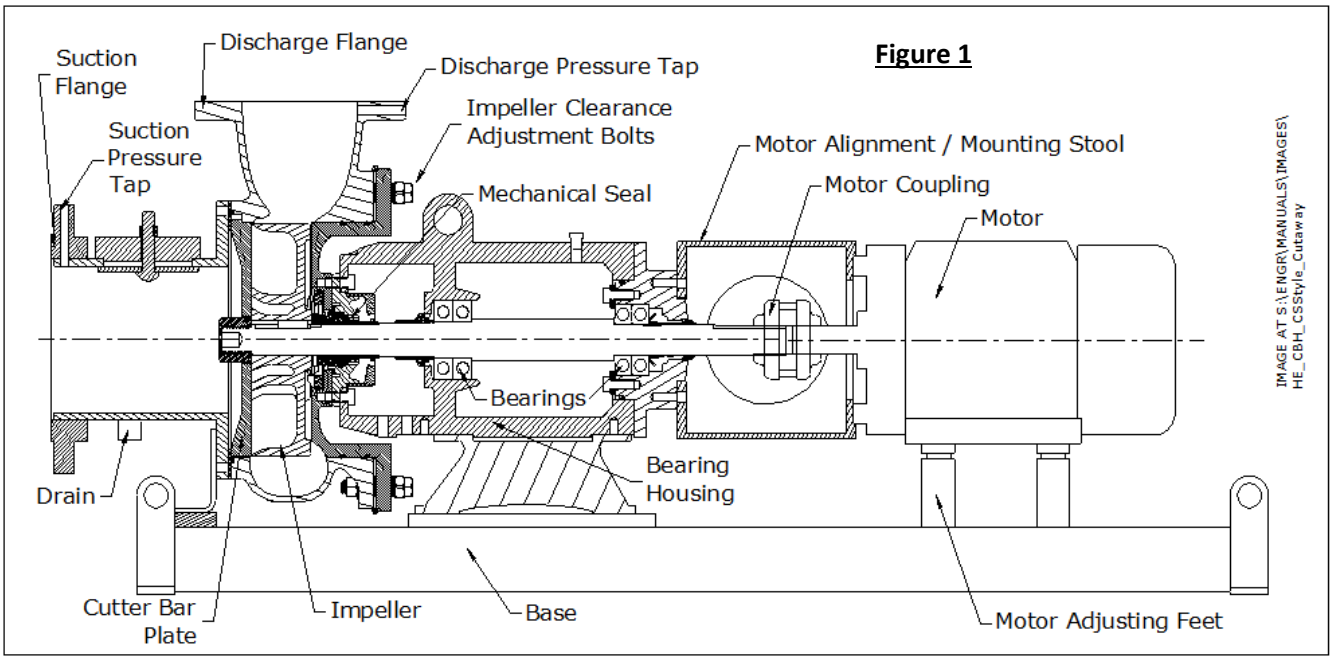
SECTION 2: DESCRIPTION OF HE-SERIES HORIZONTAL CHOPPER PUMPS

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 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 also offer these additional design features:

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 are externally adjustable.
3) Vaughan flushless cartridge seal is standard and has the additional advantage of being fully covered by the Vaughan warranty.

Figure 1



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 alloy steel and is heat treated to Rockwell 60C.

CUTTER BAR

The cutter bar is a patented design that serves two functions. First, it serves the function of a “suction 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 and the impeller. Second, the cutter bar 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 C60.

*PLEASE NOTE: SEE SECTION 2 OF THE I, O&M MANUAL FOR SEAL OIL

CUTTER NUT
The cutter nut is a patented design that serves two purposes. First it secures the impeller to the shaft. Second the raised cutter tooth design prevents pump binding by cutting stringy materials that could otherwise wrap around the shaft and block the intake opening. The cutter nut is made of cast alloy steel heat treated to Rockwell C60. All 3-6" chopper pumps have a cutter nut.

EXTERNAL CUTTER (OPTIONAL ON 3-6" PUMPS)
The external cutter has opposing cutter wings that shear against the outside face of the cutter bar. It is used to prevent binding or the buildup of string materials at the pump inlet. The external cutter is made of cast alloy steel, heat treated to Rockwell C60. Chopper pumps 8" and larger will have an external cutter.

UPPER CUTTER
The upper cutter is located behind the impeller and cuts against the pumpout vanes and the impeller hub to for the purpose of preventing stringy materials from wrapping in the mechanical seal area. The upper cutter is made of alloy steel heat treated to Rockwell C60.

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 move with the rotating assembly for adjustment or service to the wetted parts of the pump.

FLUSHLESS MECHANICAL SEAL (Vaughan 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 in Figure 2. **This seal will not require any water flush to keep it clean.** The only maintenance required of the Vaughan Cartridge Seal is a yearly change of the oil. There are three pipe plugs located on the outboard end of the seal to drain and refill the oil (see Figure 3 below). For 3"-6" and 8K pumps, use 2 oz. and for 8"-16" pumps, use 6 oz. of ~~ISO 46 oil~~ FYRQUEL-Phosphate Ester type Hydraulic oil to refill. This will fill the seal approximately 1/3 full, which is correct.

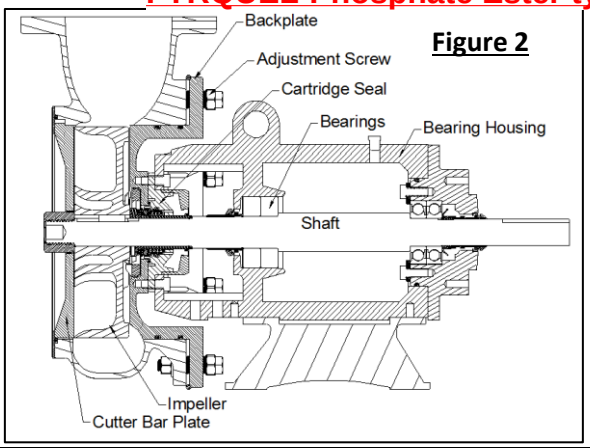


Figure 2

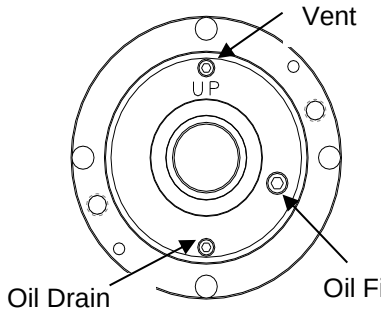


Figure 3

VAUGHAN FLUSHLESS CARTRIDGE SEAL

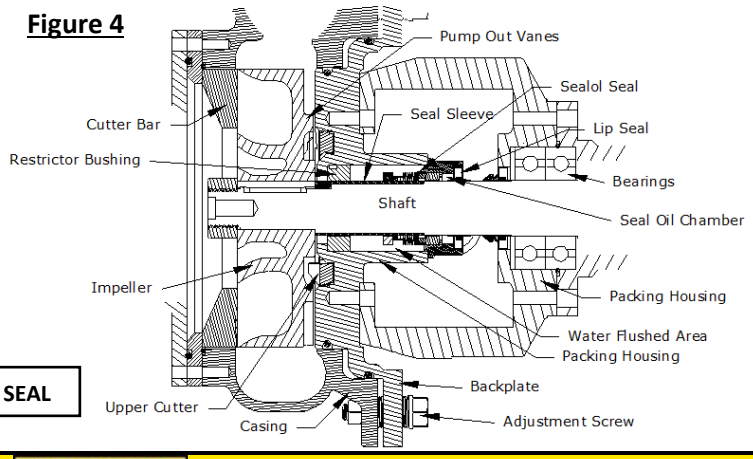
NOTICE

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.

MECHANICAL SEAL (Metal bellows type, **NON-STANDARD)**

The HE series End-Suction Chopper pump may also be supplied with a welded bellows mechanical seal with silicon carbide faces. 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.) Figure 6 on page 12 shows the recommended seal flush installation.

Figure 4



OPTIONAL WELDED BELLOWS SEAL

⚠CAUTION

Pressure may build up in the mechanical seals used in Vaughan pumps. Whenever checking or maintaining the oil in the Vaughan cartridge seal, or the welded metal bellows seal with seal oil chamber, make sure the pump and seal are cool to the touch. Use care when removing the oil chamber plugs, in case any residual pressure exists. If pressure exists, the plug could become a projectile and/or contaminated oil could spray.

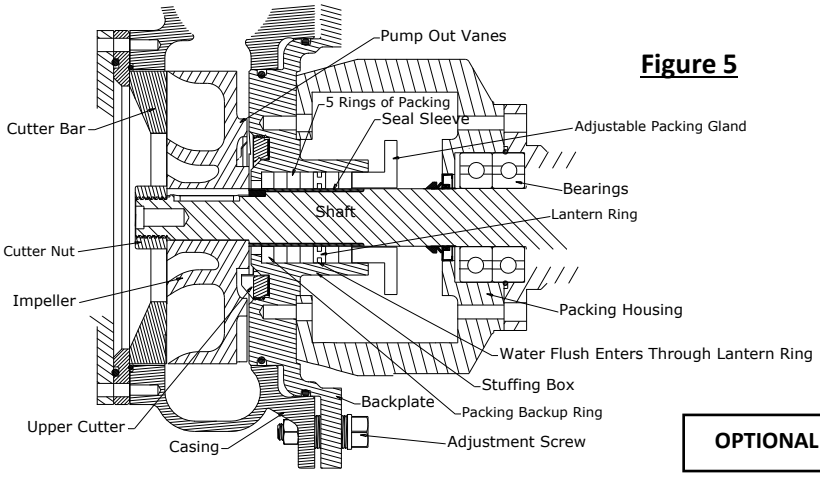
PACKING (NON-STANDARD)

If your pump was ordered with packing, the packing is typically TFE impregnated graphite packing with reinforced Kevlar corners. The lantern ring is split for easy removal and made from glass-filled TFE. All packing components run on a nickel chrome boron coated 316 stainless steel shaft sleeve. Packing should always be water flushed with the flush line interlocked with the motor starter so that flush water begins when the motor starts. Supply flush water at a pressure of about 10 psi above pump discharge pressure. Your pump has shipped with the packing gland bolts finger tight for initial break-in period of the packing. The following steps are required for proper break-in.

1. Before flooding the suction or starting the pump, turn on the flush water. If the water is leaking excessively from the stuffing box it is OK to tighten the bolts on the packing gland. Only tighten the bolts one flat at a time. Reduce flow only to the point where it is containable inside the packing housing drain.
2. Flood the pump suction and start the pump.
3. Flush water will be freely leaking from the stuffing box. Tighten the bolts on the gland one flat at a time every five to ten minutes until **the leakage rate is 17 - 30 drops per minute for 3”-6” & 8K pumps and 35 - 50 drops per minute for 8”-16” pumps**. Tightening the packing gland bolts by as little as a 1/4 turn can be enough to change the leakage rate when the assembly is close to the desired leak rate. This procedure could take a few hours.

The break in procedure is now complete. As your pump runs continue to monitor and adjust the packing gland as required to maintain proper leakage.

Figure 5



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 acceptable (solid) portion of its pump performance curve. Operation in the dashed lines indicates vibration areas. Pump damage will occur if operated in these extreme low-flow or high-flow parts of the pump curve.
2. 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.
3. When pumping materials that float or settle in a pit, mixing and chopping with the pump may be required before pit pump out. This can be done by initially directing the discharge back into the pit. This will alleviate buildup of solids in the pit.
4. 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.
5. 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.

SECTION 3: INSTALLATION INSTRUCTIONS

A. RECEIPT INSPECTION

Prior to shipment Vaughan pumps are carefully crated and inspected to ensure arrival at your plant in good condition. On receiving your pump, examine it carefully to assure that no damaged or broken parts have resulted from mishandling during shipping. 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 1-1/4 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 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

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.

⚠WARNING

The pump is to always be lifted using adequate crane and sling capacity. All applicable safe hoisting practices should be employed. When doing so, rig the load to prevent flipping. Do not use the motor lifting eye to lift the assembled pump. Use the motor lifting eye to lift the detached motor only. Cast-in lifting eyes are designed for lifting individual pump components or sub-assemblies, not the entire pump. Only base-mounted lifting eyes may be used to lift a pump and drive assembly. Do not allow people under Vaughan equipment during hoisting operations. Consult the Vaughan Co. shipping department for weight of your equipment if you are in doubt.

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.

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 with no more than 0.2” rise per foot (+/- 1° of level). If mounted at an angle, both sets of bearings may not receive adequate oil lubrication. If this cannot be accomplished consult factory for other options.

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 the base, 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
Belt-drive pumps have been aligned and tensioned at the factory, **but the belts are loosened before shipping**. You will need to properly re-adjust the belt tension and alignment following the instructions in Section 4 of this manual. Belts that are too tight can cause premature belt or bearing failures, belts that are too loose may experience belt slipping and belt failure.

D. PIPING

NOTICE

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

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.

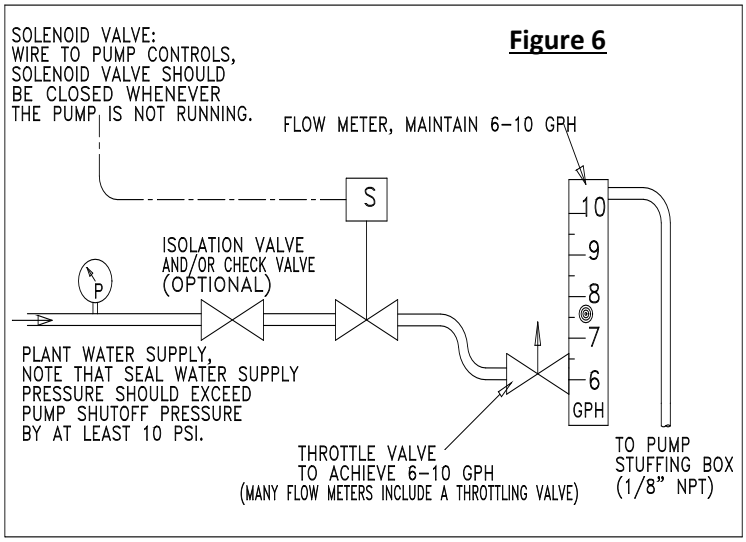
Great care should be taken with suction piping on horizontal pumps to avoid restricting flow to the pump. Avoid bends and fittings and keep suction piping as short as possible and as large as possible. *Suction piping must be as large as or larger than the pump suction flange*. Long and restrictive runs 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 feet per second 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 gauges for testing purposes, particularly important at pump startup. See Vaughan Recommended Piping Practices, Form V435 for additional information.

E. SEAL FLUSHING (FOR OPTIONAL METAL BELLOWS SEALS)

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 10 PSI above the 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 at right.

Figure 6



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. High current trip settings for Starters and VFD's should be set at 110% of motor nameplate full load current to prevent the current spikes from tripping out those devices while chopping.

Selecting a motor with a base speed at the upper end of your operating range and slowing it down to hit the low range results in lowest available torque and may not be recommended. *Note, when slowing a motor down below nameplate speed with a VFD it is very important to remember that available horsepower drops in direct proportion to speed reduction, so a 100 HP motor running at 30 Hz can only make 50 HP max at 30 Hz.*

Selecting a motor with a base speed at the lower end of your operating range and speeding it up to hit the high range results in the highest available torque and is generally preferred for chopper pump applications*. When speeding a motor up above nameplate speed, available horsepower = nameplate horsepower.*

Minimum allowable speed for Rotamix applications is 75% of base speed. Minimum allowable speed for other applications is dependent on system curve, and is the speed required to maintain minimum allowable flow per our published curves. Consult Vaughan Co. for assistance if needed.

Severe duty applications like septage receiving, screenings, beef processing, or any application with an external cutter often require oversizing the motor to get sufficient torque. Oversizing the motor has the added benefit of increasing rotational inertia to help carry the impeller through each chop.

When driving chopper pump motors with a VFD, it is important that Constant Torque type VFD's be specified. Constant torque VFD's allow for maximum chopping torque at all speeds. (Variable Torque units have reduced torque and horsepower at reduced speeds)

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 → **ISO 100 HYDRAULIC OIL**

Horizontal Chopper pumps have oil-bath bearing lubrication. The proper oil is ISO ~~46~~ hydraulic oil. Oil level is indicated by a sight glass mounted on the side of the bearing housing. 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.

Vaughan Co. uses Chevron Rando HD ~~46~~ which is ISO ~~46~~ hydraulic oil. The following oils have the viscosity and rust inhibiting additives to make them excellent alternates for the Rando HD ~~46~~: Chevron GST ~~46~~, Chevron EP ~~46~~, Exxon Terissic ~~46~~, Shell Turbo ~~46~~ and Texaco Regal ~~46~~. Most ISO ~~46~~ hydraulic oils and ISO ~~46~~ turbine oils should be compatible with Rando HD ~~46~~ supplied in our pumps.

BEARING ISOLATORS

Bronze non-contacting labyrinth style, O-ring mount bearing isolators are provided at each end of the bearing housing. The bearing isolators provide maintenance free, permanent bearing protection by keeping the oil in the bearing housing while blocking outside contaminants from entering. Oil captured in the labyrinth flows back into the bearing housing, while outside contaminants are expelled through a port in the stator.

SECTION 4: PUMP STARTUP INSTRUCTIONS

NOTICE

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

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. Four motor adjusters have been supplied with your pump. Tighten them just enough to support the weight of the motor but no more.

2) Belt-driven pumps have shipped with the belts de-tensioned and the belts will need to be tightened before startup. Vaughan's bill of material (BOM) for your particular pump and belt-drive system lists the belt tension required by the drive manufacturer. After the pump is installed, plumbed, and bolted down into final position follow the procedure below to tighten the belts to the tension noted on the pump BOM.

⚠WARNING

Lock out power source before tensioning belts. Replace belt guard before applying power to the pump.

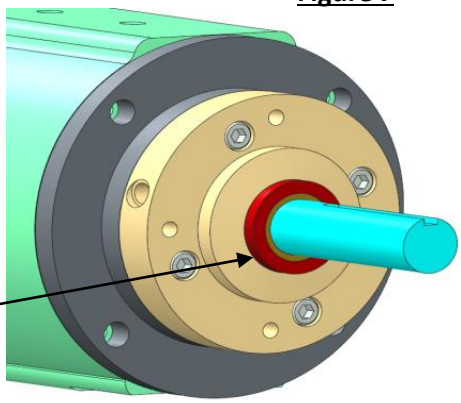
a. Remove the belt guard outer cover and set it aside. Loosen the motor hold down bolts and turn the belt tensioning bolts under motor until belts are tight and can be depressed approximately ½" in the center of one belt by hand.
b. Place a steel straight edge across the two belt sheave's centers, passing 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 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".

c. 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 tool (Vaughan #V800-860) for single belt; (Vaughan #V800-861) for banded belt. For banded belt, the total force will be lbs per rib/strand times the number of rib/strand in the belt. It is very important to set the tension correctly. See the bill of materials for the correct tension.

d. 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.

3) The red oil containment cups for both inboard & outboard bearing isolators should be removed before pump startup. No damage to the pump will occur if these are left on by accident, but they will require more power to drive because of added friction. These can simply be cut to remove from shaft.

Figure 7



4) 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 following your plants established lockout/tagout procedures open the circuit breakers to the motor panel, 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.

NOTICE

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

5) Review the start-up and certification checklist in this manual, open suction and discharge isolation valves, confirm suction is flooded, and start the pump.

⚠CAUTION

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

6) The startup instructions are incorporated into the Startup And Certification Checklist. When the Startup And Certification Checklist is completed please send a copy of the completed checklist to Vaughan Co. Engineering. We will verify that the pump and system are properly matched to protect your investment and our reputation.

NOTICE

Pump speeds and operating conditions must fall within the acceptable limits of the performance curve of the pump. Do not operate in the dashed portions of the curve

Unmatched Reliability Vaughan®

DATE: _____

Pump S/N: _____

Project Name: _____

Customer Tag#: _____

Startup Performed By (Agent & Telephone No): _____

Customer Contact/Telephone No.:_____

Contractor/Telephone No.: _____

Consulting Engineer/Telephone No.: _____

VAUGHAN HORIZONTAL CHOPPER PUMP
STARTUP AND CERTIFICATION CHECKLIST

Pump Shaft turns freely by hand?	Yes _____	No _____
All guards are in place?	Yes _____	No _____
Pump is turning CW as viewed from the motor end?	Yes _____	No _____
Vent in plug on bearing housing not plugged?	Yes _____	No _____
Is the oil level in the middle of the range of the site glass?	Yes _____	No _____
Is the pump casing vented and filled with liquid?	Yes_____	No _____
All piping attached to pump is being independently supported? (not by the pump)	Yes _____	No _____
All piping joints are leak tight?	Yes _____	No _____
Flexible joint is connected to pump discharge?	Yes _____	No _____
If yes, is piping anchored between expansion joint and pump discharge, per H.I. standards?	Yes_____	No _____
Both suction and discharge valves open?	Yes_____	No _____
Construction debris in sump or piping?	Yes_____	No _____
Does Inflow splash down into sump?	Yes _____	No _____

ELECTRICAL DATA

Motor Mfr: _____Motor S/N _____

Motor HP: _____ Motor 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 (deg F): _____ Specific Gravity: _____ %Solids:_____

Pipe size (in.): _____ Total equivalent length of pipe (Feet): _____

Elevation change from water level to discharge point (Ft.) _____

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

PUMP OPERATING DATA

Pump Model:_____ Impeller Diameter: _____

Discharge Pressure (fill in psi): **Pump Off (psi):** _____ **Pump On (psi):** _____

Dim "Z1" (distance from liquid level to pressure gauge-Ft): _____

Suction Pressure (fill in psi or in. Hg in negative): **Pump Off (psi):** _____**Pump On(psi):**_____

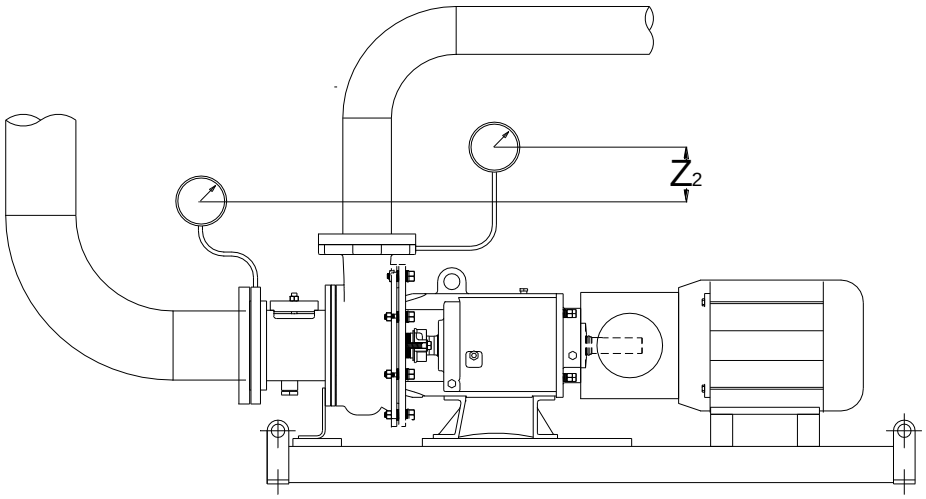
Dim "Z2" (vertical distance between gauges-Ft):_____

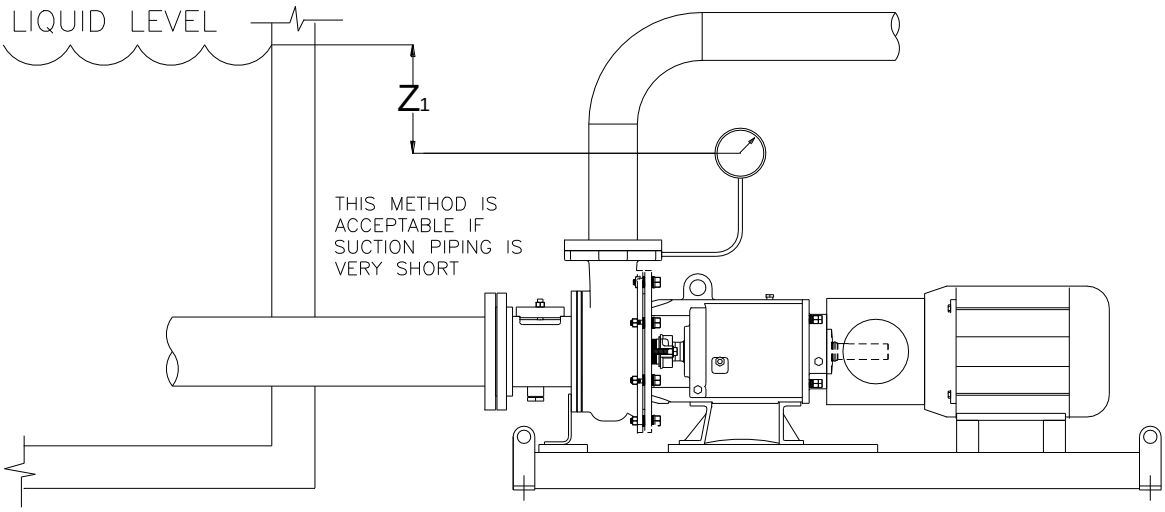
Observed Pump Flow (GPM): _____

Pump Speed:_____

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 5: 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 1 mil. or less of imbalance. The pump shaft is fully machined to be straight and is tightly held by bearings so that there is virtually no shaft movement. Your pump should not exhibit any significant vibration or noise in normal operation. If you feel that the pump is noisy or vibrating more than it should, please call Vaughan Company immediately to discuss. Excessive vibration and/or noise may be indicative of system mismatch or other problem that could severely shorten the life of your pump.

SECTION 6: SHUTDOWN INSTRUCTIONS

A. MANUAL SHUTDOWN

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 inspect, adjust, or do any maintenance, on the pump or motor, be sure to follow all warnings in this manual, and your plants safety procedures. Be certain to turn off electrical power by opening and locking out the main panel breaker to isolate the pump. Since in the automatic mode, the pump could start without warning 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 lock out the breaker to avoid accidental energization of the pump.

SECTION 7: MAINTENANCE

A. ROUTINE MAINTENANCE

⚠WARNING

Isolate the pump hydraulically and electrically before servicing or inspecting the pump. Lock out both power source and isolation valves. Never clean oil, adjust, or repair machinery while in motion.

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.
   a. **Vaughan cartridge seal**: If leakage is observed at the pressure relief valve change oil as described on page 21 of this manual.
   b. **Metal Bellows Seal**: If seal leakage is evident, the seal faces can be cleaned (metal bellows seals 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 for the 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.
   c. **Packing**: Adjust packing leakage as directed in Section 2 of this manual.

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 without vibration or cavitation.
3. Check oil level in pump bearing housing and check for oil contamination.
4. Grease motor bearings with bearing grease as specified by the manufacturer
5. Perform monthly inspection as shown above.

ANNUALLY:

1. Check clearances between impeller and cutting surfaces.
Isolate the pump electrically (open & lockout 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 illustration on page 21)

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. Please follow the 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 cutter bar side of the impeller instead of the upper cutter side. This will cause a confusing problem during the next step when the front clearances are adjusted.

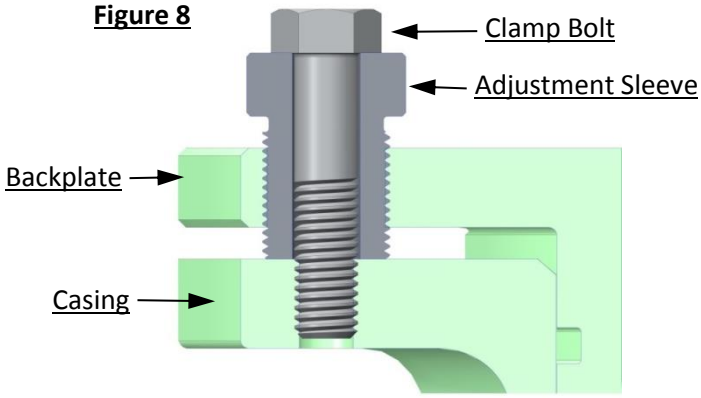
a) Remove a motor stool cover to gain access to the motor coupling. This will allow you to rotate the pump shaft by hand to check for contact between the impeller and cutting surfaces. Roll the shaft over by hand and observe how it feels before you have made any adjustments.

b) 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!*

Before beginning to make adjustments, witness mark the adjustment sleeves to help you keep track of how far the adjustment sleeves have been rotated.

c) Loosen each of the four clamp bolts on the bearing housing cap about ½ turn. Be careful to prevent the adjusting sleeves from turning with the clamp bolts. This is usually performed with two wrenches, one holding the adjuster stationary and one turning the clamp bolt.

Figure 8



d) Move the impeller closer to the upper cutter by rotating each of the adjustment sleeves one flat clockwise, and then tightening the clamp bolts onto the adjustment sleeves. It is important to turn each adjustment sleeve exactly the same amount to keep everything parallel. Turn the motor coupling by hand to check for interference between the impeller and the upper cutter. Repeat this step until you feel interference. Once interference is felt, move the impeller away from the upper cutter--loosen the clamp bolts, rotate the adjustment sleeves one flat *counter clockwise,* retighten the clamp bolts--until the shaft turns freely with no contact.

Impeller-Cutter Bar Adjustment

Once the upper cutter adjustment is complete, the cutter gap 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.

Once the upper cutter adjustment is complete, the cutter gap 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.

a) Remove a motor stool cover to gain access to the motor coupling. This will allow you to rotate the pump shaft by hand to check for contact between the impeller and cutting surfaces. Roll the shaft over by hand and observe how it feels before you have made any adjustments.

b) 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!*

c) Loosen and back off each of the clamp bolts on the casing backplate, ensuring that the adjusting sleeves do not move with the bolts. Choose three approximately equally spaced sleeves that you will use to perform the adjustments. Back all the other adjusting sleeves away from the casing by turning them counter clockwise.

d) Before dialing in the impeller-to-cutter bar clearance, it's important to verify that the impeller and cutter bar are parallel to each other. You can check this by using a piece of key stock that is larger than the gap currently present between the backplate and casing flanges. This will generally be somewhere around 3/16" to 1/4". Use the key stock to ensure that the gap is exactly equal at each of your three chosen adjustment sleeves with the clamp bolts tight. Before you begin to make adjustments, witness mark the three adjustment sleeves to help you confirm all of the sleeves have been rotated evenly, and the impeller and cutter bar stay parallel to each other.

e) Decrease the impeller-to-cutter bar gap by rotating each of the three adjustment sleeves counter clockwise by an equal amount, tightening the clamp bolts, and then checking for contact by rotating the shaft. You may need to repeat this step 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. Close up the gap until light contact occurs between impeller and cutter bar.

f) When you have the cutters lightly touching, unclamp the adjustment sleeves once again, carefully rotate them two flats clockwise, and retighten the clamp bolts. This will yield an impeller-to-cutter bar clearance of about .020" to .024". This is an acceptable number for all models of Vaughan HE series chopper pumps, 3 inch through 16 inch.

g) Snug the unused adjustment sleeves against the casing. Make sure that the adjustment sleeves bottom on the casing, 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. 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.

⚠WARNING

Isolate the pump hydraulically and electrically before servicing or inspecting the pump. Lock out both power source and isolation valves.

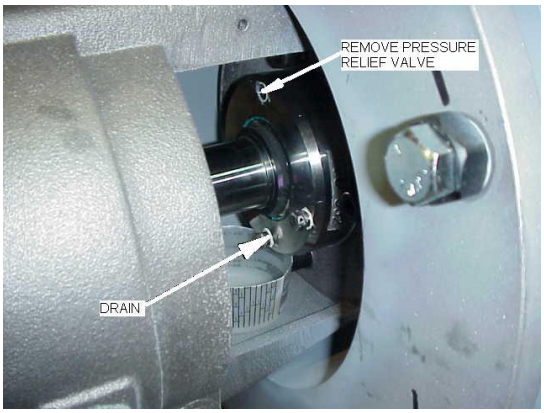
⚠CAUTION

Pressure may build up in the mechanical seals used in Vaughan pumps. Whenever checking or maintaining the oil in the Vaughan cartridge seal, or the welded metal bellows seal with seal oil chamber, make sure the pumps and seal are cool to the touch. Use care when removing the oil chamber plugs, in case any residual pressure exists. If pressure exists, the plug could become a projectile and/or contaminated oil could spray.

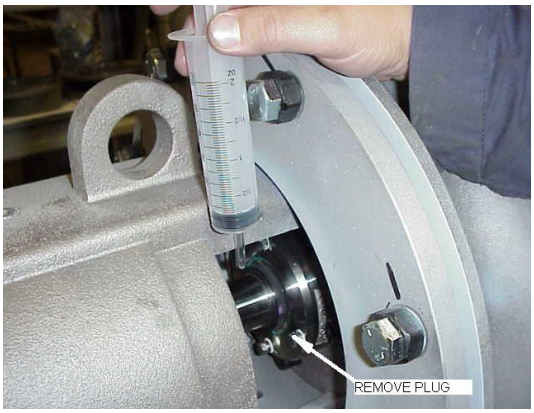
2. Change oil in Vaughan cartridge seal as described below.

USE FYRQUEL (PHOSPHATE ESTER TYPE HYDRAULIC OIL)

Drain Oil: Remove guard. Remove the pressure relief valve on top and the plug on the bottom to drain oil. Put a small container below the seal to collect oil. Plug the bottom hole after draining.



Remove plug on the side. Using a syringe and tubing fill with ~~ISO 46~~ hydraulic oil until oil flows out of the hole on the side. This amounts to about 2 oz. for 3”-6” pumps and 6 oz. for 8”-16” pumps. After filling install the pressure relief valve in the top hole, with the relief port on its side, and plug the side hole. Reinstall guard.



HE PUMPS ADJUSTMENT

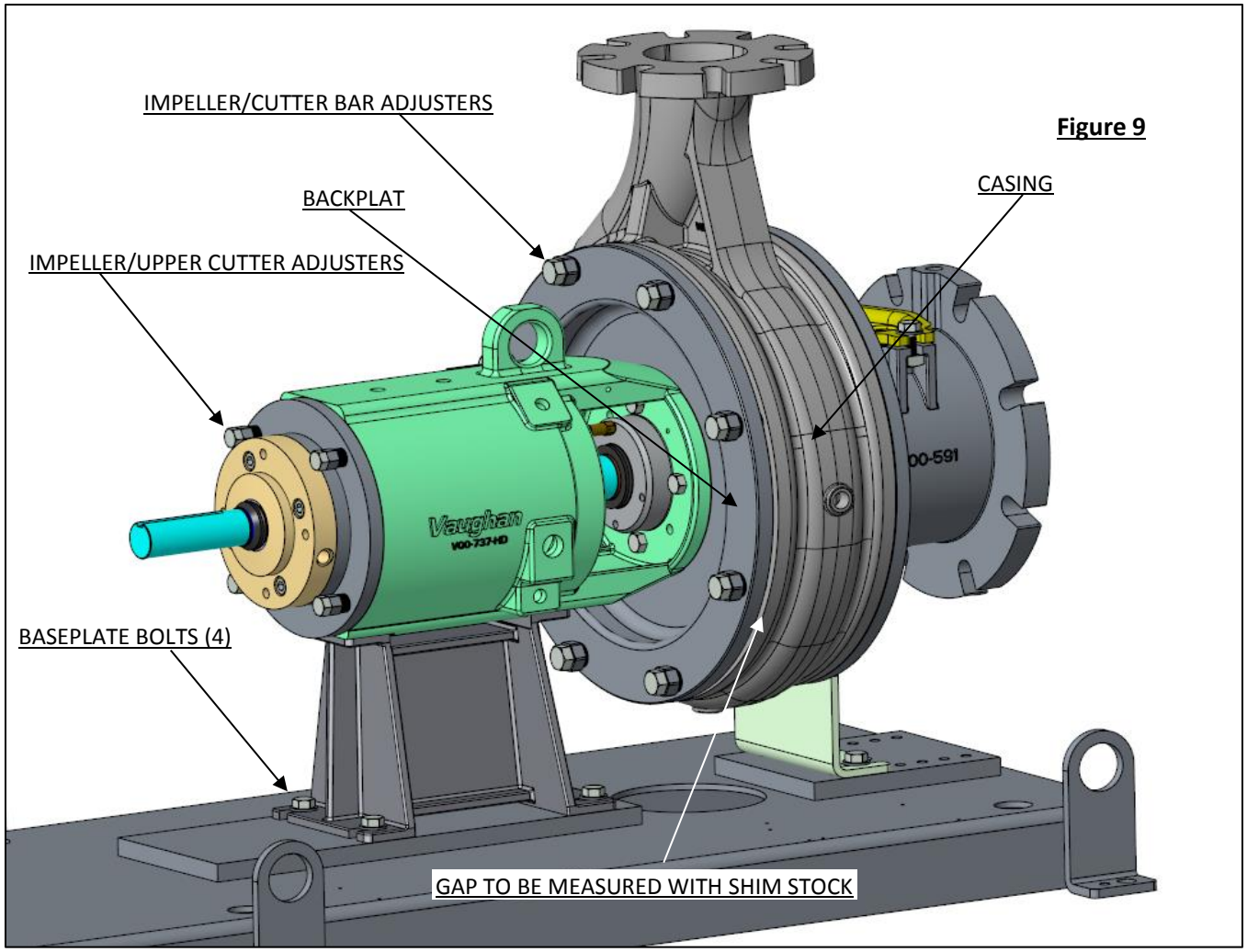


Figure 9

CORRECTIVE MAINTENANCE

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

SECTION 8: 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. for assistance.

		Low Discharge Pressure	Loss of Prime	Excessive Power Required	Excessive Stuffing Box Leakage	Short Packing or Seal Life	Abnormally High Vibration	Short Bering Life	Pump Casing Overheating	High Bearing Temperature	Low Flow
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 Expected			✓							
	Viscosity Higher Than Expected	✓		✓							✓
	Operation at Low Capacity					✓	✓	✓	✓		
	Improper Parallel Operation	✓				✓	✓		✓		✓
	Improper Series Operation						✓				
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 opening blocked	✓	✓			✓	✓		✓		✓
MECHANICAL PROBLEMS	Pump Discharge Blocked					✓	✓	✓	✓	✓	✓
	Foundation Not Rigid					✓	✓	✓			
	Damaged Bearings			✓	✓	✓	✓			✓	
	Bent Shaft				✓	✓	✓	✓			
	Rotating Member Contacts Stationary			✓		✓	✓	✓	✓		
	Cutter Bar or Impeller Worn	✓	✓	✓			✓				✓
	Impeller Damaged	✓	✓	✓		✓	✓				✓
	Gas in pumped fluid	✓	✓		✓	✓	✓	✓			✓
	Loss of Fresh Water to Stuffing Box	✓	✓		✓	✓			✓		✓
	Loss of Bearing Lubrication			✓			✓	✓		✓	
	Improper Repair/Installation of Bearings			✓		✓	✓	✓		✓	
	Contaminated Bearings					✓	✓	✓		✓	
	Shaft Sleeve Worn	✓	✓	✓	✓	✓	✓				✓
	Packing Improperly Installed		✓			✓					
	Packing Gland Too Tight			✓		✓			✓		
	Improper Seal Elastomers for Application		✓		✓	✓					
	Seal Improperly Installed				✓	✓					
	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 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.

NOTES:

BALDOR • RELIANCE

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

11/16 Installation & Operating Manual MN408

Any trademarks used in this manual are the property of their respective owners.

Important:
Be sure to check www.baldor.com to download the latest version of this manual in Adobe Acrobat PDF format.

Table of Contents

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.**

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.**

Continued on next page.

Safety Notice Continued

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 º 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 M Ω).

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 peak-to-peak 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 ºC (50 ºF) to 49 ºC (120 ºF) 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.

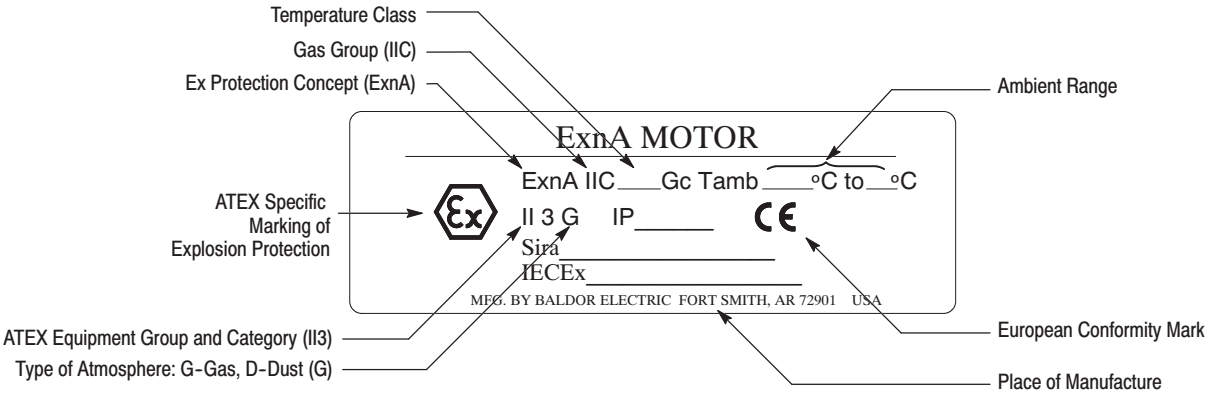
Removal From Storage

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 1-1.

Figure 1-1 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.

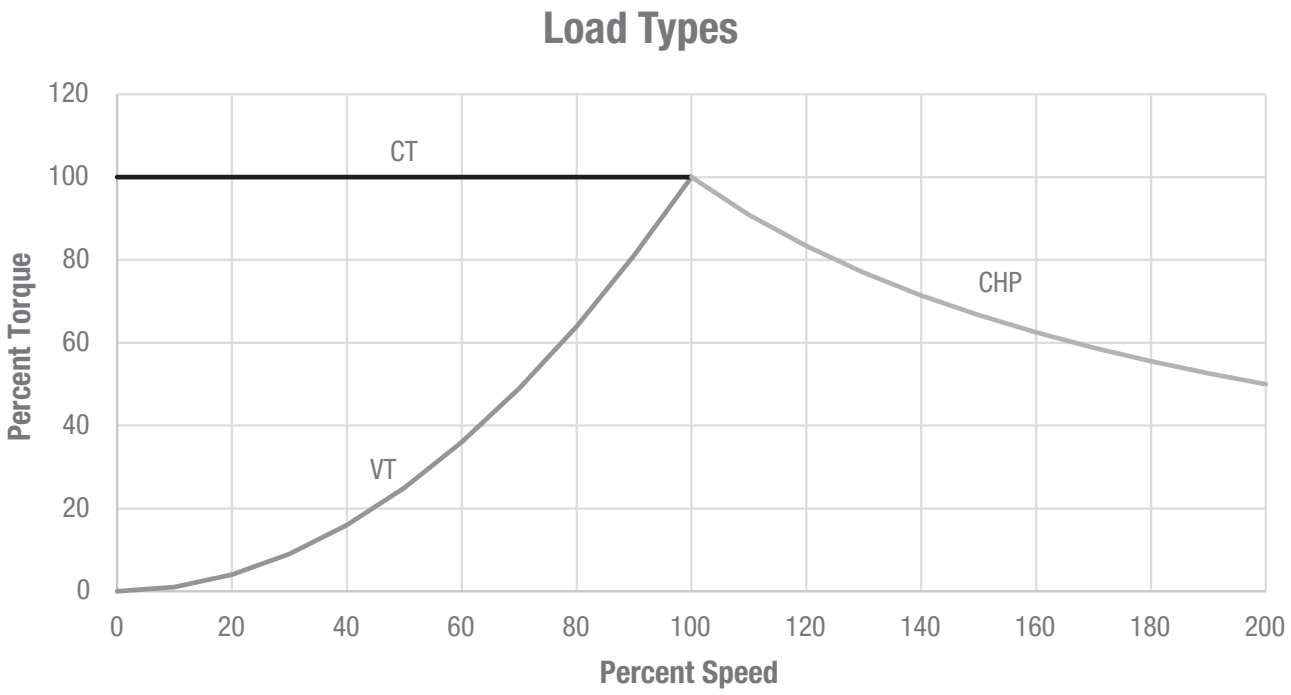
Operation On Frequency Converters:

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

Unit Conversions	
Inches to Millimeters	Inches x 25.4 = mm
Millimeters to Inches	mm x .03937 = Inches
Horsepower to Kilowatts	Hp x .746 = Kw
Kilowatts to Horsepower	Kw x 1.341 = Hp
Pounds to Kilograms	Lbs x .454 = Kg
Kilograms to Pounds	Kg x 2.205 = Lbs

Typical Speed vs Torque Curves are shown in Figure 1-2. For values relative to your specific motor, consult the motor nameplate marking.

Figure 1-2 Typical Speed vs Torque Curves



EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2014/30/EU. These motors are commercial in design and not intended for residential use. When used with converters, please consult converter manufacturers literature regarding recommendations on cable types, cable shielding, cable shielding termination, connection recommendations and any filters which may be recommended for EMC compliance. For additional information, consult Baldor MN1383.

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.

For Group I Mining Motors where breather drains are used specified, Breather drain shall be mounted or protected in installation such that it is guarded from direct impact."

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 2014/30/EU . 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.

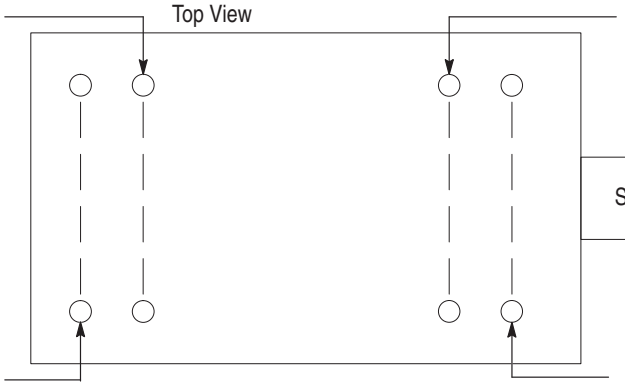
When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

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 2-1 indicates the proper mounting holes to use.

Figure 2-1 6 & 8 Hole Motor Frame Mounting



For short frame designations 182, 213, 254, 284, 324, 364, 404, 444 (NEMA)

Allows F-1 to F-2 Conversion on 8 hole frames.
Not present on 6 hole frames.
Not used on 8 hole frames.

For long frame designations 184, 215, 256, 286, 326, 365, 405, 445 (NEMA) (IEC) 112M, 132M, 160L, 200L, 225M, 250M, 280M

Always use these holes, closer to the shaft 112S, 132S, 160M, 180M, 200M, 225S, 250S, 280S, (IEC)

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:

Crosssectional area of phase conductors, S	Minimum crosssectional area of the corresponding protective conductor, S_p
mm2	mm2
6	6
10	10
16	16
25	25
35	25
50	25
70	35
95	50
120	70
150	70

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

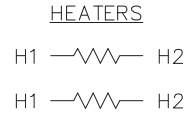
2. AC power is within ±5% of rated frequency with rated voltage.

OR

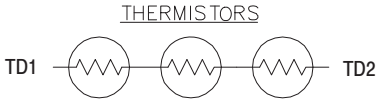
3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-3.

Figure 2-2 Accessory Connections

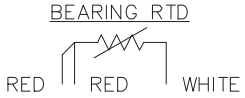


One heater is installed in each end of motor.
Leads for each heater are labeled H1 & H2.
(Like numbers should be tied together).



Three thermistors are installed in windings and tied in series.
Leads are labeled TD1 & TD2.

Winding RTDs are installed in windings (2) per phase.
Each set of leads is labeled 1TD1, 1TD2, 1TD3, 2TD1, 2TD2, 2TD3 etc.



* 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.**

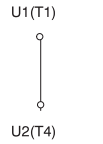
AC Motor Connection Diagram

IEC VERSUS NEMA LEAD MARKING

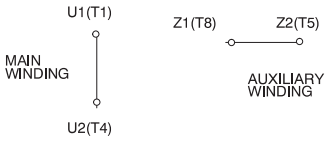
EXAMPLE COMPARISIONS OF IEC AND NEMA LEADING MARKINGS FOR COMMON CONNECTION TYPES ARE SHOWN BELOW.

SINGLE PHASE MOTORS

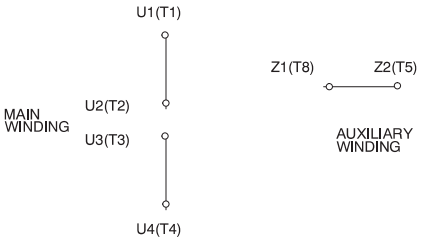
SINGLE VOLTAGE NON REVERSIBLE



SINGLE VOLTAGE REVERSIBLE



DUAL VOLTAGE REVERSIBLE



AC Motor Connection Diagram

THREE PHASE

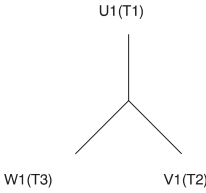
FOR SINGLE WINDING 3 PHASE MOTORS, LEAD MARKINGS CAN BE DIRECTLY TRANSLATED BETWEEN IEC AND NEMA DESIGNATIONS. FOR THESE MOTORS, THE LEAD MARKINGS ARE EQUIVALENT AS FOLLOWS:

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

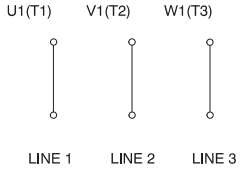
EXAMPLES OF COMMON CONNECTIONS ARE GIVEN BELOW.

THREE LEADS

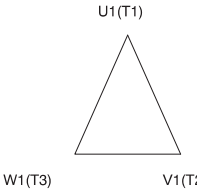
WYE CONNECT



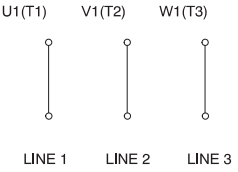
WIRING DIAGRAM



DELTA CONNECT



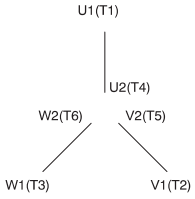
WIRING DIAGRAM



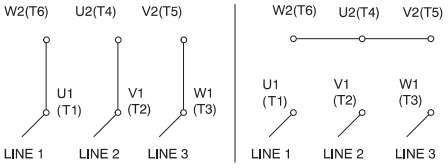
AC Motor Connection Diagram

SIX LEADS

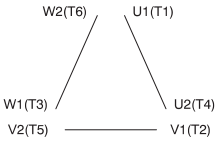
DELTA-WYE CONNECT



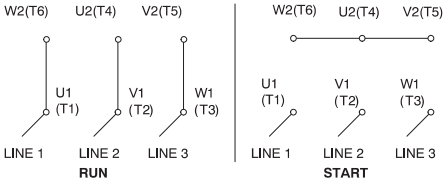
DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 1.73:1



WYE-DELTA CONNECT



WYE START-DELTA RUN SINGLE VOLTAGE

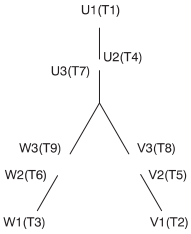


AC Motor Connection Diagram

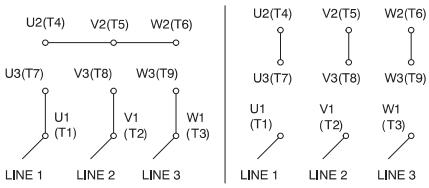
NINE LEADS

DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 2:1

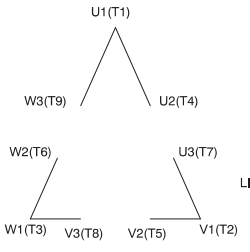
WYE CONNECT



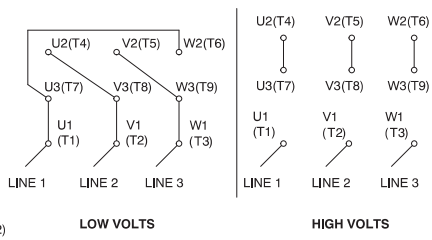
WIRING DIAGRAM



DELTA CONNECT



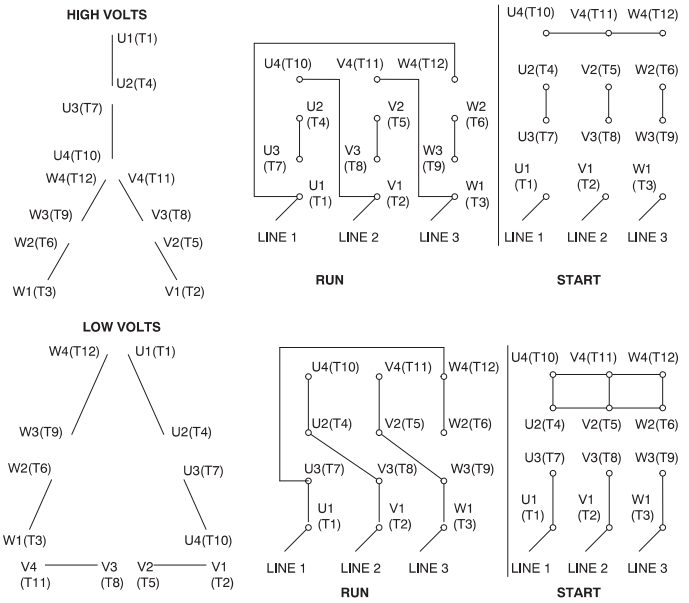
WIRING DIAGRAM



AC Motor Connection Diagram

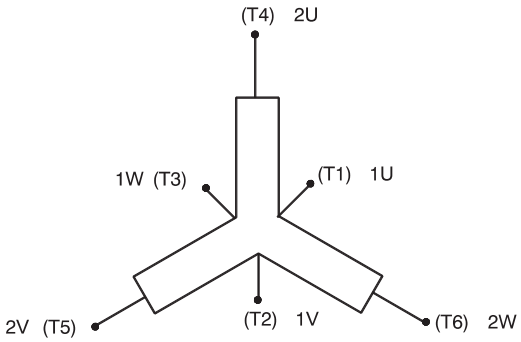
TWELVE LEADS

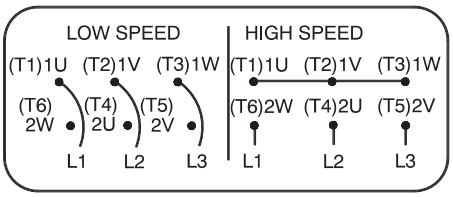
DUAL VOLTAGE WYE START – DELTA – RUN



AC Motor Connection Diagram

SINGLE WINDING MULTI-SPEEDS CONSTANT TORQUE

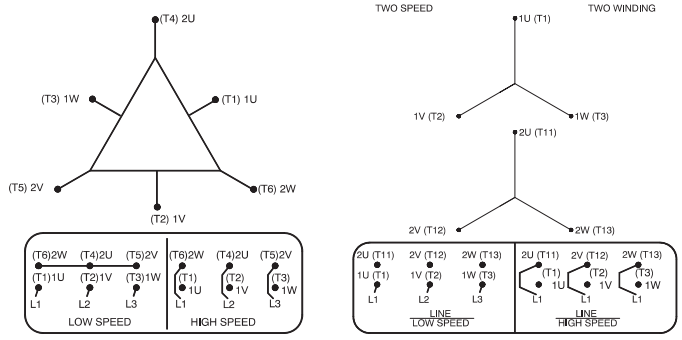




(N.P. 1634-DE)

AC Motor Connection Diagram

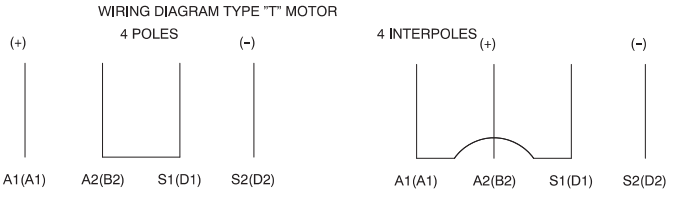
SINGLE WINDING MULTI-SPEEDS CONSTANT HP.



TWO SPEED TWO WINDING

DC Motor Connection Diagram

WIRING DIAGRAM TYPE "T" MOTOR



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

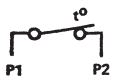
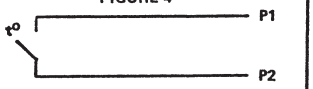
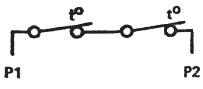
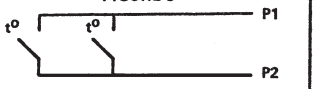
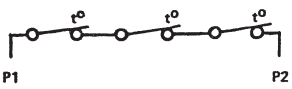
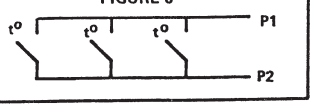
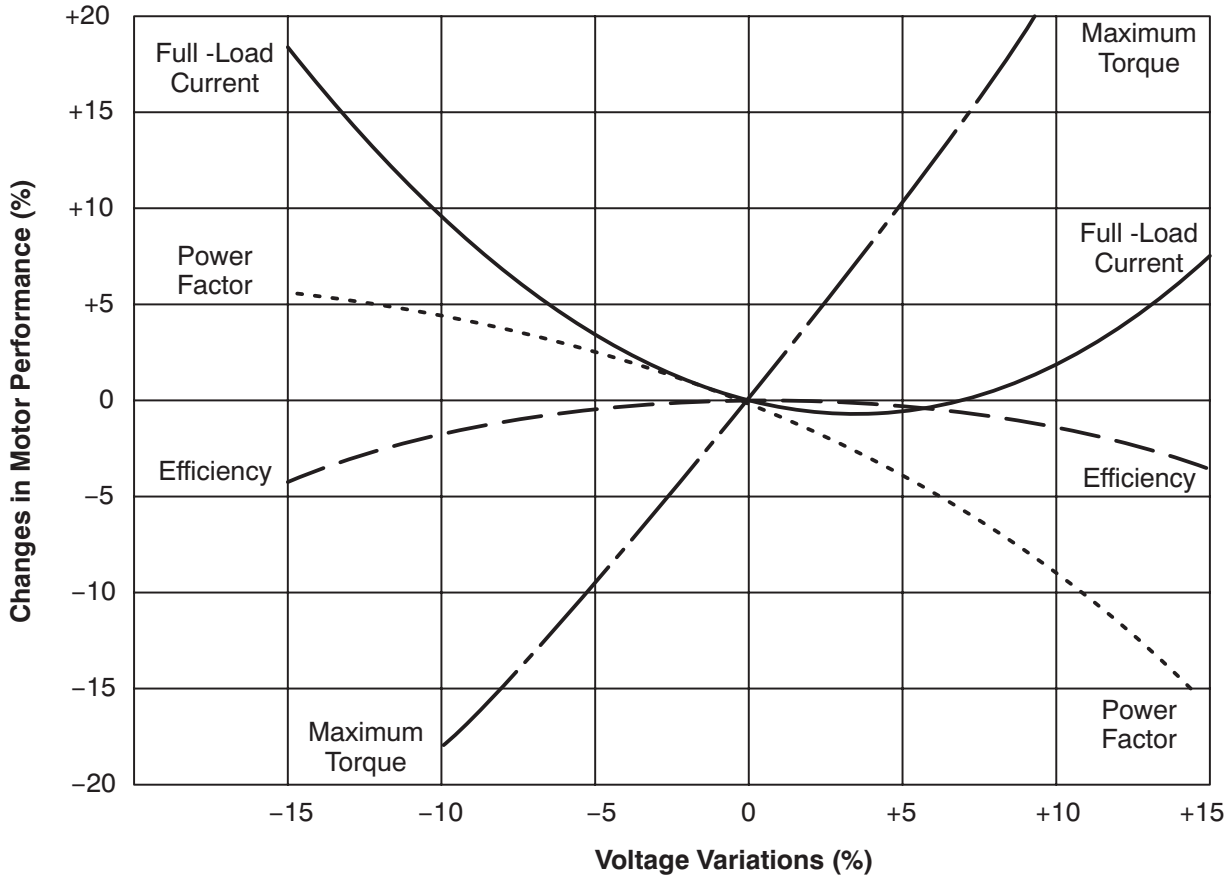
NORMALLY CLOSED	NORMALLY OPEN
FIGURE 1 	FIGURE 4 
FIGURE 2 	FIGURE 5 
FIGURE 3 	FIGURE 6 

Figure 2-3 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.

When explosion proof or flameproof motors are provided with intrinsically safe sensors, the integrity of that system relies upon the proper application and selection of barriers and cables as described in the sensor manufacturers control drawing. The control drawing will be shipped with the motor, and it is important that those instructions be provided to the equipment installer.

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 2014/34/EU, 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.

Hazardous location motors equipped with NPT pipe nipples are designed and built such that the pipe nipple is securely attached to the motor frame. This is accomplished externally by interference between the threads as well as tack welding. The conduit box is securely attached to the pipe nipple at the factory per:

1. Standard Commercial NPT & Explosion Proof IEC/ATEX parts : L-1 gauging notch +/- 1 thread (ref. ANSI/ASME B1.20.1 and Clarification Sheet ExNB/98/06/010/CS) Note: Clarification Sheet ExNB/98/06/010/CS provides inspection criteria to meet (6 threads minimum per engineering part drawing for ATEX parts).
2. Explosion Proof UL conduit boxes & MSHA parts: L-1 gauging notch "+1 min to + 3 1/2 max threads. Note: Provides inspection criteria to meet (5 threads minimum per engineering part drawing for MSHA parts and meet UL 1203 requirement for L-1 gauging notch flush to + 3 1/2 max threads).

This allows the end user to position the conduit box according to the application then secure when in place. For obvious reasons having the conduit box snug prior to affixing to the pipe nipple is preferable. However, the guidance in numbers 1 and 2 above can be used in determining thread engagement.

Note: In the United States most non-mining applications have rigid conduit for cabling, therefore not tack welding the conduit box to the pipe nipple is standard. In markets outside the United States, flexible conduit/cabling are common and end users should take note to secure the conduit box to the pipe nipple once in position. Further, the flexible leads should be secured to inhibit forces acting on the conduit box.

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. Baldor motors are pregreased, normally with Polyrex EM (Exxon Mobil) or as stated on the nameplate.
Do not mix greases unless compatibility has been checked and verified.

Ball Bearing Motors

Operating Temperature –25 ºC (–15 ºF) to 50 ºC (120 ºF)

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 ºC (–76 ºF)

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 ºC (–15 ºF) to 50 ºC (120 ºF)

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 3-1. 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 3-2, 3-3 and 3-4.

Table 3-1 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 3-2 Service Conditions

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

* 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 3-3 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 3-4 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 3-5 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 3-6 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. Eccentric air gap.	Check input line connections. 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 ºC) 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.

Table 3-7 Winding RTDs – Temperature Limit In ºC (40 ºC Maximum Ambient)

Motor Load (Typical Design)	Class B Temp Rise ≤ 80 ºC		Class F Temp Rise ≤ 105 ºC		Class H Temp Rise ≤ 125 ºC	
	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.

Table 3-8 Bearing RTDs – Temperature Limit In oC (40 ºC 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

Notes: * 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.

Notes

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Baldor Electric Company

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www.baldor.com

MN408
11/16

AC & DC Motor Installation & Maintenance

Safety Notice: Be sure to read and understand all of the Safety Notice statements in MN408 or Product Specific manual for your motor. A copy is available at: http://www.baldor.com/support/product_manuals.asp

ACCEPTANCE
Thoroughly inspect this equipment before accepting shipment from the transportation company. If any damage or shortage is discovered do not accept until noted on the freight bill. Report all damage to the freight carrier.

SAFETY
Eye bolts, lifting lugs or lifting openings, if provided, are intended only for lifting the motor and motor mounted standard accessories not exceeding, in total 30% of the motor weight. These lifting provisions should never be used when lifting or handling the motor and driven equipment. Eye bolt lifting capacity rating is based on a lifting alignment coincident with eye bolt center line. Eye bolt capacity reduces as deviation from this alignment is increased. Be sure eye bolts are tight and prevented from turning before lifting.

INSTALLATION OUTSIDE THE USA:
Refer to MN408 and MN1383 for Compliance with European Directives. Copies are available at:
http://www.baldor.com/support/product_manuals.asp

MOTOR ENCLOSURE
ODP, Open drip proof motors are intended for use in clean, dry locations with adequate supply of cooling air. These motors should not be used in the presence of flammable or combustible materials. Open motors can emit flame and/or molten metal in the event of insulation failure.
TEFC, totally enclosed motors are intended for use where moisture, dirt and/or corrosive materials are present in indoor and outdoor locations.
Explosion protected motors, as indicated by a Nationally Recognized Testing Laboratory Certification mark and marking with Class, Division and Temperature Code are intended for installation in hazardous locations as described in Article 500 of the NEC. Refer to MN408 for more details.

MOUNTING
Foot mounted machines should be mounted to a rigid foundation to prevent excessive vibration. Shims may be used if location is uneven.

Flange mounted machines should be properly seated and aligned. Note: If improper rotation direction is detrimental to the load, check rotation direction prior to coupling the load to the motor shaft.
For V-belt drive, mount the sheave pulley close to the motor housing. Allow clearance for end to end movement of the motor shaft. Do not overtighten belts as this may cause premature bearing failure or shaft breakage.
Direct coupled machines should be carefully aligned and the shaft should rotate freely without binding.

GENERAL
The user must select a motor starter and overcurrent protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or applicable local codes. Special motors for use by United States Government including special specifications, master plans, etc. refer to the applicable master plans and specifications involved. On motors received from the factory with the shaft blocked, remove blocking before operating the motor. If motor is to be reshipped alone or installed to another piece of equipment, the shaft block must be installed to prevent axial movement and prevent brinelling of the bearings during shipment.

TESTING
If the motor has been in storage for an extensive period or has been subjected to adverse moisture conditions, check the motor insulation resistance with a meg ohm meter. Depending on storage conditions it may be necessary to regrease or change rusted bearings. Contact Baldor District Office if resistance is less than 5 meg ohms.

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury.

WARNING: Be sure the system is properly grounded before applying power. Electrical shock can cause serious or fatal injury.

INSTALLATION
This motor must be installed in accordance with National Electric Code, NEMA MG-2, IEC standards or local codes.

WIRING
Connect the motor as shown in the connection diagrams. If this motor is installed as part of a motor control drive system, connect and protect the motor according to the control manufacturers diagrams. Refer to MN408 for additional details on lead marking. The wiring, fusing and grounding must comply with the National Electrical Code or IEC and local codes. When the motor is connected to the load for proper direction of rotation and started, it should start quickly and run smoothly. If not, stop the motor immediately and determine the cause. Possible causes are: low voltage at the motor, motor connections are not correct or the load is too heavy. Check the motor current after a few minutes of operation and compare the measured current with the nameplate rating.

GROUNDING
Ground the motor according to NEC and local codes. 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.

ADJUSTMENT
The neutral is adjustable on some DC motors. AC motors have no adjustable parts.

Noise
For specific sound power or pressure level information, contact your local Baldor representative.

VIBRATION
This motor is balanced to NEMA MG1, Part 7 standard.

BRUSHES (DC Motors)
Periodically, the brushes should be inspected and all brush dust blown out of the motor. If a brush is worn 1/2, (length specified in renewal parts data), replace the brushes.

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.

Reassemble and seat the new brushes using a brush seating stone. Be sure the rocker arm is set on the neutral mark.

INSPECTION

Before connecting the motor to an electrical supply, inspect for any damage resulting from shipment. Turn the shaft by hand to ensure free rotation. Motor leads must be isolated before the shaft will turn freely on permanent magnet motors.

DRAIN PLUGS

One or more condensation drain plugs are provided on each endplate for various motor mounting configurations. For Washdown and totally enclosed, fan cooled or non-ventilated motors, the plugs in the lowest portion of the ends shields should be removed for operation (unless the motor has special stainless steel drains). All drains are located in the lowest portion of the ends shields.

MOUNTING

Mount the motor on a foundation sufficiently rigid to prevent excessive vibration. Grease lubricated ball bearing motors may be mounted with the feet at any angle. After careful alignment, bolt motor securely in place. Use shim to fill any unevenness in the foundation. Motor feet should sit solidly on the foundation before mounting bolts are tightened.

IP (Ingress Protection)

IP designations include two numerals, the first characteristic numeral is for ingress solid bodies and from dust. The second for ingress protection from liquid - water. Motors marked less than IP23 require additional protection from water.

GUARDING

After motor installation is complete, a guard of suitable dimensions must be constructed and installed around the motor/gearmotor. This guard must prevent personnel from coming in contact with any moving parts of the motor or drive assembly but must allow sufficient cooling air to pass over the motor. If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure. Brush inspection plates and electrical connection cover plates or lids, must be installed before operating the motor.

STARTING

Before starting motor remove all unused shaft keys and loose rotating parts to prevent them from flying off. Check direction of rotation before coupling motor to load. The motor should start quickly and run smoothly and with little noise. If the motor should fail to start the load may be too great for the motor, the voltage is low or the motor has been miswired. In any case immediately shut motor off and investigate the cause.

ROTATION

To reverse the direction of rotation, disconnect and lockout power and interchange any two of the three AC power leads for three phase motors. For two-phase four wire, disconnect and lockout power and interchange the AC line leads on any one phase. For two phase three wire, disconnect and lockout power and interchange phase one and phase two AC line leads.

Maintenance Procedures

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury.

WARNING: Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. 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.

Lubrication Information

Refer to motor nameplate for recommended lubricant. If none is shown, the recommended lubricant for anti-friction bearings (-15°F to 120°) is POLYREX EM. For Min Start Temp -100°F use AEROSHELL #7. For roller bearings is ExxonMobil SHC-220.

Relubrication Intervals
(For motors with regrease capability)

New motors that have been stored for a year or more should be relubricated. Lubrication is also recommended at Table 1 intervals.

LUBRICATION INSTRUCTIONS

Cleanliness is important in lubrication. Any grease used to lubricate anti friction bearings should be fresh and free from contamination. Properly clean the grease inlet area of the motor to prevent grease contamination.

1. Select service conditions from Table 2.
2. Select lubrication interval (Table 1).
3. Adjust lubrication interval with multiplier from Table 3.
4. Select volume of grease from Table 4.

LUBRICATION PROCEDURE

Bearings should be lubricated while stationary and the motor is warm.

1. Locate the grease inlet, clean the area, and replace the pipe plug with a grease fitting.
2. Locate and remove the grease drain plug, if provided.
3. Add the recommended volume of the recommended grease.
4. Replace the grease inlet plug and run the motor for 15 minutes.
5. Replace the grease drain plug.

SPECIAL APPLICATIONS

For special temperature applications, consult your Baldor District Office.

Relubrication Intervals

Recommended relubrication intervals are shown in Table 1. It is important to realize that the recommended intervals of Table 2 are based on average use. Refer to additional information contained in Tables 2, 3 and 4.

Table1 Relubrication Interval

NEMA (IEC) Frame Size	Rated Speed (RPM)			
	3600	1800	1200	900
Up to 210 incl. (132)	5500Hrs.	12000Hrs.	18000Hrs.	22000Hrs.
Over 210 to 280 incl. (180)	3600Hrs.	9500Hrs.	15000Hrs.	18000Hrs.
Over 280 to 360 incl. (225)	2200Hrs.	7400Hrs.	12000Hrs.	15000Hrs.
Over 360 to 5800 incl. (400)	2200Hrs.	3500Hrs.	7400Hrs.	10500Hrs.

* 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.

Table2 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).

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

Note: Different grease types are generally incompatible and should not be mixed. Mixing different types can cause lubricant and bearing failure. Thoroughly clean bearing and cavity before changing grease type.

Table3 Lubrication 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).

Table4 Amount of Grease to Add

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 (315–400)	6328	4.70 (130)	9.2	30.0
5000 to 5800 (315–400)	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

Typical IEC vs NEMA Lead Marking

Single Phase Non-Reversible
Refer to the connection diagram provided on the Baldor motor.

Single Phase Reversible

Dual Voltage Reversible

DC Motors
Lead markings can be translated between IEC and NEMA designations as follows:

	NEMA	IEC
Armature	A1, A2	A1, A2
Series Field	S1, S2	D1, D2
Shunt Field	F1, F2	E1, E2

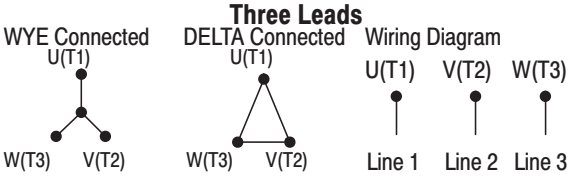
Refer to the connection diagram provided on the Baldor motor.

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:

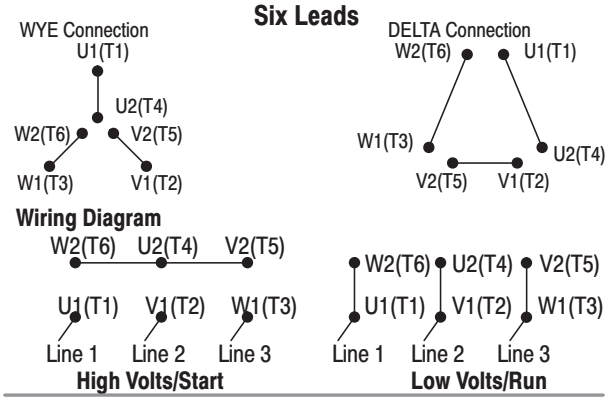
U1=T1	U2=T4	U3=T7	U4=T10
V1=T2	V2=T5	V3=T8	V4=T11
W1=T3	W2=T6	W3=T9	W4=T12

Refer to the connection diagram provided on the Baldor motor. Some examples are as follows:

Three Leads



Six Leads



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MN416
10/14

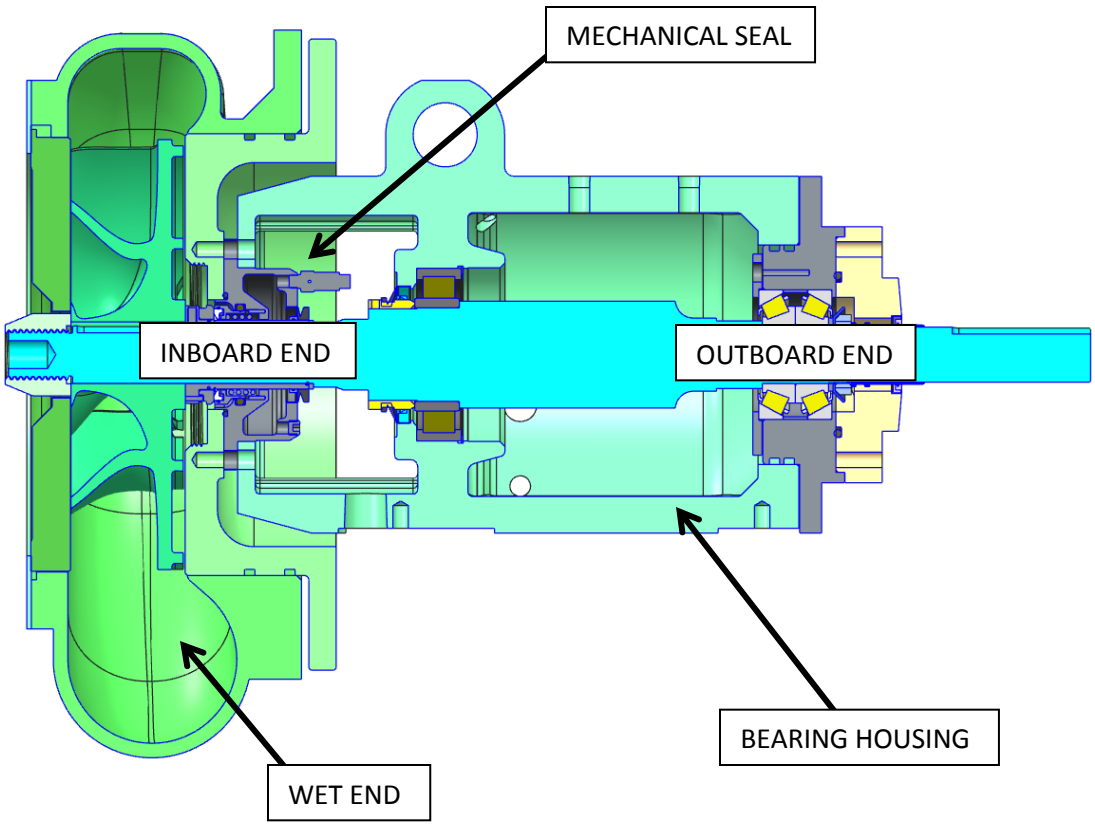
USERS GUIDE TO VAUGHAN PUMP OVERHAUL MANUALS

Overhaul Instructions for Vaughan Pumps are broken into three sections. The illustration below shows the sections the pump has been broken into. Each section is an individual manual as follows:
Wet End Section – This manual describes how to disassemble and assemble the pump impeller and casing part of the pump. Separate manuals are available for the various pump models.
Seal Section – This manual describes how to disassemble and assemble the various types of sealing systems used in Vaughan pumps. Separate manuals are available for Vaughan Cartridge mechanical seals, Vaughan Tandem Cartridge mechanical seals, metal bellows flushed mechanical seals, and packing.
Bearing Housing Section – This manual describes how to disassemble and assemble the bearing housing, shaft, and bearings used in the particular pump. As different styles of bearings are used in different models of pumps separate manuals are available for each style of bearings used.

All three sections are required for a complete pump overhaul. The correct sections (manuals) for a particular pump (serial number) are shown in the heading of the Bill of Materials for that pump.
Note: Submersible pumps will have only two sections (manuals).

For example, if you only need to replace the impeller and cutter bar in a pump you would only need the Wet End section. If you need to replace the Vaughan Cartridge seal you would need both the Wet End section and the Seal section (as you need to remove the pump Wet End to replace the Cartridge Seal).

The 'inboard end' of the bearing housing refers to the side of the bearing housing closest to the impeller, while the 'outboard end' of the bearing housing refers to the side of the bearing housing closest to the motor. Also note that CW means CLOCK WISE and CCW means COUNTER CLOCK WISE.

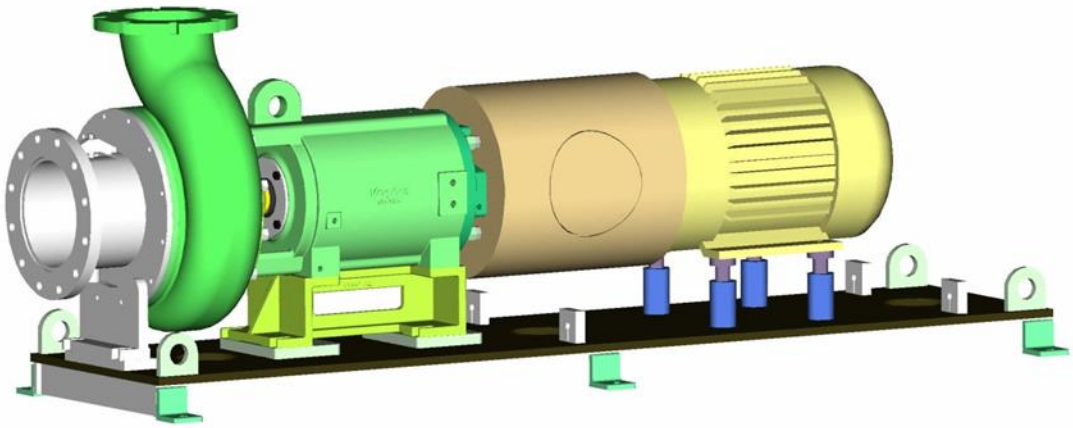


Unmatched Reliability

Vaughan®

8”, 10” & 12” HE SERIES HORIZONTAL CHOPPER PUMPS

OVERHAUL INSTRUCTIONS



VAUGHAN COMPANY, INC.

364 MONTE-ELMA ROAD, MONTESANO, WASHINGTON 98563

PHONE: (360) 249-4042 FAX (360) 249-6155

Form V434 Revision 3, 4/17

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IMPORTANT SAFETY INFORMATION

This equipment is intended to be installed, operated and maintained by technically qualified personnel. Failure to do so in compliance with national and local electrical codes, building codes, safety codes, and Vaughan Co. recommendations, may result in electrical shock, personal injury, death, fire hazard, unsatisfactory performance, and equipment failure. If further assistance is required, contact your local Vaughan Co. representative.

Keep this manual in a safe location for future reference.

The following safety warnings may appear throughout this manual, and are used to alert the customer of specific safety hazards.

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

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

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

NOTICE Indicates special operation or maintenance information.

GENERAL SAFETY INSTRUCTIONS

- Personal protective equipment to be worn when working on or making adjustments to pumps should include:
  - Heavy work gloves when handling parts with sharp edges, especially impellers.
  - Safety glasses (with side shields) for eye protection
  - Steel-toed shoes for foot protection when handling parts, heavy tools, etc.
  - Other personal protective equipment to protect against hazardous/toxic fluids and gases.
- This pump may handle dangerous or contaminated fluids. There are sharp corners, edges and pinch areas which can cause serious injury. Be careful; wear protective gloves whenever possible. If you cut yourself, seek medical help immediately to avoid serious infection.
- Isolate the pump hydraulically and electrically before servicing or inspecting pump. Lock out both power source and isolation valves.
- This pump may start automatically if wired to float switches or other equipment. Before inspecting or making adjustments disconnect electrical power and lock out circuit breakers to pump motor and associated equipment. Duplex pumps with alternating relays must both be locked out; otherwise the pump you are working on may not be isolated and could start as “the alternate”. Visually confirm that the pump has come to a complete stop before proceeding.
- Enter tanks or pits with extreme caution and only after an instrument check of the pit/tank has been completed to verify the absence of dangerous gases and the presence of safe levels of oxygen. Never enter a tank or pit without a safety harness and lifeline, and an air pack. Never enter the pit without rescue personnel standing by. Follow all national and local requirements for confined space entry.
- Keep all pit openings covered when not in use. In addition to the injuries from falling, pits may contain poisonous gases or liquids.
- Pump motors are connected to high voltage. Allow only qualified electricians to service this electrical equipment, and only in accordance with the latest revision of the National Electrical Code and other applicable requirements.

- Keep hands, feet and clothing away from moving machinery.
- 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.
- As it is possible to run Vaughan Chopper and Screw pumps dry, for quality assurance or troubleshooting reasons, it is extremely important to ensure suction and discharge connections are always properly guarded to prevent anything (i.e. foreign objects or pump parts) from being thrown from the pump as a projectile. All pumps must be run with either, a) suction and discharge piping in place, or b) blind flanges installed on suction and discharge connections. Blind flanges should be vented to avoid pressure build-up. Note that cast rotating parts could break if metal to metal contact occurs while the pump is running dry.
- Let the pump cool to ambient temperature before beginning work. A warm pump can contain compartments of pressurized fluid, which may vent violently during disassembly.
- Lifting/hoisting safety.
  - Do not use the motor lifting eyes to lift the assembled pump. Use the motor lifting eyes to lift the detached motor only.
  - Use the supplied lifting bails to hoist submersible pumps.
  - Base-mounted lifting eyes may be used to lift a pump that's bolted to its base. When doing so, rig the load to prevent flipping.
  - Cast-in lifting eyes are designed for lifting individual components or sub-assemblies, not the entire pump.
    - Bearing housing lifting eyes (horizontal and pedestal pumps) can be used to lift an assembled bearing housing assembly.
    - Back cover lifting eye (some self-priming pumps) should be used to lift the back cover only.
    - Use slings to lift assembled pumps.
- Lift pump and motor with a properly sized hoist or crane. Consult Vaughan Co. shipping department for weight of your equipment if you are in doubt.
- Do not allow people under pump assembly while it is being lifted.
- Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes should be worn at all times.
- Do not operate this equipment unless safety guards and 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, adjust, or repair machinery while in motion.
- Keep electrical control panel area clear to avoid hazards to personnel. If a person should trip and fall into an open panel enclosure, serious electrical burns can result.
- Make certain all personnel are clear of equipment before operating.
- There are sharp edges inside the pump, and you may be exposed to hazardous materials and/or communicable diseases. Among some of the sewage-borne communicable diseases that can occur in the United States are typhoid fever, poliomyelitis, and hepatitis A. Decontaminate and/or sanitize the pump before beginning work on those parts of the pump that are exposed to the process fluid. Protect yourself and wear the appropriate personal protective equipment at all times when working on Vaughan pumps.

TOOLS AND SUPPLIES

STANDARD TOOLS

SAE Wrench Set Allen Wrench Set (1/8", 1/2") Torque Multiplier

Soft hammer Slotted screwdriver Ruler

Press 3-jaw puller

SPECIAL TOOLS

Vaughan Cartridge Seal Cap, Vaughan Part #V108-854. Only required if pump is equipped with a Vaughan cartridge seal.

Bearing Installation Tool, Vaughan Part # V3500-129

Shaft Turning Tool, Vaughan Part # V3500-134

Cutter Bar alignment Pins, Vaughan Part # V3500-143

Shaft Assembly Tool, Vaughan Part # V109-469

Impeller Tool, Vaughan Part # V109-525

Lifting Fixture, Vaughan Part # V109-529

CONSUMABLES, PARTS, and SUPPLIES THAT WILL BE NEEDED FOR A REBUILD:

Loctite Nickel Anti-Seize Loctite Safety Solvent

Loctite #222 Low Strength Threadlocker Loctite #242 Threadlocker

Sunnen B200 Press Fit Lubricant

PARTS THAT WILL BE NEEDED FOR A REBUILD:

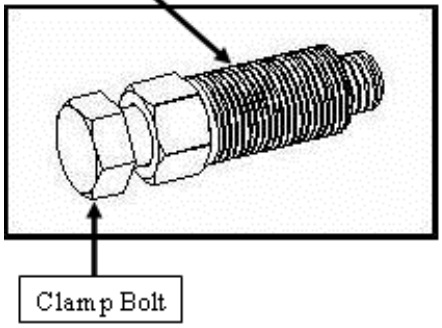
To determine which pump components are needed for overhaul, consult your bill of material. Those items referenced as recommended spare parts should be considered as required for a rebuild.

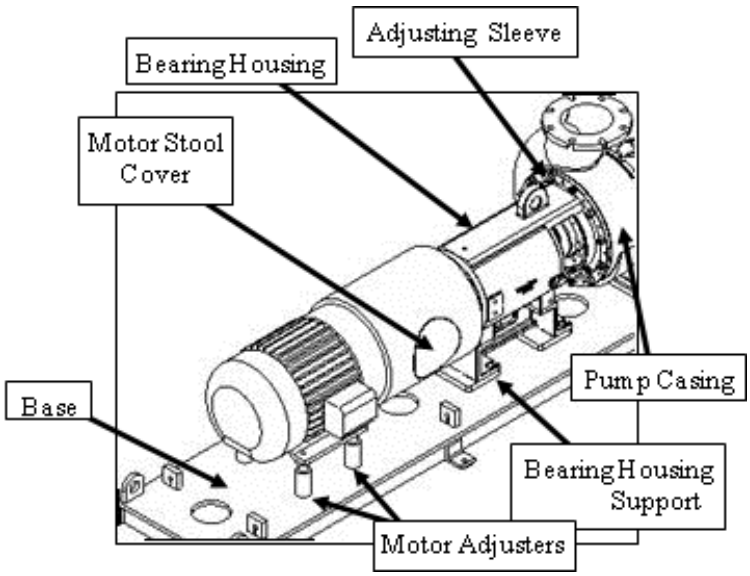
CUTTER GAP ADJUSTMENT

During operation of the pump, normal wear will gradually increase the gap between the impeller and the cutters to the point where performance will be adversely affected. The gap between the back of the impeller and the upper cutter will likewise increase. These gaps can be readjusted without pump disassembly.

Before performing this procedure, disconnect the power to the pump motor and lock it out.

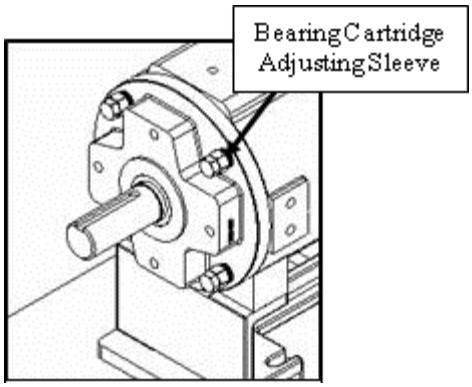
Note: This procedure requires fine adjustments to the pump assembly, and there is no need to hydraulically isolate the pump or drain the pump casing, but by not following this procedure correctly you may separate the rotating assembly of the pump from the pump casing and cause a spill.





Loosen the bolts holding the bearing housing support to the base. The motor adjusters will slide on the base and should not be loosened. Remove a motor stool cover so you can rotate the pump shaft by hand by turning the motor coupling. As you rotate, feel for any interference or bearing roughness. If bearing roughness is felt, adjustment should not be done as the pump will need a complete overhaul. Gap adjustment is accomplished by rotating the adjusting sleeves against either the back of the bearing housing or the back of the pump casing. The adjusting sleeves will change the clearance between the two parts being adjusted, and the clamp bolts will clamp the part tightly against the sleeve. In this discussion, "Clockwise" and "Counterclockwise" are referenced from the motor end of the pump.

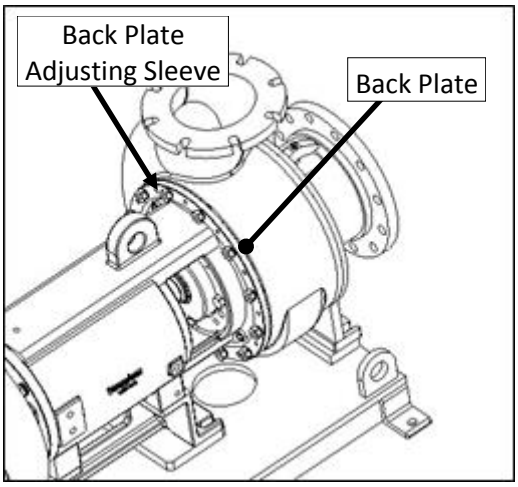
The first adjustment to make is the upper cutter adjustment. Loosen each of the four bearing cartridge adjusting sleeve clamp bolts by about 1/2 turn. Don't let the adjusting sleeves turn while loosening the clamp bolts. Rotate each of the adjustment sleeves exactly one flat clockwise, which will pull the impeller backward into the upper cutter, reducing the clearance by .010 inch. You may want to witness mark the starting position of each adjusting sleeve prior to doing this. It's important to turn each sleeve the same amount to keep the impeller parallel to the upper cutter. Retighten the clamp bolts and rotate the pump by hand to check for interference between the upper cutter and impeller.



Note: If you turn the adjustment sleeves far enough in the wrong direction you will also feel interference, but this will be the impeller rubbing the cutter bar. Make sure that you are turning the adjusting sleeves clock- wise during this operation.

Repeat this procedure until slight interference is felt, then back off the adjustment sleeves one flat exactly to obtain a proper running clearance of .010 inch. Tighten all clamp bolts securely, and move on to adjusting the impeller to cutter bar gap.

Next, adjust the impeller to cutter bar clearance with the back plate adjusting sleeves. Again, "clockwise" and "counterclockwise" are viewed from the motor end of the pump.



Loosen all clamp bolts about a turn or two.

Back all adjustment sleeves away from the casing except for three. Try to space these three evenly around the back plate at approximately 120° intervals.

Note: If you lose track of your adjustments, and suspect that you might be out of parallel, please see the calibration step at the end of this section.

Turn the three adjusting sleeves EVENLY one flat COUNTER clockwise, and then tighten the clamp bolts. This will pull the cutter bar backward into the impeller. Each flat of rotation will reduce the impeller to cutter bar gap by .012 inches. Check for interference by manually rotating the shaft. Repeat this procedure until you attain light contact between the impeller and cutter bar.

Once light contact is attained with the clamp bolts tight, loosen the clamp bolts again and turn the adjusters two points CLOCKWISE, then tighten the clamp bolts. This will give the proper operating clearance of .024 inch. Don't make the clearance tighter than this, because as the pump warms up the shaft will grow slightly and this clearance will shrink.

Snug all the unused adjustment sleeves onto the casing flange, and tighten their clamp bolts. Tighten the bearing housing support bolts.

CALIBRATION STEP:

If you lose track of parallelism, you can attain it again by using a piece of shim or key stock that is slightly thicker than the gap present between the casing and back plate. Using the stock as a feeler gauge, equalize the back plate to casing gap at each of the three adjusting sleeves. Once parallelism is restored, continue with the adjusting procedure.

VAUGHAN CARTRIDGE SEAL REPLACEMENT

VS1

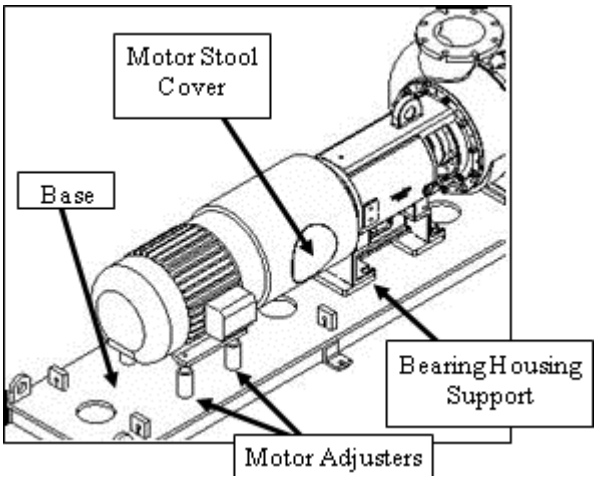
Before starting this procedure, make sure that the pump has been isolated both electrically and hydraulically via your plant-approved lock out/tag out procedures.
Drain as much of the pump casing as possible by opening the suction manifold drain. Follow all safety procedures in this manual and your plant.

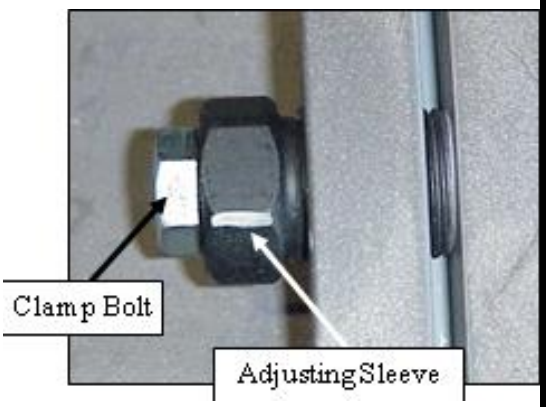
VS2

Witness mark the position of the back plate adjusting sleeves so that you can return them to their original position when reassembling the pump. While holding the adjusting sleeves stationary,remove all clamp bolts.

Unbolt the bearing housing support from the base.

The motor adjusters are designed to slide along the base **don't disturb the motor adjusters**.





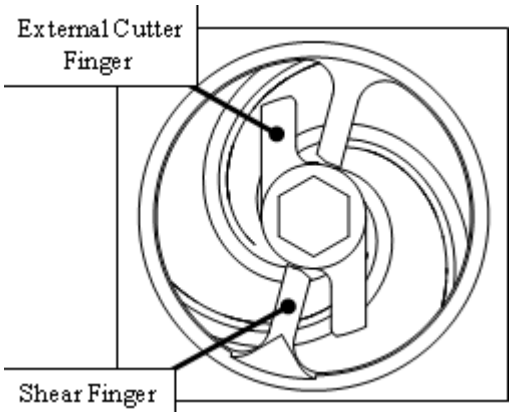
VS3

Attach a suitable lifting device to the motor and remove the motor stool cover. Loosen the pump-side coupling flange set screws and the bearing housing fasteners. Pull the motor and stool off the bearing housing. The motor adjusters are not bolted to the base and will slide—there is no need to loosen them.

VS4

Open the inspection cover in the suction manifold and check the position of the external cutter fingers in relation to the cutter bar shear fingers. Rotate the shaft at the back of the bearing housing to position the fingers as shown.

During the following step, you will be withdrawing the external cutter through the cutter bar, and if the fingers are overlapping, you may damage the components.



VS5

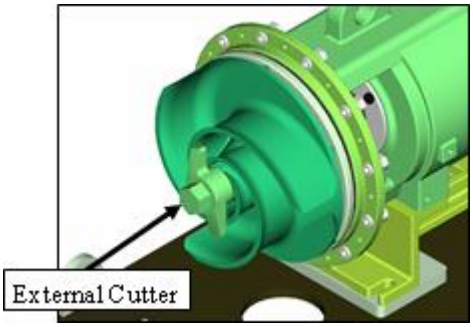
Support the pump assembly safely so it can move relative to the casing/piping. Pry it out of the casing with a pair of pry bars.

You will now be exposed to the sharp edges of the impeller and the possibly hazardous process fluid. Use caution.

VS6

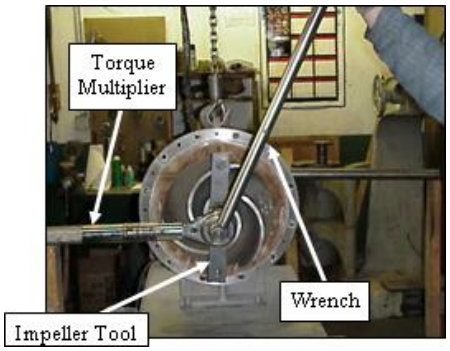
Remove the external cutter or cutter bolt, whichever is present (RH threads). This fastener was installed with 250 ft-lbs of torque so use the shaft turning tool, Vaughan Part # V3500-134, to hold the shaft at the rear of the bearing housing.

Don't get cut on the impeller

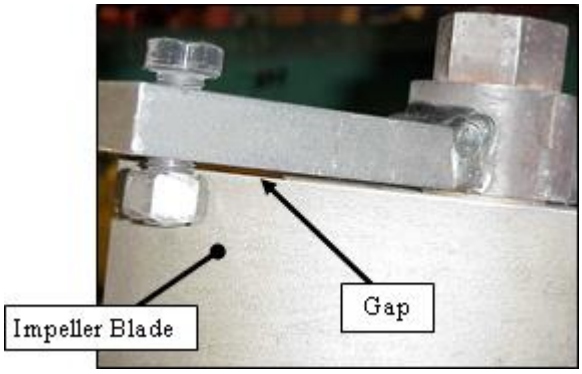


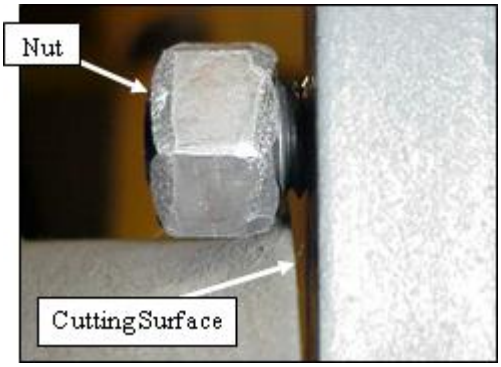
VS7

Remove the impeller (RH thread) from the pump shaft. Use the Impeller Tool, Vaughan Part # V109-525. The impeller was installed with a torque of 1000 ft-lbs, so use a torque multiplier. The photograph shows a torque multiplier being used to install the impeller. For impeller removal, the position of the torque multiplier and the wrench would be reversed, and the impeller tool would be rotated to bear against the non-cutting side of the impeller blade.



Note: The only practicable way of locking the shaft while removing the hub is to attach the Shaft Turning Tool, Vaughan Part # V3500-134, to the shaft extending from the rear of the bearing housing.

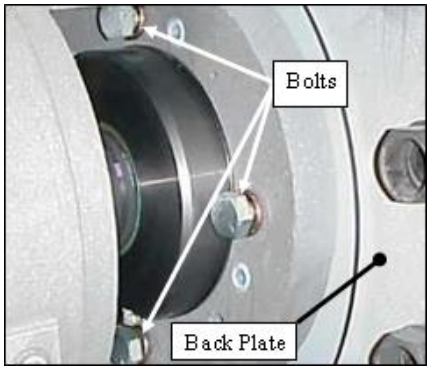




When installing the impeller tool, leave a gap between the tool arm and the front of the impeller. Then install one of the arm bolts and a hex nut. Adjust the nut so that it impinges below the cutting surface of the blade. Allowing the hex nut to touch the cutting edge of the impeller may damage it.

VS8

Attach a suitable lifting device to support the back plate. Re- move the four hex head bolts holding the back plate to the bearing housing. These fasteners are threaded into the upper cutter, and when removed, the upper cutter will only be held in place by the friction of its o-ring. Although not likely, the upper cutter may fall out during this procedure.

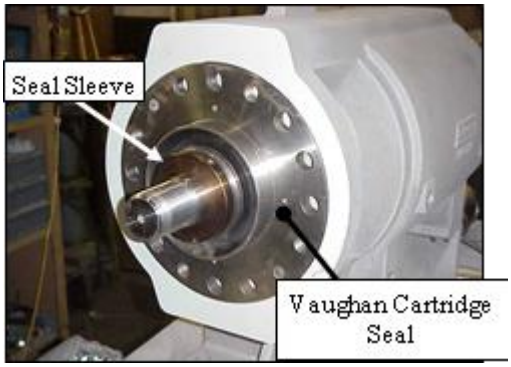


Carefully slide the back plate off the front of the bearing housing without damaging the shaft. You may have to tap it with a mallet or dead blow hammer.

VS9

The seal cartridge is now exposed.

Note: Do not loosen the seal sleeve set screws without first installing the cartridge seal cap (Vaughan Part #V108-854). To do so will release 50 lb of spring force which will cause rapid, spontaneous disassembly of the seal. Reassembly requires special tooling. If you want to reuse the seal, you will have to install the cartridge seal cap before loosening the set screws.

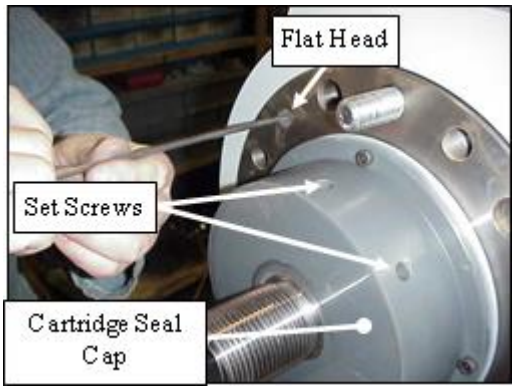


A cartridge seal cap was supplied with your pump. If another one is required, it can be ordered from Vaughan.

VS10

Install the cartridge seal cap. Before fully tightening the socket head screws that hold the cap to the seal, rotate the shaft until the seal sleeve set screws line up with the holes in the cap.

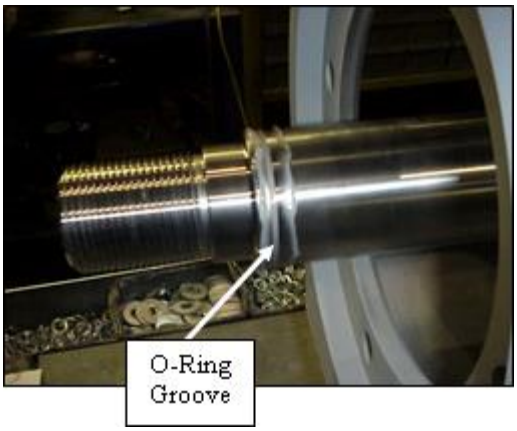
Loosen the seal sleeve set screws. Remove the two flat socket head cap screws holding the cartridge to the bearing housing. Slide the seal off the shaft.



VS11

Installation of the cartridge seal is the reverse of disassembly. Before installation, clean the shaft and bearing housing and lubricate the shaft with an anti-seize compound.

Before reassembly, ensure that the O-ring is located correctly inside the seal sleeve O-ring groove. Don't place the O-ring in the shaft groove. Fill the O-ring groove on the shaft with grease to help protect the sleeve O-ring.

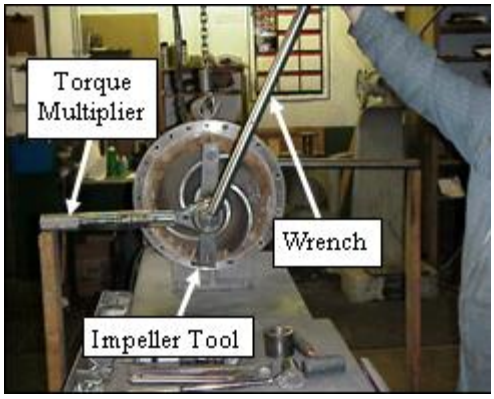


VS12

Slide the cartridge into the bearing housing and bolt it in place with the two flat head screws. Rotate the shaft until the shaft keyway is 180° opposite the center set screw. Tighten all three set screws. Remove the cartridge cap.

VS13

Install back plate and upper cutter (if it separated during the seal replacement procedure). Slide the impeller/shaft o-ring down the shaft until it contacts the seal sleeve. Install and torque the impeller to 1000 ft-lbs. Use a torque multiplier, Impeller tool (Vaughan Part # V109-525) and Shaft Turning Tool (Vaughan Part # V3500-134), to do this.



Grease the back plate O-ring and make sure that it is not nicked or twisted.

Lubricate the external cutter/cutter bolt threads with anti-seize lubricant. Install the external cutter shims and O-ring (the cutter bolt has no shims). Torque the external cutter/cutter bolt to 250 ft-lbs. Align the external cutter fingers per step VS4.

The rotating assembly will be difficult to press back into the casing because of the O-ring. To ease reassembly, loosen the four socket head fasteners holding the wear plate to the back plate. This will allow the back plate O-ring to contract inward. The impeller will keep the wear plate from going too far and pinching the O-ring.

After sliding the rotating assembly into the casing, retighten the four fasteners to reseat the O-ring.

Before installing the clamp bolts, check the witness marks on the adjusting sleeves and ensure they are in their initial orientation.

Reinstall motor stool and motor.

Reinstall the suction manifold inspection cover and replace the manifold drain plug. Use thread sealant on the drain plug threads.

Once the pump is reassembled, adjust the cutter gap with the adjustment procedure at the front of this manual.

WATER FLUSHED SEAL REPLACEMENT

WF1

Before starting this procedure, make sure that the pump has been isolated both electrically and hydraulically via your plant-approved lock out/tag out procedures.

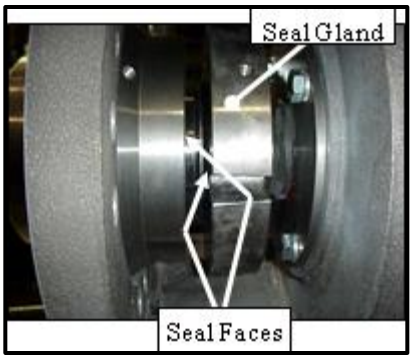
Drain as much of the pump casing as possible by opening the suction manifold drain.

Turn off the seal water flush.

Follow all safety procedures in this manual and your plant

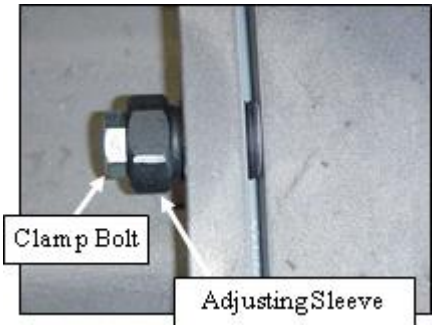
WF2

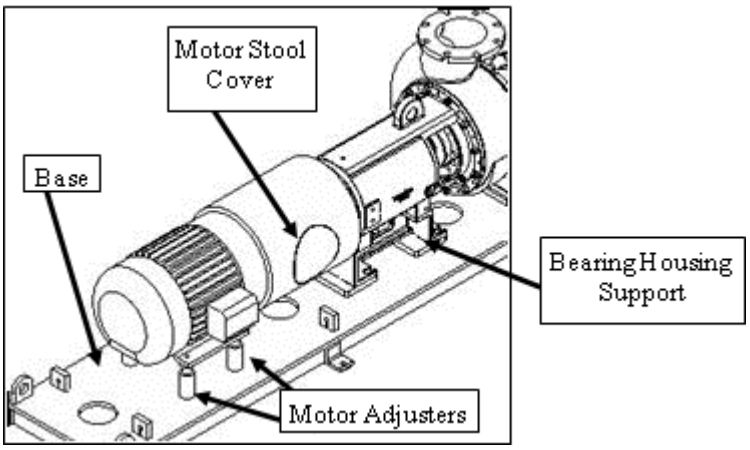
Before replacing the seal, clean the seal faces with oven cleaner on a Q-tip, followed by rubbing alcohol. To do this, unbolt the seal gland and pull it rearward to separate the faces. Add some clean oil to the faces and reassemble the seal gland. Add 1 oz (28cc) of bearing oil to the seal gland. If leakage occurs try repeating this procedure. If the seal continues to leak, it will have to be replaced.



WF3

Disconnect the seal water piping. Witness mark the position of the back plate adjusting sleeves so that you can return them to their original position when reassembling the pump. While holding the adjusting sleeves stationary, remove all clamp bolts.





Unbolt the bearing housing support from the base. The motor adjusters are designed to slide along the base— **don't disturb the motor adjusters**.

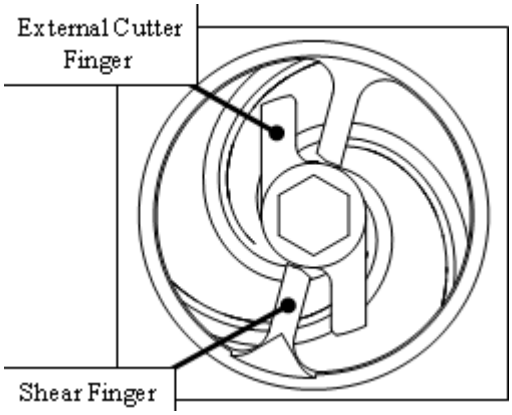
WF4

Attach suitable lifting device to the motor and remove the motor stool cover. Loosen the pump-side coupling flange set screws and the bearing housing fasteners. Pull the motor and stool off the bearing housing. The motor adjusters are not bolted to the base and will slide—there is no need to loosen them.

WF5

Open the inspection cover in the suction manifold and check the position of the external cutter fingers in relation to the cutter bar shear fingers. Rotate the shaft at the back of the bearing housing to position the fingers as shown.

During the following step, you will be withdrawing the external cutter through the cutter bar, and if the fingers are overlapping, you may damage the components.



WF6

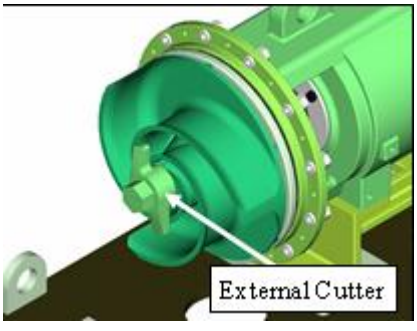
Support the pump assembly safely so it can move relative to the casing/piping. Pry it out of the casing with a pair of pry bars.

The sharp edges of the impeller are now exposed and they may be contaminated with hazardous process fluid. Use caution.

WF7

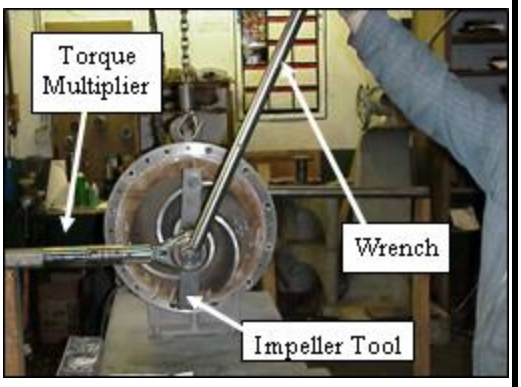
Remove the external cutter or cutter bolt, whichever is present (RH threads). This fastener was installed with 250 ft-lbs of torque so use the shaft turning tool, Vaughan Part # V3500-134, to hold the shaft at the rear of the bearing housing.

Don't get cut on the impeller

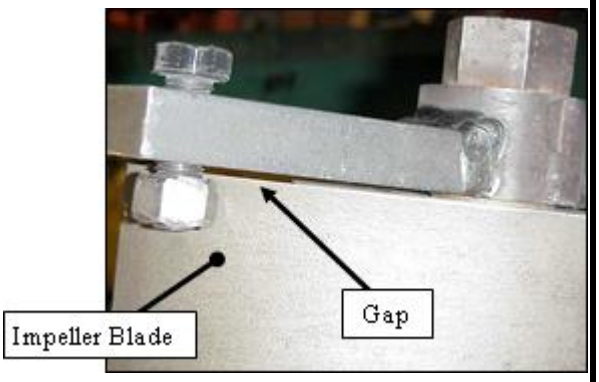


WF8

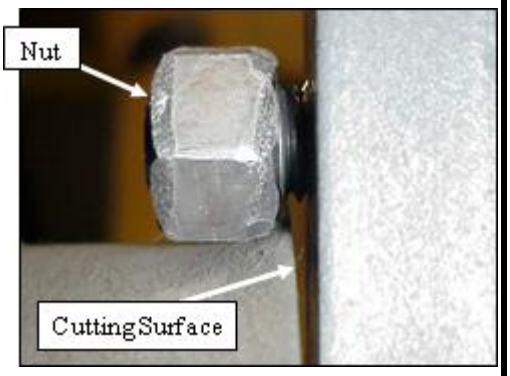
Remove the impeller (RH thread) from the pump shaft. Use the Impeller Tool, Vaughan Part # V109-525. The impeller was installed with a torque of 1000 ft-lbs, so use a torque multiplier. The photograph shows a torque multiplier being used to install the impeller. For impeller removal, the position of the torque multiplier and the wrench would be reversed, and the impeller tool would be rotated to bear against the non-cutting side of the impeller blade.



Note: The only practicable way of locking the shaft while removing the hub is to attach the Shaft Turning Tool, Vaughan Part # V3500-134, to the shaft extending from the rear of the bearing housing

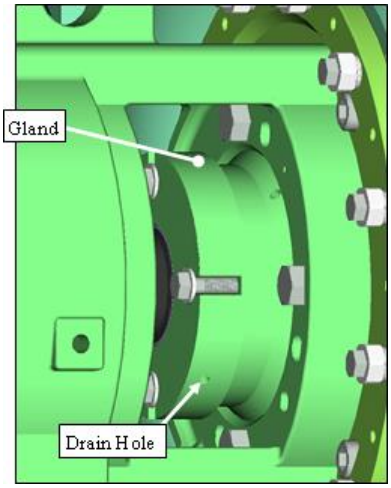


When installing the impeller tool, leave a gap between the tool arm and the front of the impeller. Then install one of the arm bolts and a hex nut. Adjust the nut so that it impinges below the cutting surface of the blade. Allowing the hex nut to touch the cutting edge of the impeller may damage it.



WF9

Drain the seal oil chamber by removing the two 1/16 NPT plugs, one on each side of the gland.

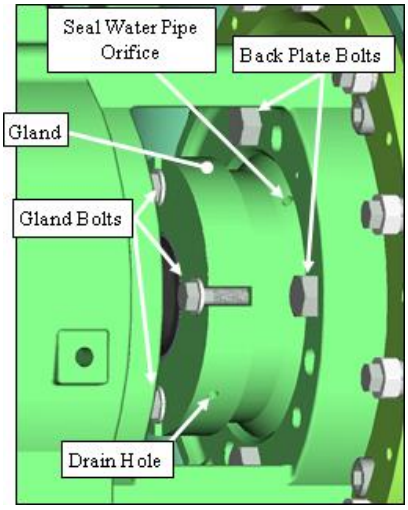


WF10

Remove the seal water pipe. Remove the four bolts holding the seal gland to the stuffing box. Slide the seal gland back to prevent damage.

Attach a suitable lifting device to support the back plate. Remove the four hex head bolts holding the back plate to the bearing housing. These fasteners are threaded into the upper cutter, and when removed, the upper cutter will only be held in place by the friction of its O-ring. Although not likely, the upper cutter may fall out during this procedure.

Carefully slide the back plate off the front of the bearing housing without damaging the shaft. You may have to tap it with a mallet or dead blow hammer



WF11

Loosen the two flat head screws holding the stuffing box to the bearing housing, then slide the stuffing box off the shaft.

Loosen the three set screws holding the seal bellows to the shaft. Slide the bellows off the shaft.

Carefully slide the seal gland through the front of the bearing housing and off the shaft.

If required, remove the seal sleeve. It is held on with an O-ring.

WF12

Pry out the stationary mechanical seal face from the seal gland.

Remove the lip seal from the back side of the gland and thoroughly clean the gland.

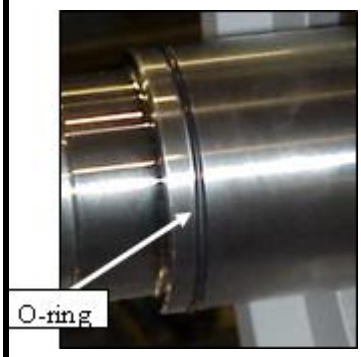
Note: Some seal face materials are brittle and may shatter or spall during removal

WF13

Lubricate new lip seal and seal o-ring with oil. Apply Loctite 222 to the lip seal OD, and then install the new lip seal with the spring side facing into the back side of the gland. Turn the gland over and install the new stationary seal.

Note: Use a plastic tool between the arbor ram and the seal for pressing the seal face into the gland. Make sure that the tool is clean—any grit imbedded in the plastic can damage the seal face. The seal face is brittle and may be chipped or cracked if care is not taken. Ensure that the seal face is not cocked when pressing into the gland

WF14



Install the O-ring in the groove near the end of the shaft. Lubricate the shaft and the outside of the seal sleeve and run the sleeve down the shaft and into the cartridge cap lip seal. Be careful when doing this as it is easy to damage the O-ring.

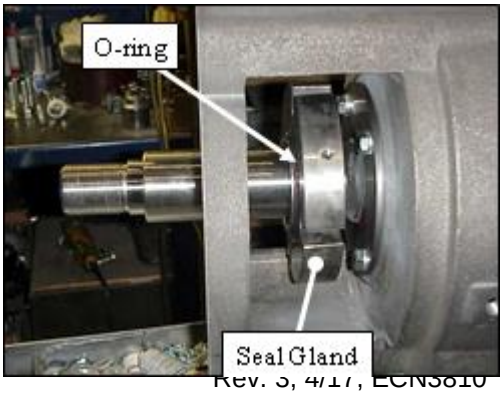
WF15 Water flushed seals and packing

Install two slingers over the seal sleeve (one is required for a pump with packing). Run them against the bearing cap lip seal. The slingers go on with the sealing lips facing away from each other (bevels together). Grease the sealing lips.

The first slinger will remain against the bearing housing lip seal and the second will be moved forward to protect the seal gland lip seal when it is installed. On pumps with packing, the slinger protects the bearing housing lip seal

WF16

Install and lubricate a new seal gland o-ring and slide the seal gland onto the pump shaft and into the bearing housing.



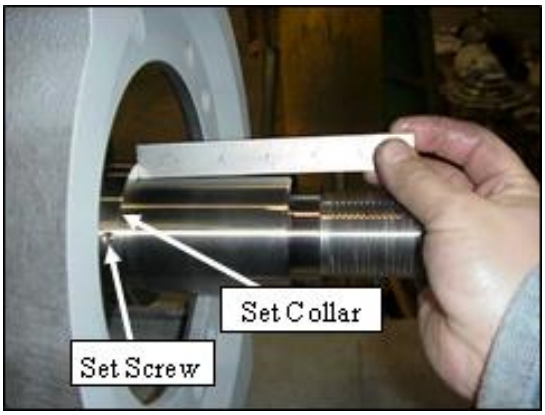
WF17

Lubricate the internal rotating member o-ring with oil, and clean both stationary and rotating seal faces with a lint free cloth. Lubricate the seal faces before sliding the rotating member onto shaft.

Don't damage the internal o-ring while installing rotating member.

WF18

Position the edge of the seal set collar 3 7/16 inch from the end of the seal sleeve and tighten the set screws carefully in two steps, starting from the center screw



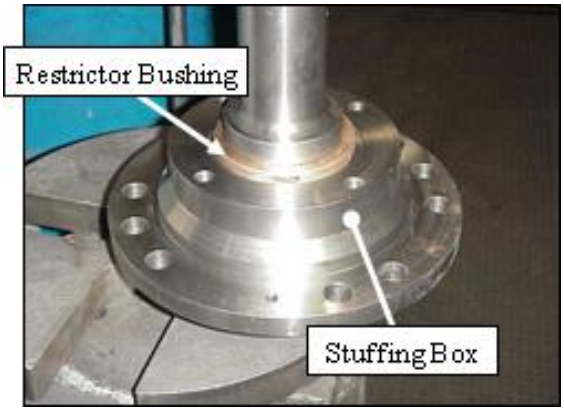
WF19

Check the restrictor bushing for wear. If it is worn, replace it.

It is locked into position with two set screws, which must first be removed.

Remove the bushing from the center of the stuffing box with a press or punch, and press in the new one. The smaller outside diameter goes in first.

Replace and tighten the set screws



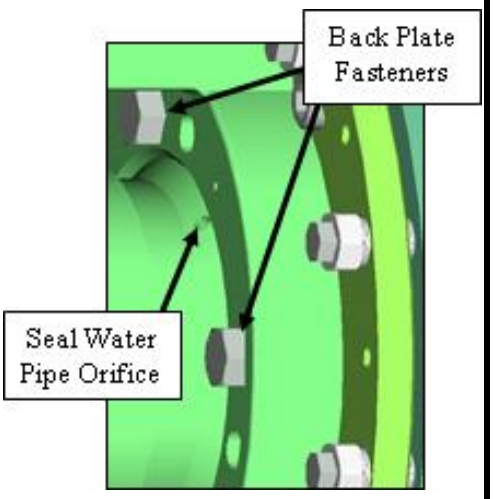
WF20

Grease the inside of the restrictor bushing.

Carefully install the stuffing box onto the shaft and bearing housing. Attach it to the front of the bearing housing with two countersunk flat head screws. Be careful not to scrape the restrictor bushing on the shaft.

Replace the back plate. Bolt the back plate into place with its four fasteners.

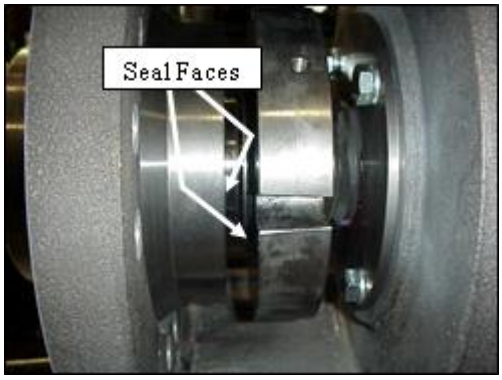
Replace the seal water pipe



WF21

Clean the faces of the mechanical seal again with a lint free cloth, oil them with clean bearing oil, and bolt the seal gland to the stuffing box.

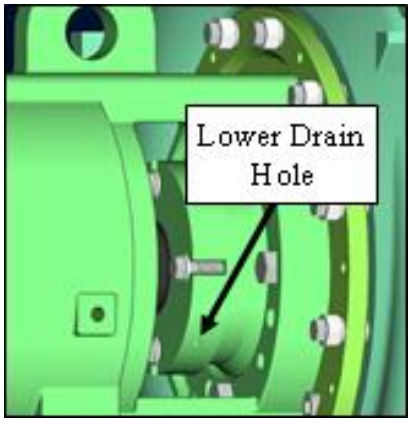
If the seal is installed correctly, the bellows will be compressed approximately 1/4 inch when tightening the gland bolts. Tighten the bolts evenly to make sure the gland goes on without cocking and binding the stationary member.



WF22

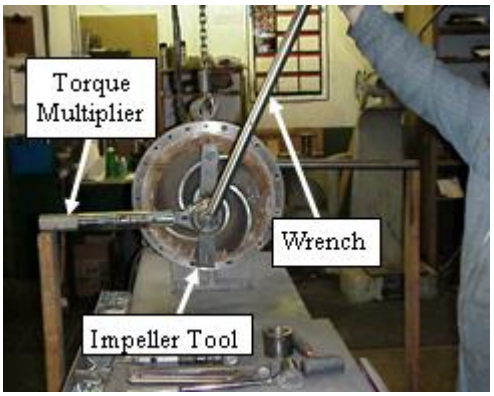
Coat the lower drain plug with thread sealant and replace. Add 1 oz. (28 cc) of bearing oil through the top drain hole. Using a syringe and a section of small diameter tubing will make this step easier.

Coat the upper drain plug with thread sealant and replace



WF23

Install back plate and upper cutter (if it separated during the seal replacement procedure). Slide the impeller/shaft O-ring down the shaft until it contacts the seal sleeve. Install and torque the impeller to 1000 ft-lbs. Use a torque multiplier, Impeller tool (Vaughan Part # V109-525) and Shaft Turning Tool (Vaughan Part # V3500-134), to do this.



Grease the back plate O-ring and make sure that it is not nicked or twisted.

Lubricate the external cutter/cutter bolt threads with anti-seize lubricant. Install the external cutter shims and o-ring (the cutter bolt has no shims). Torque the external cutter/cutter bolt to 250 ft-lbs. Align the external cutter fingers per step WF5.

The rotating assembly will be difficult to press back into the casing because of the O-ring. To ease reassembly, loosen the four socket head fasteners holding the wear plate to the back plate. This will allow the back plate O-ring to contract inward. The impeller will keep the wear plate from going too far and pinching the O-ring.

After sliding the rotating assembly into the casing, retighten the four fasteners to reseat the O-ring.

Before installing the clamp bolts, check the witness marks on the adjusting sleeves and ensure they are in their initial orientation.

Reinstall motor stool and motor.

Reinstall the suction manifold inspection cover and replace the manifold drain plug. Use thread sealant on the drain plug threads.

PACKING REPLACEMENT

P1

Before starting this procedure, make sure that the pump has been isolated both electrically and hydraulically via your plant-approved lock out/tag out procedures.

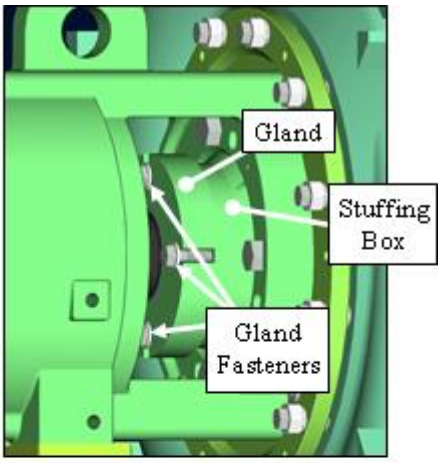
Drain as much of the pump casing as possible by opening the suction manifold drain.

Turn off the water flush.

Follow all safety procedures listed in this manual and your plant

P2

Perform this procedure if you are replacing the packing and don't need to replace the packing sleeve.

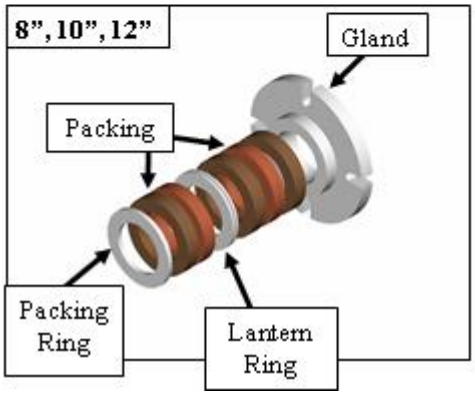


Remove the packing gland fasteners and slide the gland from the stuffing box. The gland is split in half, so separate and remove it from the shaft. Use a suitable tool to pick out the old packing and lantern ring. The lantern ring is split also. While removing the packing, don't damage the packing sleeve.

Leave the packing ring in the stuffing box, as it is not split and cannot be removed without pump disassembly.

Place new packing into the stuffing box as shown in the illustration.

Align the packing so that each seam is offset from the adjoining piece(s). Recommended placement of the seams is 12:00 (first piece), 6:00 (second piece), 3:00 (third piece), 9:00 (fourth piece), and 12:00 (last piece).



Note: Install the packing as follows—two pieces of packing, the lantern ring, then three pieces of packing.

Reassemble the gland on the shaft and bolt in place.

The packing can be replaced with this method, but not the shaft sleeve or the packing ring.

P3

Turn the seal water system back on and have an electrician reconnect the motor wires.

Replace the suction manifold drain plug. Use sealant on the threads.

Start up the pump and water flush system and adjust the packing gland fasteners to achieve 6 to 10 drips of leakage per minute out of the packing gland

OVERHAUL INSTRUCTIONS: DISASSEMBLY

D1

Before starting this procedure, make sure that the pump has been isolated both electrically and hydraulically via your plant-approved lock out/tag out procedures

Drain as much of the pump casing as possible by opening the suction manifold drain.

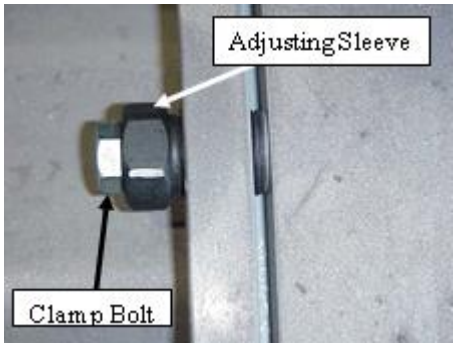
Disconnect the seal water piping if present.

Follow all safety procedures listed in this manual and your plant

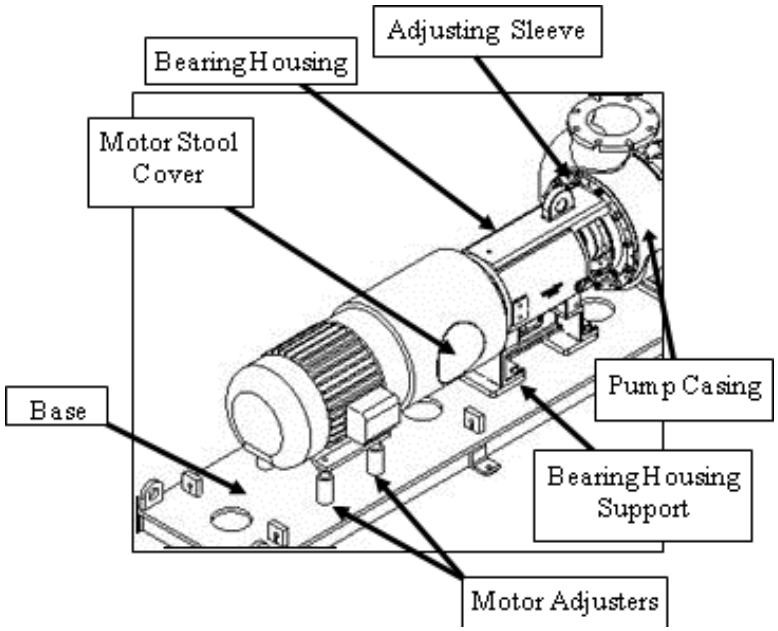
D2

Attach a suitable lifting device to the motor. Remove the motor stool cover. Loosen the pump-side coupling flange set screws and the bearing housing fasteners. Pull the motor and stool off the bearing housing. The motor adjusters are not bolted to the base and will slide—there is no need to loosen them.

D3



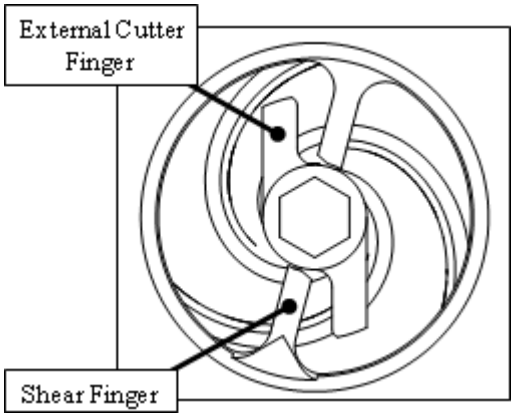
Remove the four bolts holding the bearing housing support to the base, and remove all of the clamp bolts holding the back plate adjusting sleeves tight.



D4

Open the inspection cover in the suction manifold and check the position of the external cutter fingers in relation to the cutter bar shear fingers. Rotate the shaft at the back of the bearing housing to position the fingers as shown.

During the following step, you will be withdrawing the external cutter through the cutter bar, and if the fingers are overlapping, you may damage the components.



D5

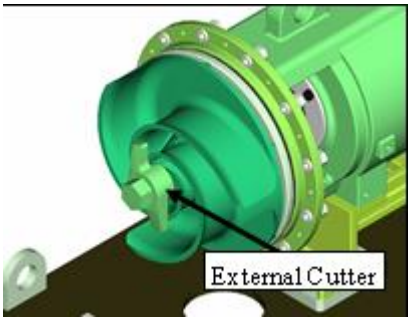
Support the pump/motor assembly safely so it can move relative to the casing/piping. Pry it out of the casing with a pair of pry bars.

You will now be exposed to the sharp edges of the impeller and the possibly hazardous process fluid. Use caution.

D6

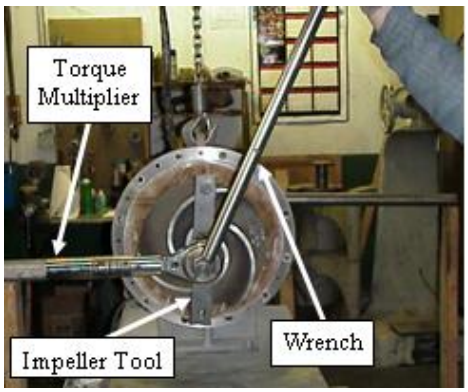
Remove the external cutter or cutter bolt, whichever is present (RH threads). This fastener was installed with 250 ft-lbs of torque so use the shaft turning tool, Vaughan Part # V3500-134, to hold the shaft at the rear of the bearing housing.

Don't get cut on the impeller!

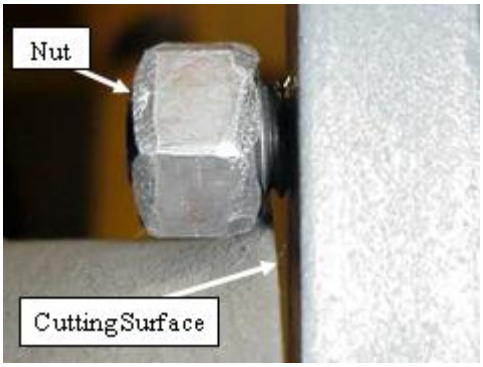


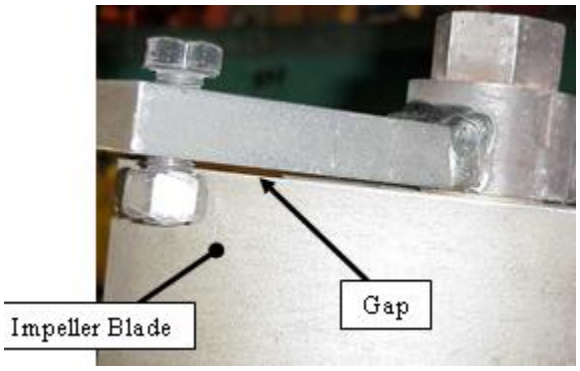
D7

Remove the impeller (RH thread) from the pump shaft. Use the Impeller Tool, Vaughan Part # V109-525. The impeller was installed with a torque of 1000 ft-lbs, so use a torque multiplier. The photograph shows a torque multiplier being used to install the impeller. For impeller removal, the position of the torque multiplier and the wrench would be reversed, and the impeller tool would be rotated to bear against the non-cutting side of the impeller blade.



Note: The only practicable way of locking the shaft while removing the hub is to attach the Shaft Turning Tool, Vaughan Part # V3500-134, to the shaft extending from the rear of the bearing housing.





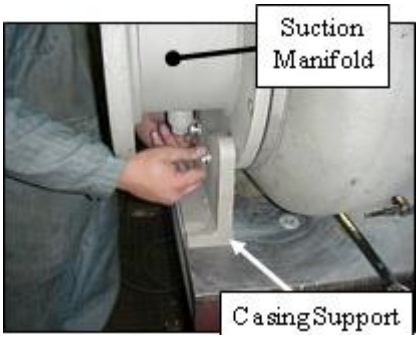
When installing the impeller tool, leave a gap between the tool arm and the front of the impeller. Then install one of the arm bolts and a hex nut. Adjust the nut so that it impinges below the cutting surface of the blade. Allowing the hex nut to touch the cutting edge of the impeller may damage it.

D8

Unbolt the suction manifold from the process piping.

Unfasten the casing support from the pump base (8” and 10” pumps only).

Remove the suction manifold from the pump casing.



D9

For 8” and 10” pumps, pry the assembled cutter bar plate and cutter bar out of the pump casing. Installing assembly pins into the pump case will prevent the assembly from falling when it comes loose. Insert a suitable tool from the side as shown.

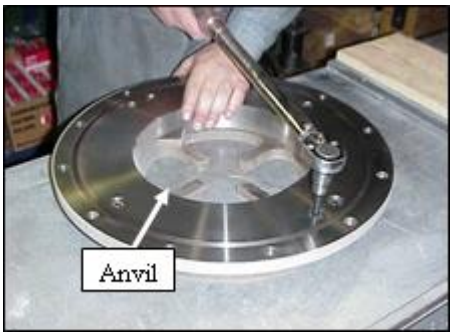
For 12” pumps, the assembled suction plate and cutter bar are inset into the pump case and have to be pried from inside the suction opening.

Note: During this step you will be exposed to sharp and possibly contaminated cutting edges

D10

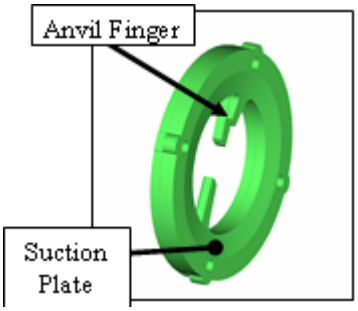
8" and 10" pumps

Check the cutter bar shear fingers and the anvil for damage. If any of these parts needs to be replaced, remove the fasteners holding the cutter bar plate and cutter bar together and separate the assembly. The anvil is a separate piece.



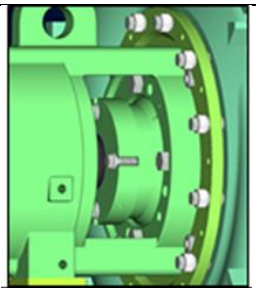
12" pumps

Check the cutter bar shear fingers and the anvil finger for damage. The anvil is integral with the suction plate. If replacement is required, separate the two pieces after removing the fasteners.



D11

If your seal looks like this you have a Vaughan Cartridge seal. Proceed with the step D12

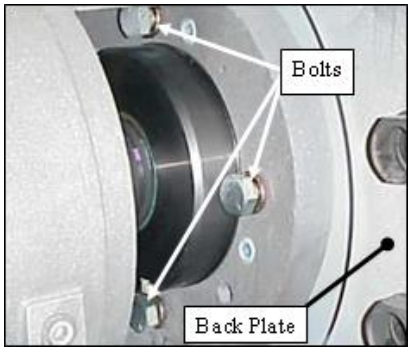


If your seal looks like this, you either have a water flushed metal bellows seal, or you have a sleeve and packing. Skip to step D15.

D12

Attach a suitable lifting device to support the back plate. Remove the four hex head bolts holding the back plate to the bearing housing. These fasteners are threaded into the upper cutter, and when removed, the upper cutter will only be held in place by the friction of its O-ring. Although not likely, the upper cutter may fall out during this procedure.

Carefully slide the back plate off the front of the bearing housing without damaging the shaft. You may have to tap it with a mallet or dead blow hammer.



D13

Vaughan Cartridge Seal

The seal cartridge is now exposed.

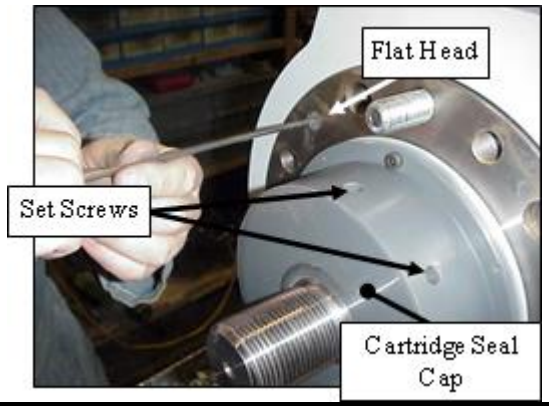
Note: Do not loosen the seal sleeve set screws without first installing the cartridge seal cap (Vaughan Part #V108-854). To do so will release 50 lb of spring force which will cause rapid, spontaneous disassembly of the seal. Reassembly requires special tooling. If you want to reuse the seal, you will have to install the cartridge seal cap before loosening the set screws.

A cartridge seal cap was supplied with your pump. If another one is required, it can be ordered from Vaughan.

D14

Vaughan Cartridge Seal

Install the cartridge seal cap. Before fully tightening the socket head screws that hold the cap to the seal, rotate the shaft until the seal sleeve set screws line up with the holes in the cap.



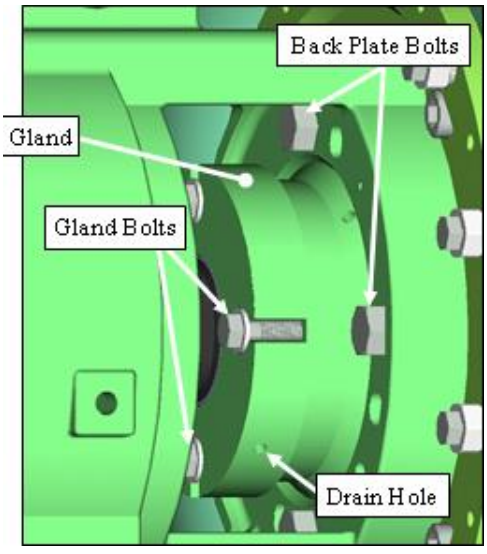
Loosen the seal sleeve set screws. Remove the two flat socket head cap screws holding the cartridge to the bearing housing. Slide the seal off the shaft.

Skip to step D18

D15

Water flushed bellows and packing

Drain the seal oil chamber by removing the two NPT plugs, one on each side of the gland. Remove the four bolts holding the seal or stuffing gland to the stuffing box. Slide the seal gland back to prevent damage. Split and remove the stuffing gland.



Attach a suitable lifting device to support the back plate. Remove the four hex head bolts holding the back plate to the bearing housing. These fasteners are threaded into the upper cutter, and when removed, the upper cutter will only be held in place by the friction of its O-ring. Although not likely, the upper cutter may fall out during this procedure.

Carefully slide the back plate off the front of the bearing housing without damaging the shaft. You may have to tap it with a mallet or dead blow hammer.

The wear plate and back plate are separate pieces that are bolted together. If the wear plate needs to be replaced, unbolt it from the back plate at this time. Remove the upper cutter also.

Pick out the packing, lantern ring, and packing ring if applicable

D16

Water flushed bellows and packing

Loosen the two flat head screws holding the stuffing box to the bearing housing, then slide the stuffing box off the shaft.

For water flushed seals, loosen the three set screws holding the seal bellows to the shaft. Slide the bellows off the shaft.

Carefully slide the seal gland through the front of the bearing housing and off of the shaft.

If required, remove the seal sleeve. It is held on with an o-ring

D17

Water flushed bellows seals

Pry out the stationary mechanical seal face from the seal gland.

Remove the lip seal from the back side of the gland and thoroughly clean the gland.

Note: The seal face is brittle and may shatter or spall during removal.

D18

All seal types

Remove the drain plug from the bearing housing and drain the lubricant.

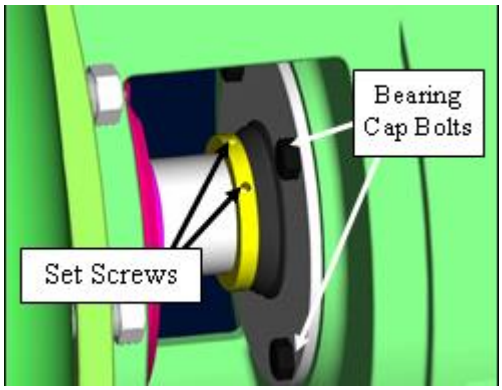
D19

Vaughan cartridge seal

Remove the three set screws from the bearing housing lip seal sleeve and slide the sleeve off the shaft.

All seal types

Remove the bearing cap bolts at the front of the bearing housing. Slide the bearing cap off the end of the shaft



D20

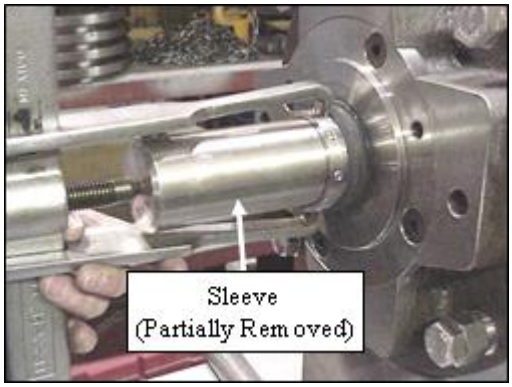
Remove the two rubber slingers that protect the lip seals on either end of the bearing housing.

Remove the four clamp bolts from the thrust bearing cartridge adjusting sleeves. Leave the adjusting sleeves in place. Remove the thrust bearing cartridge and the shaft. You may have to press the shaft assembly out or tap with a soft-face hammer carefully on the impeller end of the shaft. Don't damage the shaft threads.

Note: The shaft is heavy and will require a hoist. This photograph shows a version of the lifting fixture, Vaughan Part # V109-529, which has been temporarily fastened to the thrust bearing cartridge. Use of this tool allows the shaft to balance while being removed from the bearing housing

D21

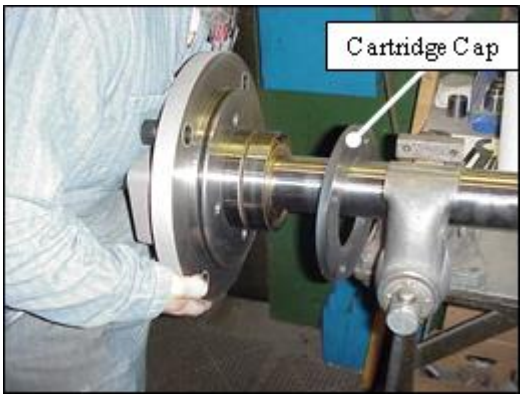
Use a soft-jawed vise to hold the shaft securely.



There is a sleeve locked on the shaft that must be removed before the thrust bearings can be removed. Remove the three set screws and the sleeve will slide off. Use a puller on the flange if necessary

D22

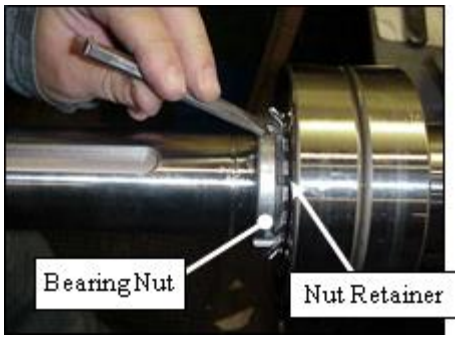
Unbolt the thrust bearing cartridge cap and slide the thrust bearing cartridge off the end of the shaft.



D23

On the thrust bearing end of the shaft, there is a bearing nut retainer. Lift the retainer tab and remove the bearing nut.

To remove the bearings, use a press or puller



D24

Press or pull off the radial bearing on the impeller end of the shaft

D25

Inspect all parts and evaluate for replacement. When ordering parts for repair, don't forget lip seals, gaskets, o-rings, damaged sleeves, and all worn parts.

OVERHAUL INSTRUCTIONS: ASSEMBLY

A1

Prepare to install the bearings onto the shaft by cleaning the shaft and bearing ID's with safety solvent. Coat the press fit areas of the shaft with press fit lubricant

A2

Install the thrust bearings (with race numbers facing each other) onto the end of the shaft that is threaded for the bearing nut.

Ensure that you are installing the thrust bearings and not the radial bearing.

Vaughan Part # V801-729 (2 required)

Press on the inner race so as not to stress the bearings. Seat the bearings fully against the shaft shoulder.

A3

Slide the thrust bearing cartridge cap onto the shaft, and press the radial bearing(s) over the impeller end of the shaft.

Again, press on the inner race with a suitable driver until the bearings seat against the shaft shoulder.

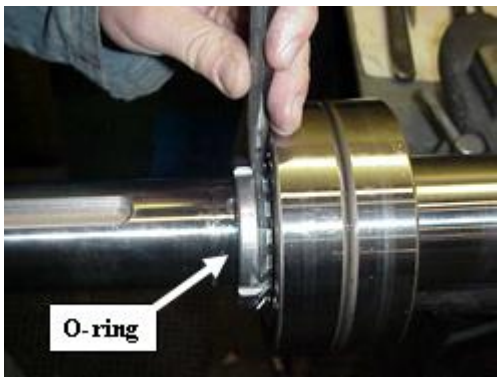
Vaughan Part # V801-783 (1 required

A4

Install the bearing nut retainer and nut to the thrust bearing end of the shaft.

After tightening the nut, bend one tab down into a nut recess to lock it in place.

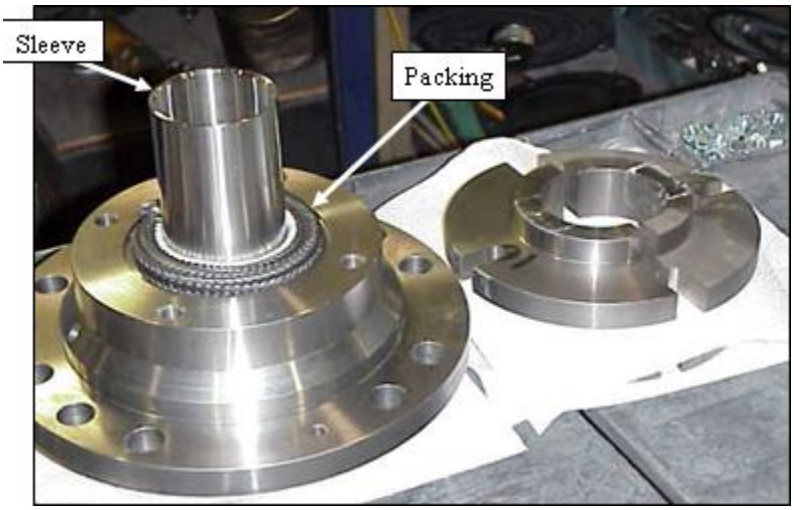
Install O-ring in the groove on the shaft, for sleeve to be installed later (A12).



A5

Pumps with packing

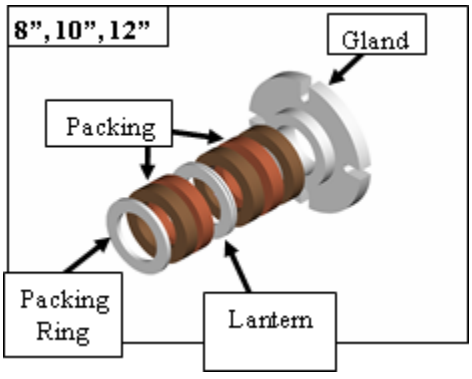
Press the packing ring into the bottom of the stuffing box. Place the shaft sleeve into the stuffing box and press the packing rings and lantern ring between the sleeve and the side of the stuffing box as shown in the illustration.



Align the packing so that each seam is offset from the adjoining piece(s). Recommended placement of the seams is 12:00 (first piece), 6:00 (second piece), 3:00 (third piece), 9:00 (fourth piece), and 12:00 (last piece).

Note: Install the packing as follows—the packing ring, two pieces of packing, the lantern ring, then three pieces of packing.

Remove the packing sleeve from the stuffing box.



A6

All Seal Types

Press a new lip seal into the thrust bearing cartridge, spring side down. Apply Loctite 222 to the OD of the seal before installation.

A7

All Seal Types

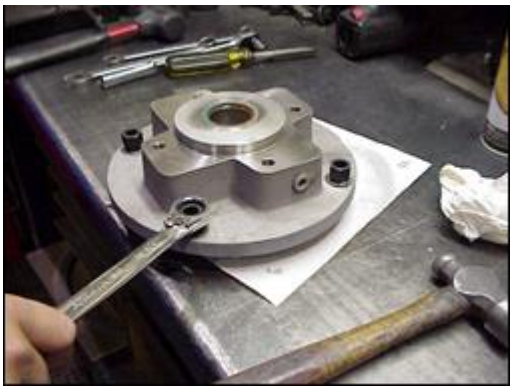
Place O-ring around the back of the thrust bearing cartridge

A8

All Seal Types

Remove thrust bearing cartridge adjusting sleeves and lubricate them with anti-seize compound.

Re-install the sleeves and set them so that they extend 0.010 inches out of the machined side of the thrust bearing cartridge.



A9

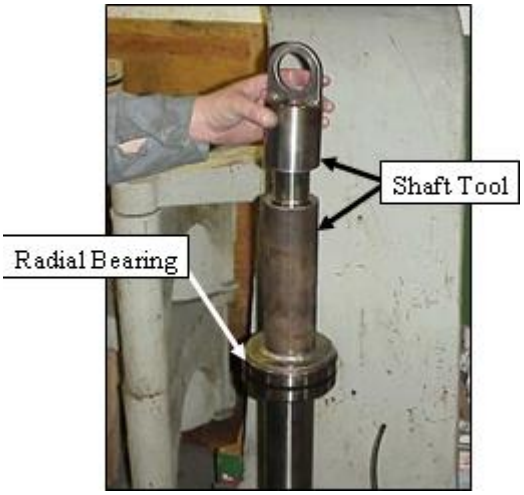
All Seal Types

The radial bearing on the large pumps is a spherical roller bearing, and requires that the outer race be fixed in place in order for the shaft to be assembled into the bearing housing.

If the outer race slews, as shown in the photograph at right, the shaft cannot be installed in the bearing housing.

To ensure the correct alignment of the outer race, use the Shaft Assembly Tool, Vaughan Part # V109-469.

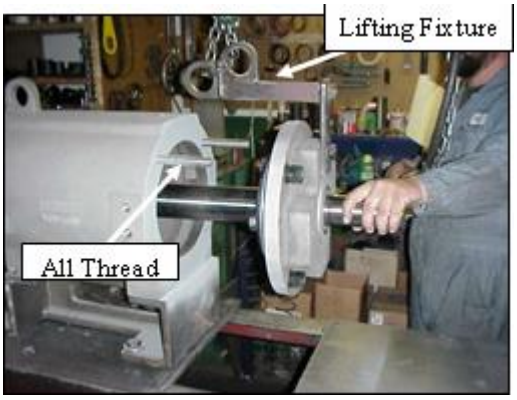
Lower the shaft into the thrust bearing cartridge as shown below. The shaft is heavy and should be lifted with a hoist. Use Loctite 242 thread locker on the cartridge cap fastener threads before installing and tightening.



A10

All Seal Types

Thread two short pieces of 3/4”-10 all thread into the bearing housing, to act as assembly guides. Lift the assembled shaft/thrust bearing cartridge with a suitable hoist. This photograph shows a version of the lifting fixture, Vaughan Part # V109-529, which has been temporarily fastened to the thrust bearing cartridge. Use of this tool allows the shaft to balance while being removed from the bearing housing.



Slide the shaft forward until the radial bearing slips into its housing.

A11

All Seal Types

The all thread can be used, with nuts and washers, to pull the thrust bearing cartridge fully into the bearing housing. Alternately, you can use pipe clamps as shown in the second photograph.

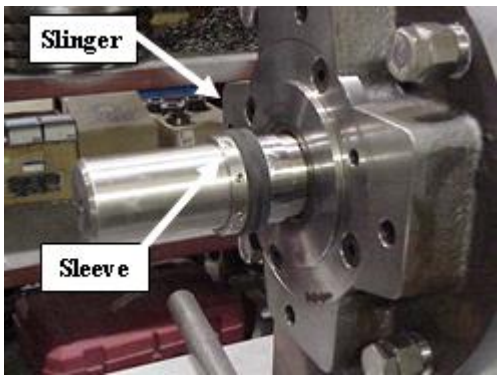
Install the clamp bolts for the thrust bearing cartridge adjusting sleeves and check the thrust bearing cartridge to bearing housing gap with a feeler gauge. If it is not 0.040" all around, loosen the clamp bolts and readjust with the adjusting sleeves. Once the proper gap is attained, remove the clamp bolts and reinstall with Loctite 242.

Refer to 'Horizontal Pumps, HE Series, Installation, Operation and, Maintenance Instructions, Section 8A: Maintenance-Annually', for details on Impeller-Upper Cutter adjustments.

A12

To install the thrust bearing cartridge lip seal sleeve, slide the slinger onto the sleeve and slide the sleeve (small end) against the bearing nut. Tighten the three set screws.

Be careful not to damage the sleeve or O-ring during installation.



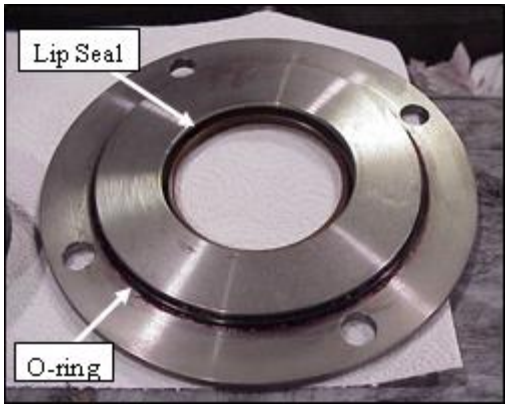
A13

All Seal Types

Remove the tooling used to install the shaft in step A10. Install the lip seal into the bearing cap, so that the spring faces the interior of the bearing housing. Apply Loctite 222 to the OD of the seal and grease the lips before installation. Install the O-ring on the shoulder at the back of the bearing cap and grease.

Slide the bearing cap down the shaft and fasten to the front of the bearing housing after adding Loctite 242 to the fasteners. Be careful not to damage the O-ring or lip seal when doing this.

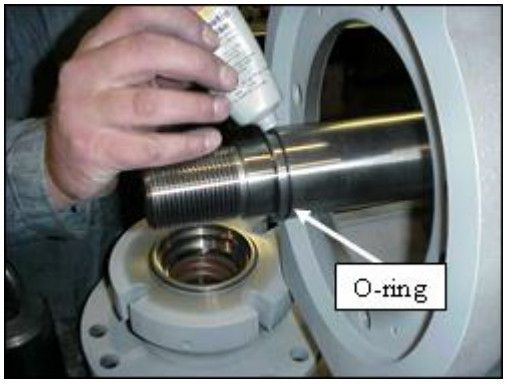
If you have a Vaughan Cartridge Seal, skip to step A25.

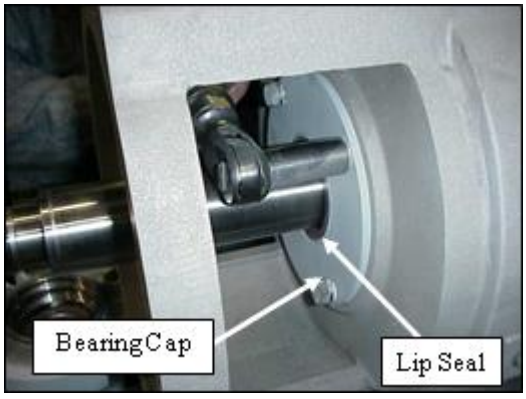


A14

Water Flushed Seals And Packing

Fit an O-ring into the groove on the shaft and lubricate. Slide the seal sleeve down the shaft until it seats firmly on the shaft shoulder. The end of the sleeve will be located inside the lip seal. Be careful not to cut the O-ring or damage the lip seal while performing this step

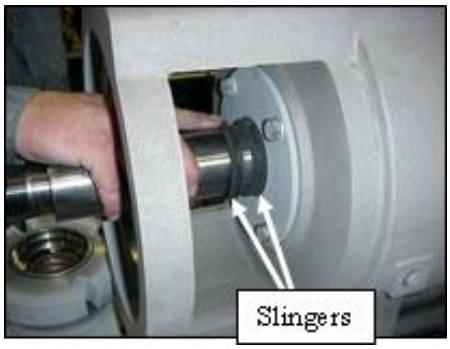




A15

Water Flushed Seals And Packing

Install two slingers over the shaft (only one is required for a pump with packing). Run them against the bearing housing lip seal. The slingers go on with the sealing lips facing away from each other (bevels together). Grease the sealing lips.



The first slinger will remain against the bearing housing lip seal and the second will be moved forward to protect the seal gland lip seal when it is installed. On pumps with packing, the slinger protects the bearing housing lip seal.

Fit another greased slinger on the other end of the shaft, and slide it against the thrust bearing cartridge lip seal.

A16

Water Flushed Metal Bellows Seals

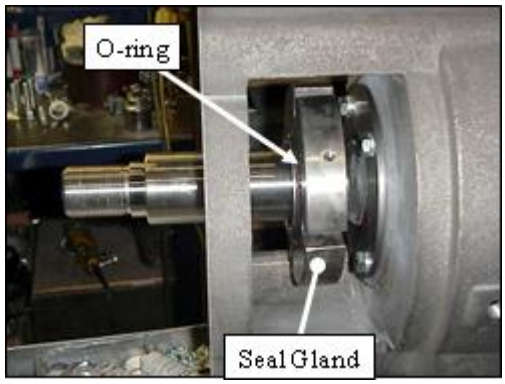
Lubricate new lip seal and stationary seal o-ring with oil. Apply Loctite 222 to the lip seal OD, then install the new lip seal with the spring side facing into the back side of the gland. Turn the gland over and install the new stationary seal.

Note: Use a plastic tool between the arbor ram and the seal for pressing the seal face into the gland. Make sure that the tool is clean—any grit imbedded in the plastic can damage the seal face. The seal face is brittle and may be chipped or cracked if care is not taken. Ensure that the seal face is not cocked when pressing into the gland

A17

Water Flushed Metal Bellows Seals

Lubricate the shaft sleeve where the lip seal will ride. Install and lubricate a new seal gland O-ring and slide the seal gland onto the pump shaft and into the bearing housing.



A18

Water Flushed Metal Bellows Seals

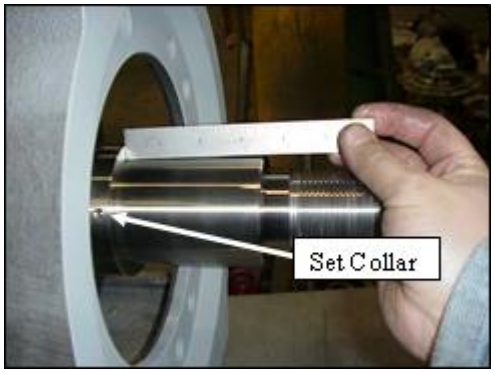
Lubricate the internal rotating member O-ring with oil, and clean both stationary and rotating seal faces with a lint free cloth. Lubricate the seal faces before sliding the rotating member onto shaft.

Don't damage the internal O-ring while installing rotating member.

A19

Water Flushed Metal Bellows Seals

Position the set collar 3 7/16” from the end of the seal sleeve and tighten the set screws carefully in two steps, starting from the center screw.



A20

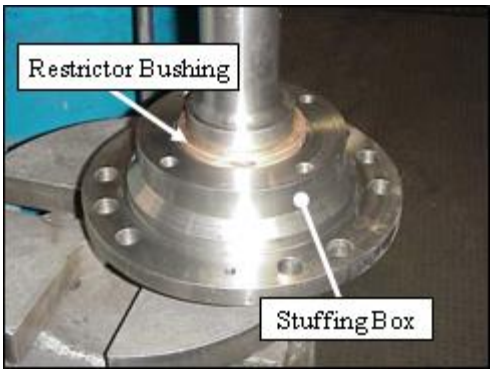
Water Flushed Metal Bellows Seals

Check the restrictor bushing for wear. If it is worn, replace it.

It is locked into position with two set screws, which must first be removed.

Remove the bushing from the center of the stuffing box with a press or punch, and press in the new one. The smaller outside diameter goes in first.

Replace and tighten the set screws



A21

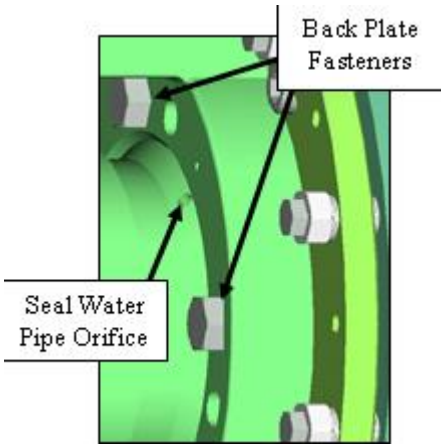
Water Flush Seal or Packing

Grease the inside of the restrictor bushing.

Carefully install the stuffing box onto the shaft and bearing housing. Attach it to the front of the bearing housing with two countersunk flat head screws. Be careful not to scrape the restrictor bushing on the shaft.

Replace the back plate. Bolt the back plate into place with its four fasteners.

Replace the seal water pipe

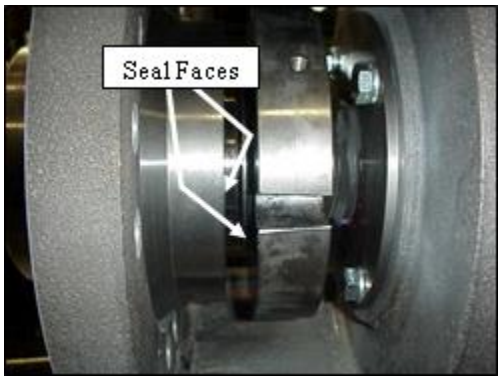


A22

Water Flush Seals

Clean the faces of the mechanical seal again with a lint free cloth, oil them with clean bearing oil, and bolt the seal gland to the stuffing box.

If the seal is installed correctly, the bellows will be compressed approximately 1/4 inch when tightening the gland bolts. Tighten the bolts evenly to make sure the gland goes on without cocking and binding the stationary member.



A23

Pumps With Packing

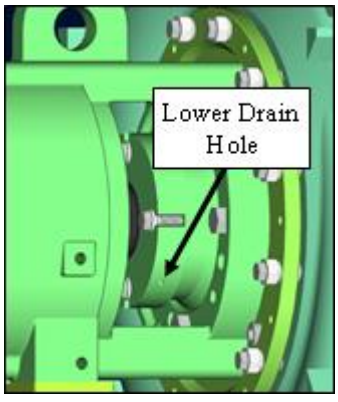
Assemble the two halves of the packing gland onto the shaft and fasten to the stuffing box. Do not fully tighten the fasteners

A24

Water Flush Seals

Coat the lower drain plug with thread sealant and replace. Add 1 oz. (28 cc) of bearing oil through the top drain hole. Using a syringe and a section of small diameter tubing will make this step easier.

Coat the upper drain plug with thread sealant and replace.



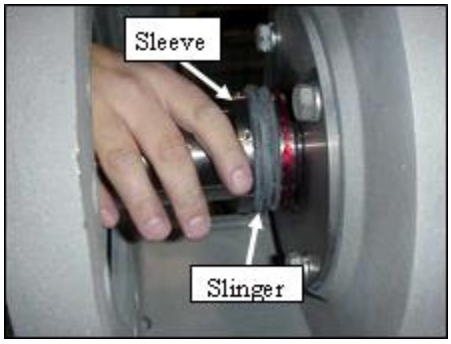
A25

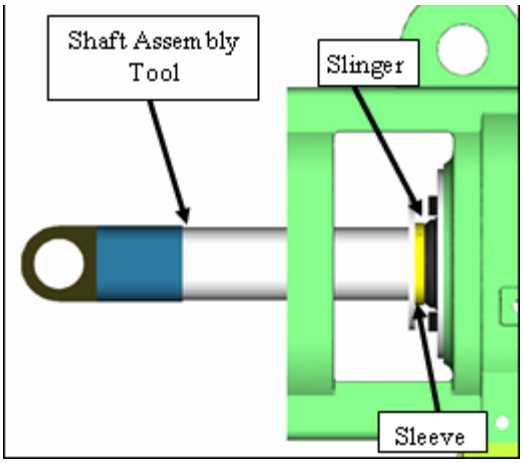
Vaughan Cartridge Seal

Grease the outside of the bearing housing lip seal sleeve, and slide a slinger onto the sleeve. Install the slinger, so that when the sleeve is slid down the shaft, the slinger lips will bear against the bearing housing lip seal. Slide an O-ring down the shaft to the bearing cap. Install the sleeve and slinger and push the sleeve and O-ring through the lip seal.

Compress the o-ring against the radial bearing's inner race with the Shaft Assembly Tool, Vaughan Part # V109-469, as shown.

When the O-ring is compressed and the sleeve contacts the radial bearing, tighten the three set screws of the sleeve, starting with the centermost screw.





A26

Vaughan Cartridge Seal

Installation of the cartridge seal is the reverse of disassembly. Before installation, clean the shaft and bearing housing and lubricate the shaft with an anti-seize compound.

Before reassembly, ensure that the O-ring is located correctly inside the seal sleeve o-ring groove. Don't place the o-ring in the shaft groove. Fill the O-ring groove on the shaft with grease to help protect the sleeve O-ring

A27

Vaughan Cartridge Seal

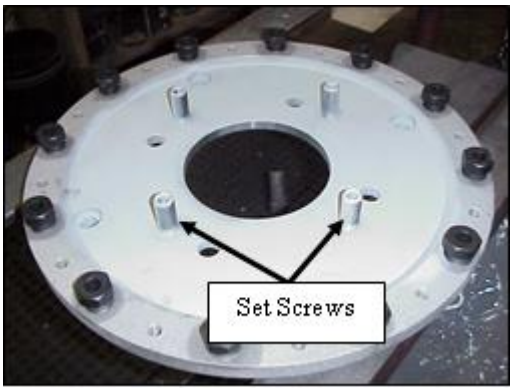
Slide the cartridge into the bearing housing and bolt it in place with the two flat head screws. Rotate the shaft until the shaft keyway is 180° opposite the center set screw. Tighten all three set screws. Remove the cartridge cap

A28

All Seal Types

Before installing the back plate, back the four set screws partially out, so that they do not protrude from the opposite side of the back plate. Slide the back plate down the shaft and locate it on the bearing housing by using the set screws.

Note: The photograph shows the back plate separated from the upper cutter and wear plate. If the wear plate and/or upper cutter do not need replacing, then the back plate, upper cutter, and wear plate can be installed as a unit. Use a hoist to lift the assembled unit.

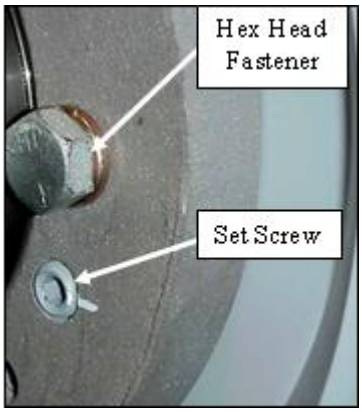


A29

All Seal Types

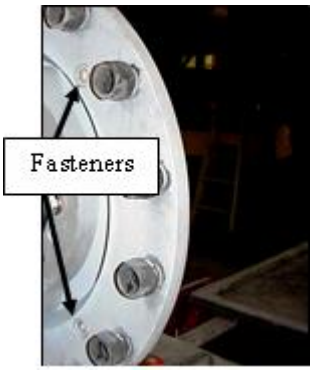
Note: This step is necessary if the back plate, upper cutter, and wear plate were separated earlier.

Install the inner and outer O-rings on the upper cutter. Grease the inner O-ring and slide the upper cutter down the shaft. Install and fully tighten the hex head fasteners which clamp the upper cutter and back plate to the front of the bearing housing. Run the set screws in until they contact the upper cutter. Witness mark the set screws.

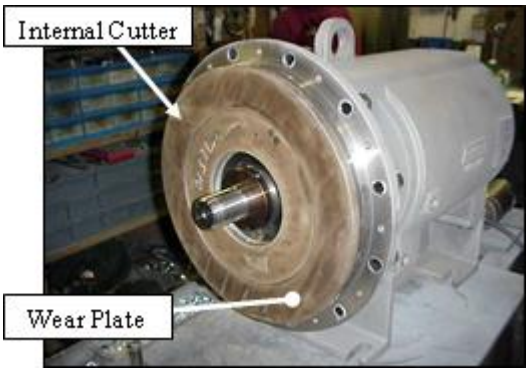


A30

All Seal Types



Grease the external o-ring on the upper cutter and install the wear plate. The position of the internal cutter on the wear plate depends on the position of the pump discharge. In this instance, the pump is being set up for a 12:00 discharge. Install and tighten the four fasteners on the opposite side of the back plate.

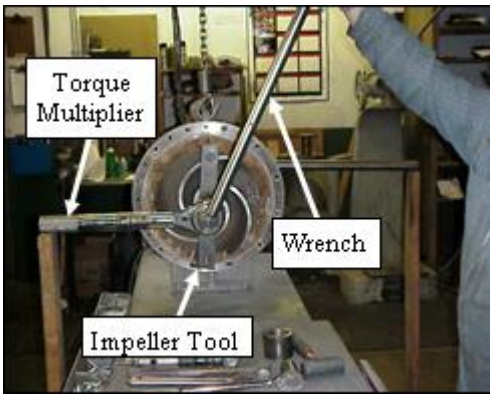


A31

All Seal Types

Slide the impeller/shaft O-ring down the shaft until it contacts the seal sleeve. Install and torque the impeller to 1000 ft-lbs. Use a torque multiplier, Impeller tool (Vaughan Part # V109-525) and Shaft Turning Tool (Vaughan Part # V3500-134), to do this.

Grease the back plate O-ring and make sure that it is not nicked or twisted.

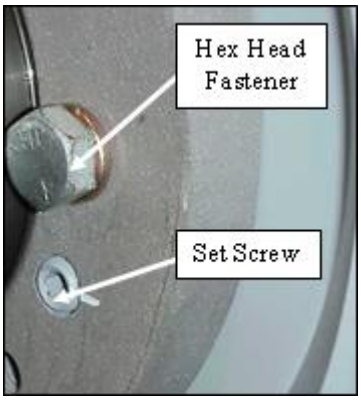


A32

All Seal Types

Rotate the impeller by hand to feel for interference between the back of the impeller and the upper cutter. With the set screws backed out as they are, you should not feel any. Loosen the hex head fasteners and advance the each set screw equally, one to two points. Tighten the hex heads again and check for interference.

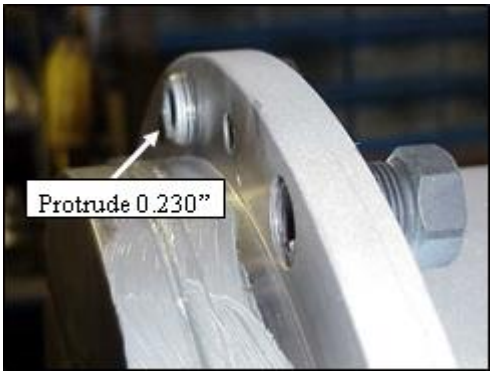
Repeat the procedure until you feel the upper cutter touching the back of the hub. Loosen the hex heads again, back off the set screws one point each, and retighten the hex heads. Check for interference again.



A33

All Seal Types

Back all back plate adjusting sleeves away from the casing except for three. Try to space these three evenly around the back plate at approximately 120° intervals. Run these three sleeves in until they protrude from the back plate 0.230 inch.



A34

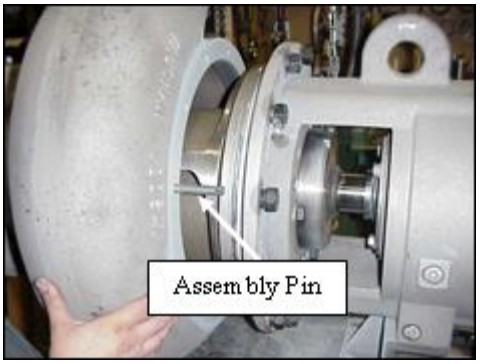
All Seal Types

The rotating assembly will be difficult to press back into the casing because of the back plate o-ring. To ease reassembly, loosen the four socket head fasteners holding the wear plate to the back plate. This will allow the back plate o-ring to contract inward. The impeller will keep the wear plate from going too far and pinching the o-ring.

After sliding the rotating assembly into the casing, retighten the four fasteners to reseat the o-ring.

Before installing the adjusting sleeve clamp bolts, check the witness marks on the three “screwed-in” adjusting sleeves and ensure they are in their initial orientation.

Use of assembly pins will simplify this step.



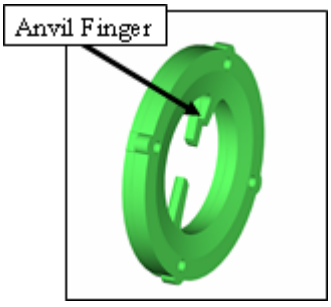
A35

8” & 10” Pumps

Assemble the cutter bar, anvil, and the mounting plate. The anvil can be placed on either side of the cutter bar ring and can be flipped without jeopardizing pump performance.

12” Pumps

Assemble the cutter bar and the suction plate. Ensure the anvil finger on the suction plate lies along the top of one of the cutter bar fingers on two finger cutter bars. It can’t be assembled incorrectly on four finger cutter bars.



A36

8" & 10" Pumps

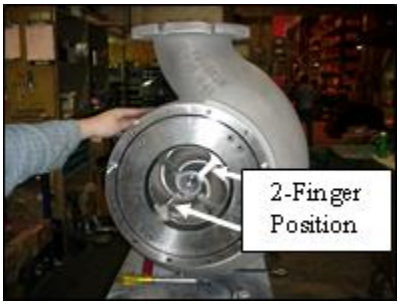
Install and grease the O-ring on the inside groove of the cutter bar plate. Place the cutter bar assembly into the pump case. Use assembly pins to align and hold the assembly in place, while pressing it in with two fasteners as shown.

12" Pumps

Press the cutter bar assembly into the pump case, using the rounded projections along the OD as guides to align the piece.

All Pumps

On two fingered cutter bars, align the shear fingers with respect to the pump discharge as shown in the illustration. The position of the anvil is not critical.

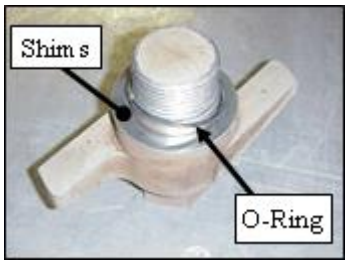


A37

Install and grease the O-ring on the face of the cutter bar mounting plate (8" and 10" pumps). On 12" pumps, install and grease the O-ring around the joint between the suction plate and casing face. Replace the suction manifold. For 8" and 10" pumps, replace the casing support

A38

Lubricate the threads of the external cutter with anti-seize compound. Place three external cutter shims on the cutter, followed by an O-ring.



A39

Thread the external cutter/cutter nut into the front of the impeller and torque to 250 ft-lbs. Use the Shaft Turning Tool (Vaughan Part # V3500-134) to hold the pump shaft at the rear of the bearing housing.

A40

Check the clearance between the external cutter and the cutter bar shear fingers. Remove or add external cutter shims until you achieve 0.010 inch to 0.015 inch clearance. Each shim is 0.010 inch thick. Fully torque the external cutter between each shim adjustment.

A41

Reattach the suction manifold to the system piping.

A42

All Seal Types

Install the motor stool, coupling, and motor.

Install motor stool covers

A43

All Seal Types

Coat the bearing housing drain plug with thread sealant and install. Refill the bearing housing with Chevron Rando HD 100. Acceptable alternates are Chevron GST 100, Cheveron EP-100, Exxon Teressic 100, Shell Turbo 100, Texaco Regal 100 & Royal Purple Synfilm GT 100. For food grade applications, use Chevron FM ISO 100 hydraulic oil. Fill the bearing housing until the oil level reaches the center of the sight glass. This will require about 3.5 gallons (13.2 l).

A44

All Seal Types

Reconnect seal water system (if equipped) and have an electrician reconnect the motor wires. Open isolation valves to the pump.

Follow all the safety procedures in the Vaughan Installation Operation, and Maintenance manual and your plant.

When pump is operational again, check pressures at suction and discharge and make sure that the pump is operating in a safe portion of its performance curve.

Vaughan Company engineering can help with this if you have questions.

A45

Pumps With Packing

Start up the pump and water flush system and adjust the packing gland fasteners to achieve 6 to 10 drips of leakage per minute out of the packing gland.

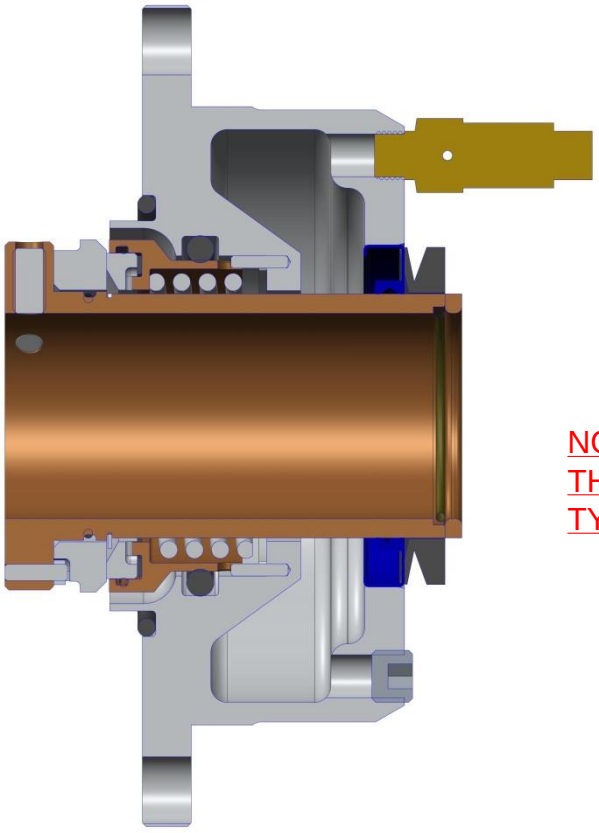
Unmatched Reliability

Vaughan®

Vaughan Horizontal and Pedestal Cartridge Seal Manual

PUMP MODELS

Horizontal (HE & HSC)	Pedestal (PE & PSC)
ALL	ALL



NOTE: PLEASE REFER TO THE I,O&M MANUAL FOR OIL TYPE

VAUGHAN COMPANY, INC.

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WWW.CHOPPERPUMPS.COM

Unmatched Reliability
Vaughan®

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Unmatched Reliability
Vaughan®

IMPORTANT NOTICE

DO NOT DISASSEMBLE ANY PART OF THE SEAL.

DO NOT REMOVE THE PLASTIC CAP PRIOR TO THE INSTALLATION STEP THAT SPECIFICALLY SAYS TO DO SO.

REMOVING THE CAP BEFORE THE SEAL HAS BEEN ASSEMBLED INTO THE PUMP WILL CAUSE THE SEAL TO AUTO-DISASSEMBLE BECAUSE OF THE INTERNAL SPRING.

IT IS NOT POSSIBLE TO REASSEMBLE THE SEAL IN THE FIELD, AND IT WILL HAVE TO BE RETURNED TO VAUGHAN TO BE REPAIRED FOR A FEE.

THE SEAL IS PRE-ASSEMBLED WITH A PRELOADED SPRING AND PRE-FILLED WITH OIL.

THERE IS NO NEED TO SET SPRING COMPRESSION OR MAKE ANY ADJUSTMENTS TO THE SEAL.

IMPORTANT SAFETY INFORMATION

This equipment is intended to be installed, operated and maintained by technically qualified personnel. Failure to do so in compliance with national and local electrical codes, building codes, safety codes, and Vaughan Co. recommendations, may result in electrical shock, personal injury, death, fire hazard, unsatisfactory performance, and equipment failure. If further assistance is required, contact your local Vaughan Co. representative.

Keep this manual in a safe location for future reference.

The following safety warnings may appear throughout this manual, and are used to alert the customer of specific safety hazards.

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

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

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

NOTICE Indicates special operation or maintenance information.

GENERAL SAFETY INSTRUCTIONS

- Personal protective equipment to be worn when working on or making adjustments to pumps should include:
  - Heavy work gloves when handling parts with sharp edges, especially impellers.
  - Safety glasses (with side shields) for eye protection
  - Steel-toed shoes for foot protection when handling parts, heavy tools, etc.
  - Other personal protective equipment to protect against hazardous/toxic fluids and gases.
- This pump may handle dangerous or contaminated fluids. There are sharp corners, edges and pinch areas which can cause serious injury. Be careful; wear protective gloves whenever possible. If you cut yourself, seek medical help immediately to avoid serious infection.
- Isolate the pump hydraulically and electrically before servicing or inspecting pump. Lock out both power source and isolation valves.
- This pump may start automatically if wired to float switches or other equipment. Before inspecting or making adjustments disconnect electrical power and lock out circuit breakers to pump motor and associated equipment. Duplex pumps with alternating relays must both be locked out; otherwise the pump you are working on may not be isolated and could start as “the alternate”. Visually confirm that the pump has come to a complete stop before proceeding.
- Enter tanks or pits with extreme caution and only after an instrument check of the pit/tank has been completed to verify the absence of dangerous gases and the presence of safe levels of oxygen. Never enter a tank or pit without a safety harness and lifeline, and an air pack. Never enter the pit without rescue personnel standing by. Follow all national and local requirements for confined space entry.

- Keep all pit openings covered when not in use. In addition to the injuries from falling, pits may contain poisonous gases or liquids.
- Pump motors are connected to high voltage. Allow only qualified electricians to service this electrical equipment, and only in accordance with the latest revision of the National Electrical Code and other applicable requirements.
- Keep hands, feet and clothing away from moving machinery.
- 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.
- As it is possible to run Vaughan Chopper and Screw pumps dry, for quality assurance or troubleshooting reasons, it is extremely important to ensure suction and discharge connections are always properly guarded to prevent anything (i.e. foreign objects or pump parts) from being thrown from the pump as a projectile. All pumps must be run with either, a) suction and discharge piping in place, or b) blind flanges installed on suction and discharge connections. Blind flanges should be vented to avoid pressure build-up. Note that cast rotating parts could break if metal to metal contact occurs while the pump is running dry.
- Let the pump cool to ambient temperature before beginning work. A warm pump can contain compartments of pressurized fluid, which may vent violently during disassembly.
- Lifting/hoisting safety.
  - Do not use the motor lifting eyes to lift the assembled pump. Use the motor lifting eyes to lift the detached motor only.
  - Use the supplied lifting bails to hoist submersible pumps.
  - Base-mounted lifting eyes may be used to lift a pump that's bolted to its base. When doing so, rig the load to prevent flipping.
  - Cast-in lifting eyes are designed for lifting individual components or sub-assemblies, not the entire pump.
    - Bearing housing lifting eyes (horizontal and pedestal pumps) can be used to lift an assembled bearing housing assembly.
    - Back cover lifting eye (some self-priming pumps) should be used to lift the back cover only.
    - Use slings to lift assembled pumps.
- Lift pump and motor with a properly sized hoist or crane. Consult Vaughan Co. shipping department for weight of your equipment if you are in doubt.
- Do not allow people under pump assembly while it is being lifted.
- Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes should be worn at all times.
- Do not operate this equipment unless safety guards and 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, adjust, or repair machinery while in motion.
- Keep electrical control panel area clear to avoid hazards to personnel. If a person should trip and fall into an open panel enclosure, serious electrical burns can result.
- Make certain all personnel are clear of equipment before operating.
- There are sharp edges inside the pump, and you may be exposed to hazardous materials and/or communicable diseases. Among some of the sewage-borne communicable diseases that can occur in the United States are typhoid fever, poliomyelitis, and hepatitis A. Decontaminate and/or sanitize the pump before beginning work on those parts of the pump that are exposed to the process fluid. Protect yourself at all times by wearing the appropriate personal protective equipment when working on Vaughan pumps.

HOW TO USE THIS MANUAL

This manual is for all horizontal and pedestal pumps equipped with a Vaughan Cartridge seal. This manual covers the removal, installation, operation and maintenance of your Vaughan Cartridge seal. If your pump model number includes an:

- HE
- PE
- HSC
- PSC

Then you can use this manual to remove, install or maintain your Vaughan Cartridge seal.

READ ALL STEPS BEFORE STARTING.

Start this manual after the pump has been isolated both electrically and hydraulically via your plant-approved lock-out/tag-out procedure. Once the wet end has been disassembled, refer to this seal manual for removal, and then, bearing housing manual appropriate for your pump to continue a complete pump overhaul. Refer back to this manual when you are ready to re-install the seal.

This manual also includes information on maintenance and normal operating parameters.

This manual's pictures show a small horizontal & pedestal bearing frame, but the steps still apply to large horizontal & pedestal bearing frames. The differences in installation and removal between the large and small bearing housings will be made apparent where appropriate.

Before servicing your Vaughan pump read the safety section in the front of this manual, and follow the safety procedures in your plant.

If, after reading this manual, you have any doubt about your ability to safely perform any of the following steps, please contact Vaughan Company for our recommendations or further information.

To increase clarity some photographs in this manual show work being done without the models using proper safety gear. The pumps pictured in this manual are new, and have never been contaminated. Appropriate personal protective equipment should always be worn when performing the procedures in this manual.

Also note that CW means CLOCK WISE and CCW means COUNTER CLOCK WISE.

CONVERTING FROM A DIFFERENT STYLE SEAL TO A VAUGHAN SEAL:

If you have a metal bellows seal or packing currently installed and you wish to convert to packing, you can use the manual for Vaughan Seal installation instructions. You should refer to your pumps original overhaul manual for instructions regarding removal of the metal bellows or packing. Metal bellows and packing have a sleeve on the shaft that needs to be removed before a Vaughan seal can be installed. The sleeve can be removed by heating length wise along the shaft with a torch. This will break down the Loctite and with the help of a chisel the sleeve can be removed.

NOTE some pumps from the late 80's and early 90's have a sleeveless shaft with packing or a metal bellows seal. If you have a sleeveless shaft, you cannot install a Vaughan Seal into this pump without replacing the shaft. Please contact Vaughan Parts department if you have any questions regarding if your pump can or cannot be converted to a Vaughan seal.

TOOLS AND SUPPLIES

STANDARD TOOLS

A set of Allen keys and a couple jacking bolts are usually the only tools required to install or remove a Vaughan Cartridge Seal. The specific sizes needed are:

3”-6”, 8K & 8L Pumps

- 1/8” Allen Key
- 9/64” Allen Key
- 5/32” Allen Key
- Two 1/2”-13 Bolts

8M, 8N, 8P & 10”-16”

- 5/32” Allen Key
- 3/16” Allen Key
- Two 3/4”-10 Bolts

SPECIAL TOOLS

For changing seal oil we recommend a syringe with a flexible tube. This makes it easier to get oil in and out of the tight space in a packing housing. Pedestal pumps have no other way to drain oil out of the seal without a syringe.

- Seal Oil Syringe V9991343

The seal cap is a special tool that is required if you wish to remove a Vaughan Cartridge seal from a pump and you wish to be able to re-install the seal back into the pump. The seal cap prevents the spring loaded seal from unloading and self-disassembling when removing the seal from the pump.

3”-6”, 8K & 8L Pumps

- Cartridge Cap V108-834

8M, 8N, 8P & 10”-16”

- Cartridge Cap V108-854

If your seal is old and worn out, you do not need to use the seal cap to remove the seal as it will be discarded after removal.

CONSUMABLES

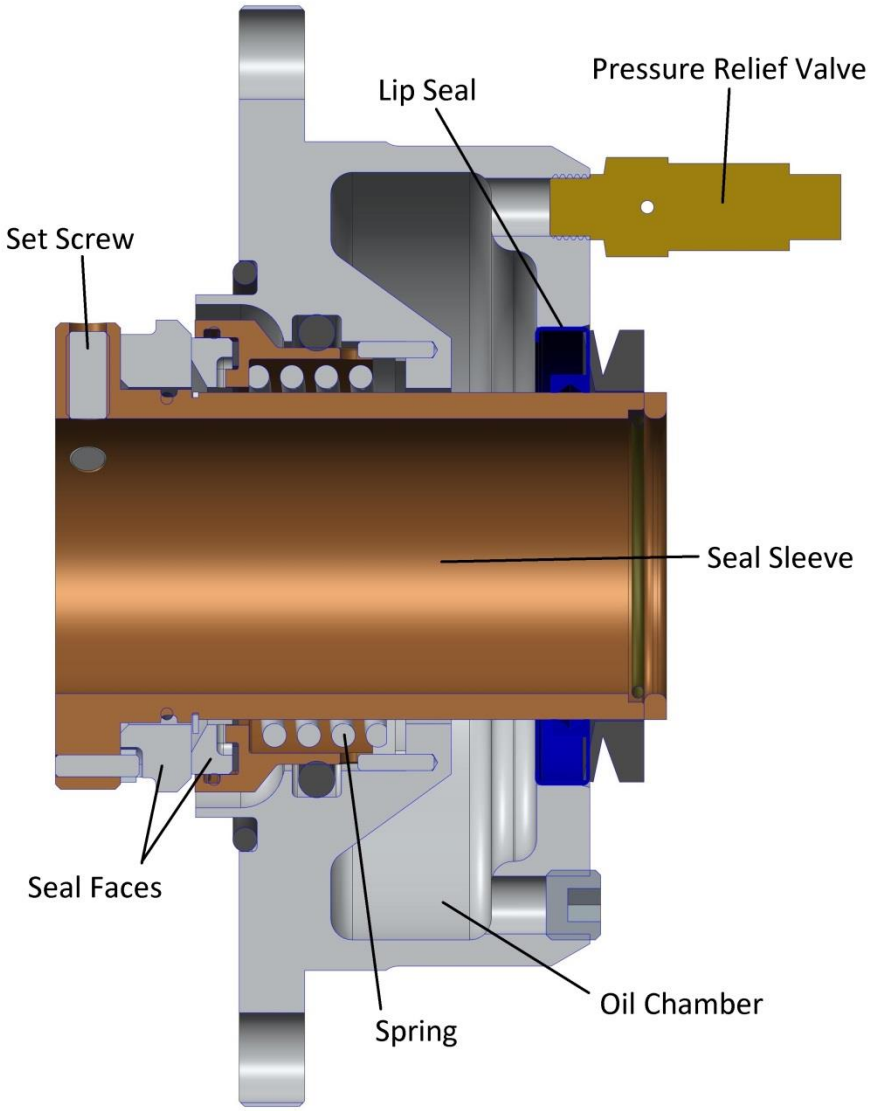
You will need the following consumables, or their equivalents:

- nonmetallic anti-seize

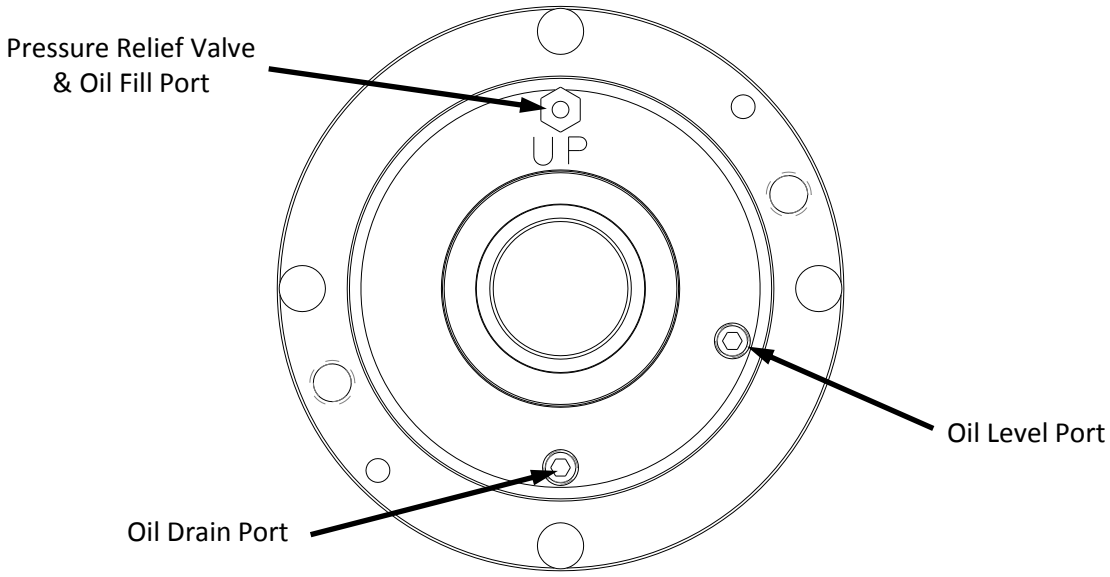
OPERATION AND MAINTENANCE

The Horizontal and Pedestal Vaughan Chopper Pumps and Triton Screw Centrifugal Pumps that are supplied with Vaughan Cartridge Mechanical Seals all have a configuration as seen below. The seal is placed directly behind the impeller to help keep the seal faces free of debris. This seal will not require any water flush to keep it clean. However, when contaminated oil starts flowing out of the pressure relief valve during operation, the seal will need to be drained and refilled with fresh oil. Brand new seals are packaged pre-filled with oil.

Seal Configuration



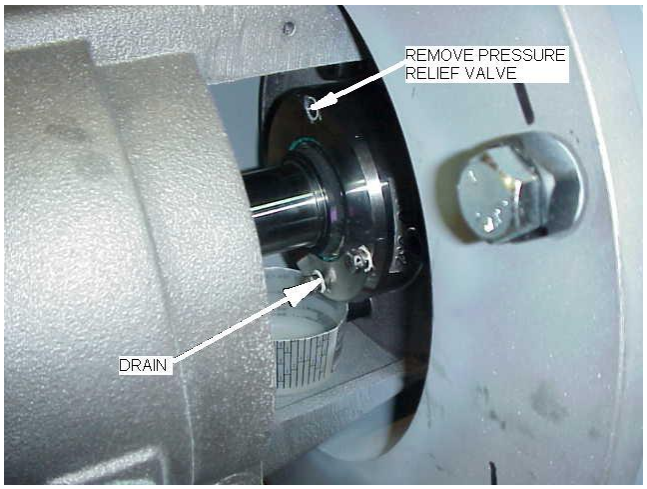
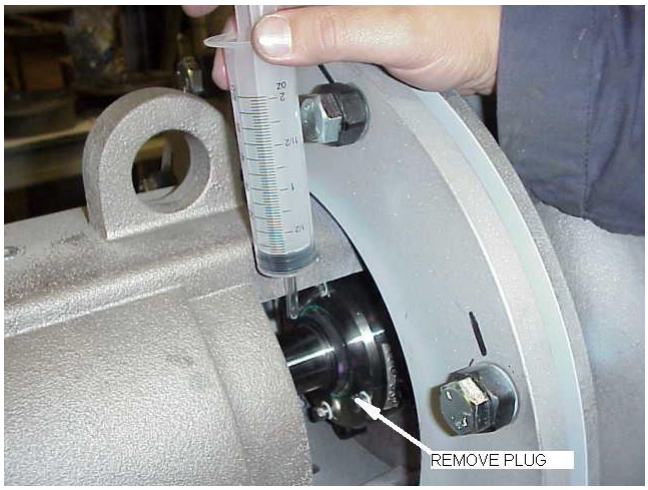
Seal Configuration Continued



CAUTION

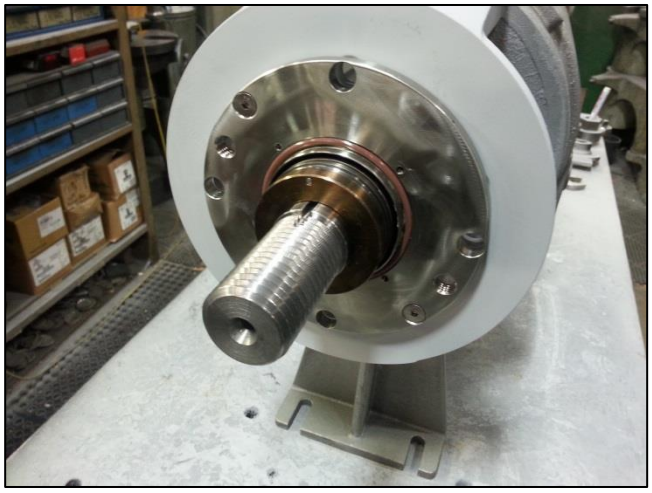
Pressure may build up in the standard mechanical seals used in Vaughan Horizontal or Pedestal pumps. Whenever checking or maintaining the oil in the Vaughan Cartridge Seal, make sure the pump and seal are cool to the touch and use care when removing the oil chamber plugs and pressure relief valve in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

Oil Change Instructions

Horizontal Pump	Pedestal Pump
Drain Oil: Remove guard. Remove the pressure relief valve on top and the plug on the bottom to drain oil. Put a small container below the seal to collect oil. Plug the bottom hole after draining.  	**Drain Oil:** Remove guard. Remove the pressure relief valve and the drain plug. Removing the drain plug helps by venting the oil chamber. Using a syringe and tubing (Part no. V9991343) provided suck as much of the oil out of the seal as possible. 
Fill Oil: FYRQUEL (Phosphate Ester type) Remove plug on the side. Using a syringe and tubing (Part no. V9991343) provided, fill with ~~46 wt hydraulic~~ oil until oil flows out of the hole on the side. This amounts to about 2 oz. for 3”-6” 8K & 8L pumps and 6 oz. for 8N, 8P, 8F & 10”-16” pumps. Plug side hole and install pressure relief valve on the top, with the hole on its side, after filling. Reinstall guard.  	**Fill Oil:** Using a syringe and tubing (Part no. V9991343) provided, fill with 46 wt hydraulic oil until oil flows out of the the drain plug hole. This amounts to about 3 oz. for 3”-6” 8K & 8L pumps and 13 oz. for 8N, 8P, 8F & 10”-16” pumps. This will fill the seal approx. ¾ full. Plug drain hole and install pressure relief valve, after filling. Reinstall guard. 

Step 1

Use the wet end manual appropriate to your pump model to disassemble the pump until only the Vaughan seal is exposed on the bearing housing as seen to the right. You should see similar looking seal as the last step of the disassembly section in the wet end manual.



Step 2

Install the seal cap.

3”-6”, 8K & 8L Pumps
The seal sleeve has (3) set screws in the shoulder that need to be lined up with the corresponding holes in the cap.

8F, 8N, 8P & 10”-16”
The seal sleeve has at least (3) set screws in the shoulder that need to be lined up with the corresponding holes in the cap. Newer seals will have (5) set screws in the shoulder.

All Pumps

NOTICE

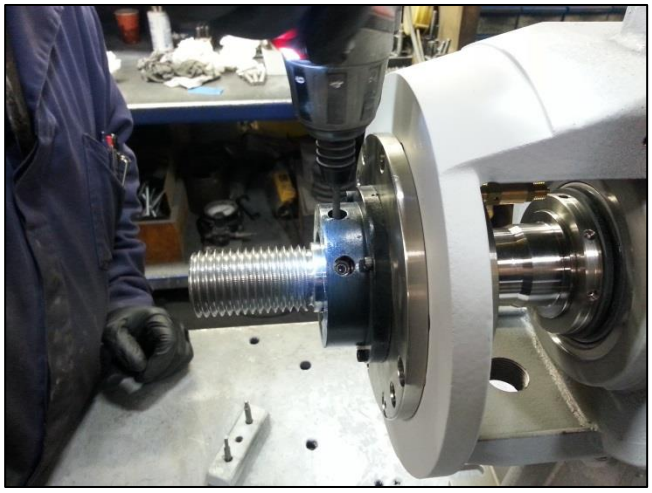
Installing the seal cap is **MANDATORY** if you wish to be able to re-install the seal into a pump after removal. If the seal is worn out and damaged and it will be discarded after removal, then you can skip this step.

Step 3

Loosen the seal sleeve set screws. Loosen the screws enough so that they are in the holes of the seal cap, but not enough to remove them. This will ensure the set screws stay lined up with holes in the seal cap.

3”-6”, 8K & 8L Pumps
The seal sleeve has (3) set screws in the shoulder that need to be loosened.

8F, 8N, 8P & 10”-16”
The seal sleeve has at least (3) set screws in the shoulder that need to be loosened. Newer seals will have (5) set screws in the shoulder.



⚠CAUTION

The seal sleeve is spring loaded. Removing the seal sleeve set screws without the cap being installed may allow the seal to self-disassemble. If this happens contaminated oil may spray.

Step 4

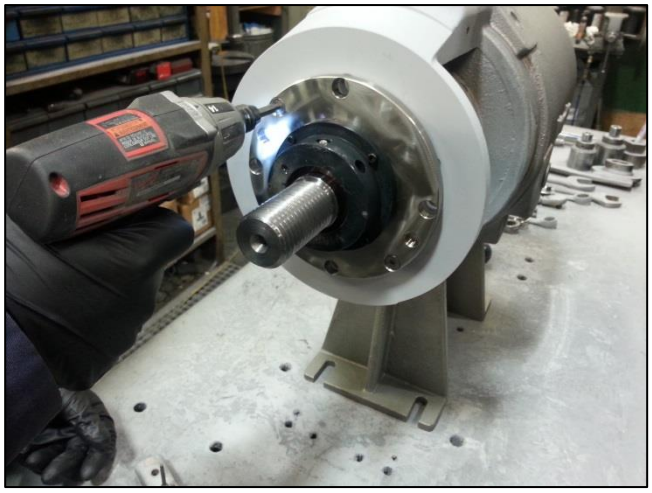
Remove the two stainless steel flat head screws from the seal housing flange. These screws are located 180 degrees apart.

At this point the seal can be slid off the shaft and out of the packing housing.

The seal can get stuck due to thick paint, wear, corrosion, or buildup of pumpage. In this case use the two threaded jacking bolt holes located on the flange of the seal.

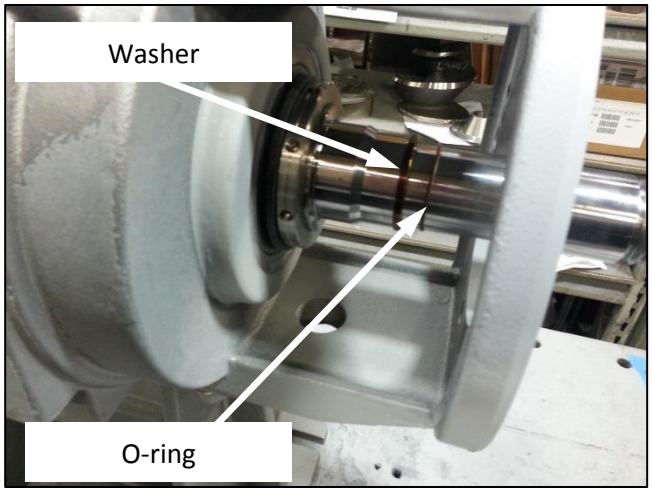
3”-6”, 8K & 8L Pumps
Use 1/2”-13 jacking bolts

8F, 8N, 8P & 10”-16”
Use 3/4”-10 jacking bolts

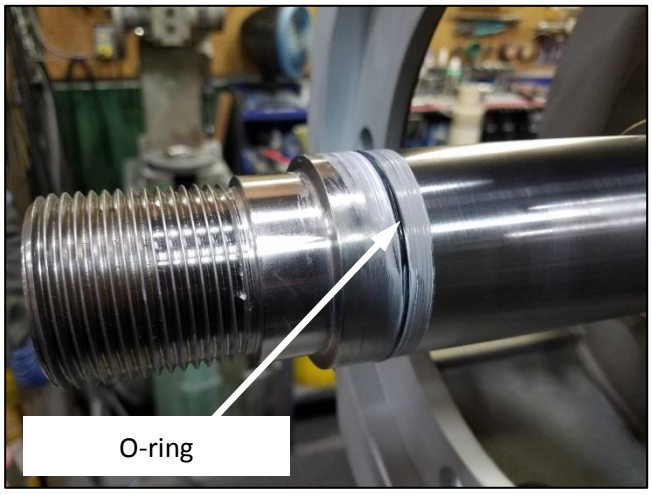


Step 5

3”-6”, 8K & 8L Pumps
Remove the seal O-ring remaining on the shaft, along with the brown washer.



8F, 8N, 8P & 10”-16”
Remove the seal O-ring in the groove on the shaft. Some shafts will not have an O-ring groove and the O-ring will be in groove in the inner diameter of the seal sleeve.



Step 6

The seal is now removed from the bearing housing. If you are overhauling the bearing housing, start the bearing housing overhaul manual now. If you are only replacing the seal. Go the installation instructions on the next page of this manual.

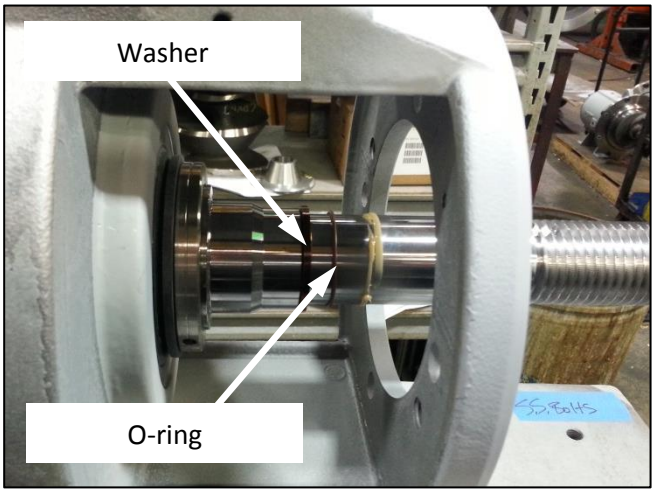
Step 1

Start here once your old seal has been removed or once your bearing housing rebuild has been completed. The pump bearing housing should appear similar to the pictures on the right.

3”-6”, 8K & 8L Pumps
Install the brown washer that came with the seal. Install the shaft O-ring. Apply anti-seize to the shaft surface where the seal sleeve will sit. If you cannot fit the brown washer over the shaft then you either have a seal sleeve, from a different style seal still remaining on the shaft, or you have a sleeveless shaft.

If you have an old sleeve still on the shaft it can be removed by heating length wise along the shaft with a torch. This will break down the Loctite and with the help of a chisel the sleeve can be removed.

If you have a sleeveless shaft, you cannot install a Vaughan Seal into this pump without replacing the shaft.

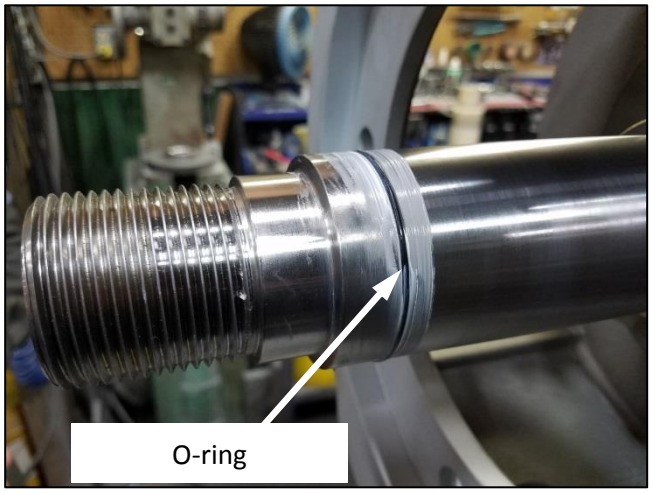


8F, 8N, 8P & 10”-16”
There are a couple different variations for the shaft O-ring placement for Vaughan seals in this size range of pumps.

If your shaft has an O-ring groove, install the O-ring on the shaft in the groove.

If your shaft does NOT have an O-ring groove, make sure your seal is a version that has an O-ring in the inner diameter of the seal sleeve.

Lubricate the O-ring and area on the shaft where the seal sleeve will sit with anti-seize.

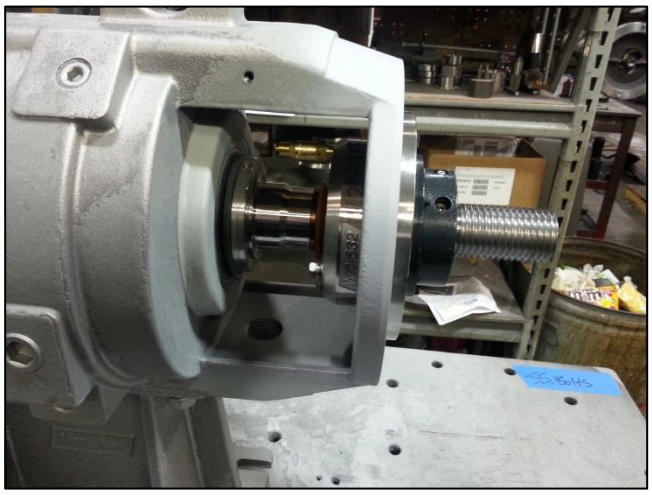


Step 2

If your shaft has a key way, rotate the shaft so the key way is facing down. This will insure the set screws do not tighten into the key way.

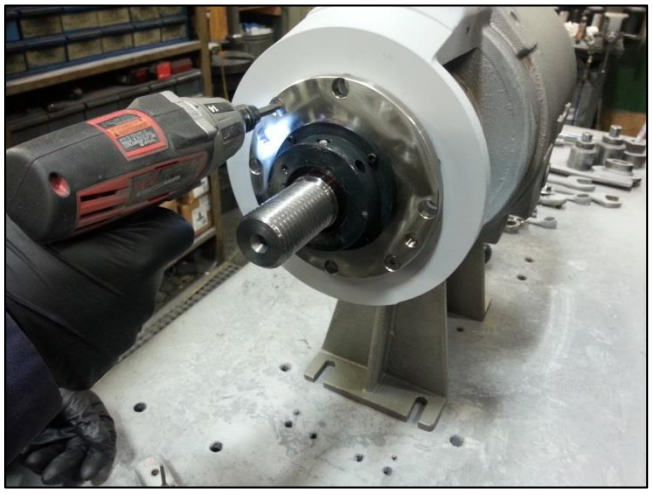
Install the seal in the packing housing. Slide the seal onto the shaft. The brass pressure relief valve should be at the top.

You may have to use a moderate amount of force to get the seal to slide over the O-ring on the shaft. This is why it is important to have the anti-seize on the shaft in the previous step.



Step 3

Install and tighten the two stainless steel flat head screws from the seal housing flange. These screws are located 180 degrees apart.



Step 4

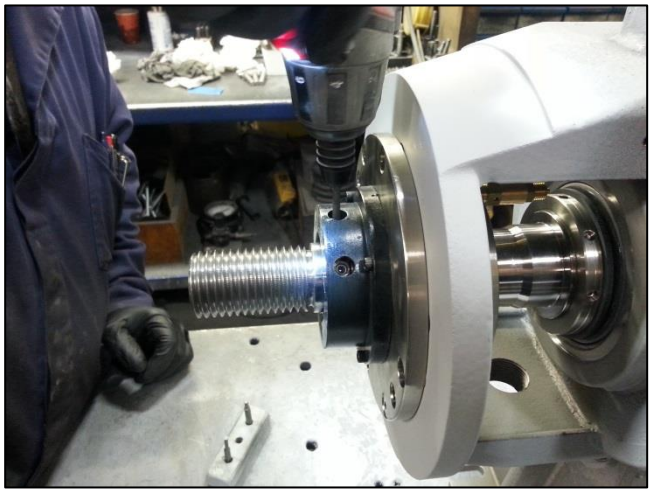
Install and tighten the set screws in the seal sleeve.

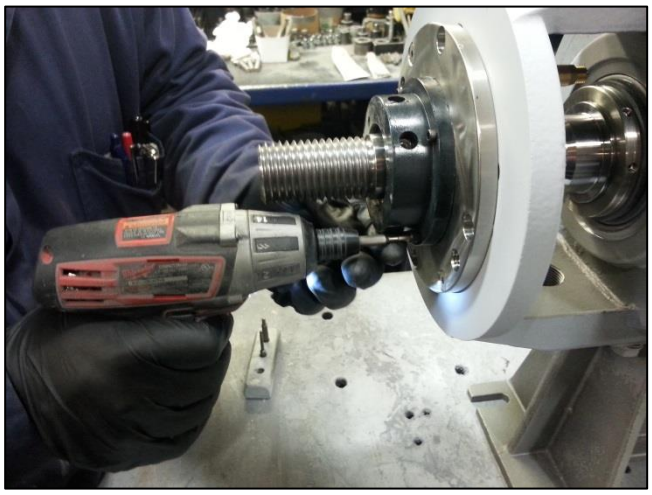
3”-6”, 8K & 8L Pumps

The seal sleeve has (3) set screws in the shoulder that need to be tightened.

8F, 8N, 8P & 10”-16”

The seal sleeve has at least (3) set screws in the shoulder that need to be tightened. Newer seals will have (5) set screws in the shoulder.



Step 5 Remove the seal cap.	
Step 6 Seal installation is complete. Refer to the wet end manual for your pump to continue assembling your pump. **3”-6”, 8K & 8L Pumps** The O-ring is located under the seal cap. Leave it in place in preparation for installing the backplate. **8F, 8N, 8P & 10”-16”** There is no O-ring under the cap on these seals. You will install an O-ring in the upper cutter bore in the wet end overhaul manual.